Integrating Technology to Foster Critical Thinking Skills in Higher Education Courses: A Survey-Based Study of Lecturers Perceptions

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Abstract: This study examines lecturers' perceptions of technology integration in fostering students' critical thinking skills in higher education. Employing a quantitative approach with a survey research design, data were collected from 62 lecturers across various academic disciplines at Universitas Muhammadiyah Bone, Indonesia. A structured Likert-scale questionnaire was used to capture lecturers' perceptions across three dimensions: personal attitudes, pedagogical understanding, and teaching experience related to technology-supported critical thinking instruction. The data were analysed using descriptive statistics, including frequencies and percentages, with the aid of SPSS for windows (IBSM SPSS statistic 28.0). The findings indicate that lecturers generally demonstrate positive attitudes and high awareness regarding the importance of critical thinking as a core learning outcome in higher education, and they perceive technology as a valuable pedagogical tool for supporting analysis, evaluation, evidence-based argumentation, and metacognitive reflection. Lecturers also reported a relatively strong conceptual understanding of critical thinking frameworks and technology integration principles. However, the results reveal a noticeable gap between lecturers' perceived readiness and the consistent implementation of complex, technology-based argumentative learning practices. Additionally, perceived challenges related to infrastructure limitations, institutional support, and pedagogical training were identified. This study highlights the need for structured instructional design frameworks and sustained institutional support to translate positive perceptions into effective pedagogical practice. The findings contribute insight into lecturers' perceptions and inform future efforts to enhance technology-supported critical thinking in higher education.

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INTRODUCTION

Higher education institutions face a double challenge: restoring quality after a massive digital shift while ensuring the achievement of higher-order thinking skills, particularly critical thinking. However, recent research shows that ICT adoption in the classroom often stops at the substitution level. It has not yet penetrated task engineering that truly triggers analysis, evaluation, and evidence-based reasoning. Paul & Elder, (2014) emphasize that 'students who learn to think critically are better able to analyses information, solve problems, and communicate clearly and logically. The development of digital technology has brought significant changes to learning practices in higher education, particularly in efforts to enhance higher-order thinking skills such as critical thinking. Critical thinking is commonly defined as the capacity to reflectively and rationally analyze, evaluate, and synthesize information for decision-making (Facione, 1990; Ennis, 2011). In the context of higher education, these skills are considered one of the main learning outcomes that must be developed to prepare graduates to face academic, professional, and social challenges in the 21st century.

The integration of technology in learning through learning management systems, digital collaborative tools, simulations, and artificial intelligence-based technologies is believed to have great potential in facilitating the development of critical thinking. Technology enables the creation of interactive, collaborative, and student-centered learning environments that encourage the exploration of ideas, problem-solving, and deep reflection (Laurillard, 2012; Redecker, 2017). However, the effectiveness of technology integration is not solely determined by the availability of infrastructure but rather heavily relies on the awareness and beliefs of lecturers as the main actors in the learning process. Lecturer awareness refers to their understanding of the pedagogical potential of technology and its relevance in supporting learning achievement, particularly the development of critical thinking. Lecturers with high pedagogical awareness tend to view technology not merely as a technical aid, but as a strategic means to design meaningful learning experiences (Mishra & Koehler, 2006). Conversely, limited understanding of the pedagogical functions of technology often leads to its superficial use, which is not aligned with high-level learning objectives (Kirkwood & Price, 2014).

Conceptually, critical thinking is understood as a set of skills and dispositions that can be trained in the context of authentic tasks in higher education. Higher education can foster critical thinking among prospective teachers by integrating subject matter instruction with strategies that cultivate critical thinking skills and attitudes (Lithoxoidou & Georgiadou, 2023). University educators must understand that to adapt their teaching strategies to student learning, they must undergo a metamorphosis because their thinking processes can lead to rigid teaching routines(Mahdi et al., 2020). A synthesis of recent reviews confirms that Critical Thinking is learned, not innate; therefore, instructional designs that deliberately orchestrate activities such as investigating, writing, reflecting, evaluating, and sharing products/ideas are necessary. A systematic review of technology-enhanced critical thinking also concludes that technology-based learning environments effectively promote CT when metacognitive strategies and evidence-based tasks are explicitly designed.

The core problem in higher education classrooms: technology is often used merely for the distribution of materials/automatic quizzes, rather than as a tool for argumentative tasks that require claims, evidence, reasoning, and counterarguments. Integrating educational technology involves selecting suitable electronic tools and methodologies tailored to address specific classroom situations and challenges (Roblyer, 2003). Furthermore, the rise of generative AI expands both opportunities and risks: without a pedagogical framework, students may rely on 'instant answers' rather than practising reasoning; therefore, it is necessary to design CT tasks and performance assessments that demand authentic reasoning processes.

A number of technology-based strategies are consistently associated with improvements in CT: social annotation increases focus on specific issues in the text and facilitates evidence-based discussion; argument/concept mapping strengthens argument construction and understanding; and structured forums debates tend to produce more evidence-based contributions than general forums.

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This evidence is reported in reputable journals (BJET, Computers & Education/Internet and Higher Education), as well as a comparative summary of forums vs annotations.Various recent studies confirm that critical thinking (CT) skills are trainable and need to be developed through authentic tasks that require analysis, evaluation, and defense of arguments.

Specifically in the Indonesian context, evidence from journals shows a trend of strengthening CT through digital media and ecosystems: e-modules and e-books have been proven to boost CT indicators; the development of Moodle-based LMS combined with PBL strengthens the cognitive domain; and a recent study in the Journal of Education Technology highlights the design of a metacognition-based LMS to foster independence and CT. Additionally, the class/network-based debate model in national journals shows an increase in the level of reasoning among students. This series of findings reinforces the need for digital task designs that require claims-evidence-reasons, counterarguments, and revision trails, rather than the use of administrative platforms. Based on Indrasiene et al., (2021) research shows that the development of critical thinking is not a static process, influenced by teachers' understanding, position, and critical thinking skills.

Based on recent findings, this study proposes an argument-based technology task flow in a single lecture block: (1) social annotation to identify claims, evidence, and reasons in scientific readings; (2) argument mapping to map logic and counterarguments; (3) debate/peer review in the LMS to compel source-based justification and substantive revision; and (4) metacognitive reflection for students to reassess the strength of their arguments. International evidence shows that social annotation strengthens critical reading and collaborative reasoning, argument mapping (including qualitative studies) deepens argument structure, and structured debates—even those assisted by catboats improve the quality of argumentation and critical thinking. This approach is consistent with the qualitative nature of the study, as it focuses analysis on the reasoning construction process recorded in comments, argument maps, and revision trails.

Its pedagogical novelty lies in its standardized yet contextual implementation package: CT performative rubrics, weekly task protocols, and digital artefact analysis guidelines compatible with common LMSs in Indonesia. This research also formulates the use of GenAI as an 'ethical scaffold'. limited to brainstorming and self-explanation with a transparency ledger (prompt–output–revision trail) to maintain accountability for reasoning. Thus, this innovation fills a gap in the literature: it not only shows that technology 'correlates' with CT, but also explains the mechanisms of CT improvement in detail and offers a replicable model to encourage analysis, evaluation, inference, counter-arguments, and metacognition in higher education learning.

The objective of this study is to describe the perception of lectures in critical thinking formation among students when technology is integrated as a series of argumentative tasks. Theoretically, this study provides a model of the mechanism for improving critical thinking based on process traces (annotation comments, argument maps, revision rounds, reflections), thereby not only showing that 'improvement occurred', but also explaining how and why that improvement occurred.

METHODOLOGY

Research Design

This research uses Quantitative research with a survey design. It is a research approach that aims to collect numerical data from a number of respondents in order to describe and analyse specific attitudes, perceptions, opinions, or characteristics within a population. According to (Creswell & Poth, 2018), survey designs in quantitative research are conducted by distributing structured instruments, such as questionnaires, to a sample or the entire population to obtain data that can be statistically analysed. In line with this view, Sugiyono, (2015) emphasizes that survey research is conducted on both large and small populations by studying data from a sample taken, without providing treatment or manipulation of the variables being studied. In the context of higher education, survey design is highly relevant for examining faculty perceptions regarding the integration of technology in teaching.

Because the perceptual data can be measured objectively through Likert-scale questionnaires and analyzed using both descriptive and inferential statistical techniques.

Participants Of The Study And Data Collection

This study involves 62 lecturers who teach at Universitas Muhammadiyah Bone in Bone Regency, South Sulawesi Province, Indonesia. The lecturers come from various educational backgrounds. The study utilized a non-probability sampling method, specifically convenience sampling, where participants were chosen based on their accessibility and willingness to participate. This approach is typical in educational research when facing limitations regarding time, access, or resources (Creswell & Creswell, 2018). The sampling strategy utilized purposive sampling to select participants, specifically lecturers who met certain professional criteria relevant to the research objectives. By combining convenience and purposive sampling, data were collected from accessible and pertinent respondents. While this approach may limit the generalizability of findings, it remains methodologically appropriate for exploratory and perception-based studies in higher education research.

This research adhered to ethical principles relevant to social and educational studies, emphasizing respect for individuals, beneficence, and justice. Prior to data collection, participants received detailed information about the research objectives, questionnaire procedures, and data usage for academic purposes. Informed consent was obtained electronically, ensuring participants understood and agreed to participate. To ensure the privacy protection of participants, this study strictly implements data anonymity and confidentiality procedures. The practice of anonymity is a fundamental principle in social and educational research, especially in perception-based survey studies, to protect the rights and dignity of participants (Creswell & Creswell, 2018; Israel & Hay, 2006).

Consistent application of anonymity and data confidentiality procedures is expected to increase participants' trust in the research process and encourage honest, objective, and reflective responses. Participant trust is an important element in survey-based research because it directly affects data quality and the validity of research findings (Bryman, 2016). The questionnaire was conducted using Google Forms, which was then distributed to groups and individuals. So, everyone who filled out the questionnaire was lecturers who teach various subjects in the classroom. So the researchers in this study want to explore the participants' perceptions of classroom teaching using critical thinking skills. In addition, the participants filled out their names, majors, and ages in the Google Form questionnaire.

A questionnaire was used to generate data to find out this investigation. A total of 62 respondents were asked to answer questionnaire with a total of 20 questions. The questions focused on finding out their perceptions of integration technology to promote critical thinking skills in the Teaching of Higher Education Courses. The questionnaire design use Likert scale ranging from 1- 5 in scale: 1 (strongly disagree), 2 (disagree), 3 (neutral/undecided), 4 (agree) and 5 (strongly disagree).

Data analysis

Data analysis in this study was conducted descriptively, in line with the main objective of survey research, which is to describe and map lecturers' perceptions of technology integration in the development of critical thinking skills in higher education. Therefore, the research findings are not intended to test hypotheses, determine cause-and-effect relationships, or draw inferential conclusions, but rather to provide a factual overview of the respondents' viewpoint trends.Perception-based survey data are commonly analysed descriptively to capture respondents' viewpoints rather than to test predictive relationships (Dornyei & Taguchi, 2010).

The data obtained from the questionnaire were analyzed using descriptive statistics, including frequency, percentage, mean, and standard deviation. This analysis aims to show the level of faculty agreement with statements related to technology use, the types of technology used, and their perceptions regarding the contribution of technology in stimulating students' critical thinking aspects, such as analysis, evaluation, and reflection. The quantitative data from Google form were analyzed utilizing descriptive statistics of percentage calculation. Both descriptive and quantitative analyses

were performed on the collected data. Software such as IBSM SPSS statistic 28.0 and Microsoft Excel helped with the study's data analysis.

RESULTS AND DISCUSSIONS

Findings

Table 1: Lectures Perception Of Integrating Technology
And Critical Thinking Skills In The Teaching Of Higher Education Courses.

No	Item Statement	Likert Scale				
		Strongly disagree	Disagree	neutral/ undecided	Agree	Strongly Agree
1	I understand the concept of critical thinking in teaching	1 (1.6%)	0 (0%)	4 (6.5 %)	47 (75.8 %)	10 (16.1%)
2	I recognize the importance of integration and critical thinking in learning	1 (1.6%)	0 (0%)	2 (3.2%)	44 (71 %)	15 (24.2 %)
3	I know learning approaches that integration technology encourages critical thinking.	1 (1.6%)	0 (0%)	5 (8.1 %)	46 (74.2%)	10 (16.1%)
4	I am concerned that generative AI will 'replace' students' critical thinking processes.	1 (1.6%)	0 (0%)	4 (6.5 %)	38 (61.3%)	19 (30.6%)
5	I feel inspired when moderating evidence-based online debates/peer reviews.	3 (4.8 %)	22 (35.5 %)	9 (14.5 %)	24 (38.7 %)	4 (6.5 %)
6	I feel that institutional support (policy/training) gives me the confidence to implement digital task design.	4 (6.5 %)	22 (35.5 %)	14 (22.6%)	20(32.3%)	2 (3.2%)
7	I understand the characteristics of students who have integration technology and critical thinking skills.	0 (0%)	0 (0%)	7 (11.3%)	40 (64.5%)	15 (24.2 %)
8	I know how to link platform features (comments, highlights, version history) with the claim–evidence–reasoning rules.	0 (0%)	1 (1.6 %)	8 (12.9%)	40 (64.5%)	13 (21 %)
9	I understand how to organize critical thinking sections (analysis, evaluation, inference, counterargument, metacognition).	0 (0%)	0 (0%)	4 (6.5%)	42 (67.7%)	16 (25.8 %)
10	I understand how TPACK guides the selection of digital tools according to objectives and content.	0 (0%)	0 (0%)	0 (0%)	34 (54.8%)	28 (45.2%)
11	I understand the contribution of social annotation to critical reading and knowledge	0 (0%)	2 (3.2%)	9 (14.5%)	42 (67.7%)	9 (14.5%)

	construction.					
12	I understand when and how argument mapping is used to clarify the structure of reasoning.	0 (0%)	0 (0%)	2 (3.2%)	46 (74.2%)	14 (22.6%)
13	I use technology (such as online discussion forums, analysis quizzes, or AI platforms) to practice critical thinking skills.	0 (0%)	2 (3.2%)	8 (12.9%)	40 (64.5%)	12 (19.4%)
14	I In the last semester, I implemented the annotation → argument mapping → debate/peer review → reflection process.	0 (0%)	0 (0%)	2 (3.2 %)	48 (77.4 %)	12 (19.4%)
15	I use version history/revision history to assess improvements in students' arguments.	0 (0%)	0 (0%)	5 (8.1%)	42(67.7%)	15 (24.2%)
16	I facilitate structured debates on the LMS with the requirement to include counterarguments and citations.	3 (4.8%)	22 (35.5%)	13 (21%)	20 (32.3%)	4 (6.5%)
17	I provided feedback based on the CT rubric and requested substantive revisions, not just grammatical corrections.	0 (0%)	0 (0%)	2 (3.2%)	40 (64.5%)	20 (32.3%)
18	I train students to verify sources (relevance, credibility) when constructing arguments.	0 (0%)	1 (1.6%)	4 (6.5%)	34 (54.8%)	23 (37.1%)
19	I asked students to write a metacognitive reflection on how their arguments changed after receiving feedback.	0 (0%)	1 (1.6%)	4 (6.5%)	43 (69.4%)	14 (22.6%)
20	In practice, infrastructure/ platform constraints often cause me to reduce my digital argumentative activities.	1 (1.6%)	4 (6.5%)	6 (9.7%)	46(74.2%)	5 (8.1%)

Based on perception theory of Sperling (1987) in this research, the questions to the lectures on their personal feelings, understanding, and experience were focused on the stimuli regarding lectures' act, sight and hearing. There are three classifications in exploring their perceptions, i.e. (1) lectures' personal feelings. There were six questions related to this aspect. In this aspect, lecturers' personal feelings showed their enthusiasm that critical thinking-based teaching enhances the quality of the teaching and learning process in the classroom. (2) Lectures' understanding. There were seven questions related to this aspect. In this study, lectures' showed their understanding perceiving the concept and the important of critical thinking in teaching, and understand the characteristics of students who have critical thinking skills. (3) Lectures' experience. There were seven questions related to this aspect. In this study, lectures' experience showed their method in teaching, and use technology to practice critical thinking skills.

Based on Table 1, the lecturers' perception of technology integration in developing critical thinking skills in higher education shows a generally positive trend, although variations in readiness levels and consistency of practice are still found. Statistically, the majority of items showed a

dominance of responses in agree and strongly agree categories, indicating a good level of awareness, conceptual understanding, and affective attitude toward the importance of critical thinking and technology in higher education.

Regarding conceptual understanding, the data indicates that 91.9% of lecturers agree and strongly agree that they understand the concept of critical thinking in learning. These findings indicate that lecturers have an adequate theoretical foundation regarding critical thinking as a high-level thinking skill. Theoretically, this understanding is an important prerequisite for developing critical thinking pedagogy, as lecturers' ability to design learning is highly influenced by their understanding of the cognitive structure of critical thinking itself. The same is also reflected in the item assessing faculty recognition of the importance of technology integration and critical thinking, where 95.2% of respondents stated they agreed or strongly agreed. The result confirms that lecturers recognize the relevance of critical thinking skills as a 21st-century competency and view technology as a strategic supporting tool in the learning process.

Furthermore, the majority of respondents (90.3%) also showed a positive response regarding their understanding of technology-based learning approaches that encourage critical thinking, as indicated by the technology-based pedagogical knowledge indicator. This finding reinforces the assumption that lecturers not only understand the concept of critical thinking abstractly but also recognize teaching approaches that can be used to develop it. Theoretically, this condition aligns with the Technological Pedagogical Content Knowledge (TPACK) framework, which emphasizes the importance of simultaneously integrating technological, pedagogical, and content knowledge in learning.

The statement that 77.4% of lecturers agreed and 19.4% strongly agreed with the use of a fully technology-based argumentative learning flow—which includes annotation, argument mapping, debate or peer assessment, and reflection stages—indicates a very high level of acceptance of this pedagogical approach. The dominance of this positive response indicates that the majority of lecturers view the integration of technology-based argumentative flows as a relevant and valuable strategy in supporting the learning process, particularly in developing students' critical thinking skills.

The absence of disagreeing responses (0%) reinforces the finding that respondents perceive the approach positively. This suggests that, at least at the perceptual level, lecturers do not see significant conceptual barriers to implementing technology-based argumentative learning flows. In other words, this approach has gained pedagogical legitimacy among respondents, although the actual level of implementation in classroom practice still requires further exploration.

Meanwhile, the presence of 3.2% of neutral respondents indicates that a small portion of lecturers had not fully formed a clear evaluative attitude toward the approach. This neutral stance may reflect limitations in implementation experience, variations in institutional context, or differences in technology readiness levels that influenced lecturers' beliefs about the overall effectiveness of implementing the learning flow.

Descriptively, the response distribution shows that lecturers perceive the technology-based argumentative learning flow very positively and relatively uniformly. These findings confirm that this approach has strong potential for widespread adoption in higher education and also indicate the importance of providing practical support and institutional policies to ensure that these positive perceptions can be translated into consistent and sustainable learning implementation.

Lectures personal feelings

The researchers distributed a closed questionnaire to 62 lecturers from various study programs to identify their personal opinions and feelings about critical thinking skills in the teaching process. The questionnaire was designed using a 5-point Likert scale, ranging from strongly disagree (1) to strongly agree (5). The majority of lecturers agreed that to cultivate critical thinking in students by teaching them to verify the authenticity and quality of information before using it in arguments. This involves assessing the relevance and credibility of sources, which helps students develop structured and logical arguments. By learning this verification process, students become more discerning in accepting information, minimizing the influence of inaccurate data in both academic and everyday

contexts. As seen in the results, 54.8% agreed and 37.1% strongly agreed. Additionally, lecturers feel that their students who are taught are very confident in determining their academic performance after implementing technology and critical thinking in the classroom, with 69.4% of lecturers agreeing.

A total of 64.5% of respondents agreed that provided feedback based on the CT rubric and requested substantive revisions, not just grammatical corrections. Lecturers disagreed that limited lectures are one of the problems or obstacles in improving students' thinking skills. Then, based on the students responded regarding facilitate structured debates on the LMS with the requirement to include counterarguments and citations. The results showed that 35.5% of lecturers disagreed, 32.3% agreed, 6.5% strongly agreed, 4.8% strongly disagreed, and 21% were undecided. The results of data analysis on the emotional dimension based on technology and critical thinking scores in university teaching can be seen in Table 2 below:

Table 2. Distribution of Emotional Dimension Scores

Score	Category	Frequency	Percentage
$X > 82$	Very Positive	7	11
$74 \leq X < 82$	Positive	20	32
$65 \leq X < 74$	Negative	26	42
$X < 65$	Very Negative	9	15
		62	100

Based on Table 2, it can be seen that the respondents' critical thinking scores in teaching by lecturers at universities show that in the feeling dimension, 15% are very negative, 42% are negative, 32% are positive, and 11% are very positive. Additionally, when considering the total score of all respondents, which is 1368, and the maximum total score of 62 respondents with 6 statements, which is 1860, the scores can be categorized into the following proficiency levels:

$$N=\frac{\text{Total Responden Score} \times 100\%}{\text{Total maximum Score}} = \frac{1368 \times 100\%}{1860} = 74$$

It can be concluded that the respondents' scores regarding integrating technology and critical thinking in college lecturers' teaching, as observed, indicate a positive category within the feeling dimension. The score of the critical thinking feeling questionnaire results in college lecturer teaching, based on the respondents' scores in this study, can also be illustrated as in Figure 1 below:
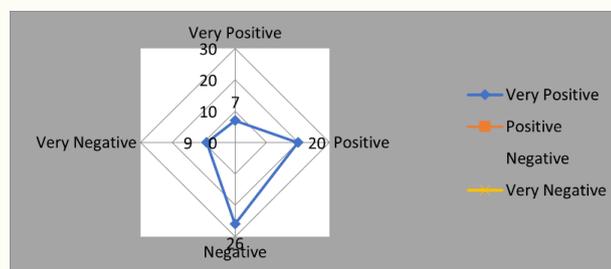

Figure 1. Distribution of Dimension Scores for Feelings integration technology and Critical Thinking in Higher Education Institutions

In general, the impact of lecturers' personal feelings on integration technology and critical thinking skills in the classroom learning process demonstrates that lecturers have positive feelings and are committed to the development of critical thinking skills integration technology, despite the fact that they recognize that not all students are ready to engage in the critical thinking process. As to the lecturers' responses, 74.2% felt that not all students are prepared to participate in critical thinking when taught.

Lectures understanding to integration technology and the critical thinking skill in the teaching.

Most lecturers stated that they understood the concept of critical thinking in teaching, as shown by the fact that 75.8% of lecturers agreed with the concept of critical thinking, and 16.1 % strongly agreed. Only 6.5% of the teachers were undecided, and 1.6% of the lectures disagreed. This indicates that lecturers have an adequate theoretical foundation regarding the meaning of critical thinking in the context of higher education.

Lecturers' statements regarding the importance of integration technology and critical thinking in the learning process scored highly, with 71% of lecturers agreed and 24.2% strongly agreed. This shows that the majority of lecturers view critical thinking skills as an essential element in the learning process. They believe that integration technology in critical thinking encourages students to think more deeply, construct logical arguments, and evaluate information objectively. They also acknowledge that critical thinking is a 21st-century skill relevant to the needs of the workplace and social development. Therefore, they consider it important to integrate approaches that encourage critical thinking into their teaching methods.

Based on the responses of lecturers to learning approaches that promote on integration technology and critical thinking, 74.2% agreed,16,1% strongly agreed, 8.1% undecided, and 1.6% Strongly disagree. This demonstrates how incorporating critical thinking skills into the teaching and learning setting might enable students to produce ideas on their own. Then, the results of a questionnaire answered by lecturers from various disciplines, it was found that lecturers have a fairly good understanding of the characteristics of students who demonstrate of integration technology and critical thinking skills. Generally, lecturers identify that students with critical thinking skills exhibit certain characteristics that can be observed through classroom interactions, discussions, and academic assignments. This is supported by the fact that 64.5% of respondents agreed with this statement. 24.2 % Strongly Agreed, and 11.3% undecided.

To find out how lecturers concerned that generative AI will 'replace' students' critical thinking processes, 62 lecturers from various disciplines teaching at the campus presented data showing that most lecturers agreed with a score of 61.3%. 30.6 % of the respondents strongly agreed. 1.6 % strongly agreed, and 6.5% undecided. So, the meaning of the statement is the lecturer who said it claims to have sufficient understanding to know the generative AI will 'replace' students' critical thinking .The results of data analysis on the dimension of understanding based on critical thinking scores in university teaching can be seen in Table 4.1 below:

Table 3. Distribution of Understanding Dimension Scores

Score	Category	Frequency	Percentage
% - 100%	Very Good	9	15
% - 89%	Good	45	72
% - 79%	Fairly Good	6	10
0%	Poor	2	3
		62	100

Based on Table 3, it can be seen that the respondents' critical thinking in integration technology scores in teaching by lecturers in higher education institutions show that in the understanding dimension, 3% are in the poor category, 10% are in the adequate category, 72% are in the good category, and 15% are in the very good category. Additionally, when considering the total score of all respondents, which is 1291, and the maximum total score of 62 respondents with 5 statements, which is 1550, the following proficiency levels can be determined:

$$N = \frac{\text{Total Responden Score} \times 100\%}{\text{Total maximum Score}} = \frac{1291 \times 100\%}{1550} = 83\%$$

It can be concluded that the respondents' critical thinking score regarding integration technology in university teaching observed show a good level of understanding.
The critical thinking comprehension test scores in university teaching based on the respondents' scores in this study can also be illustrated as shown in Figure 2 below:
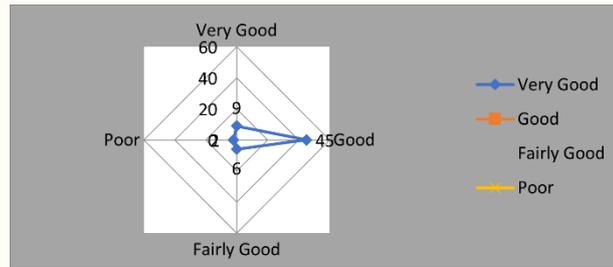
Figure 2. Distribution of Scores for the Dimension of Understanding integration technology and Critical Thinking in Teaching by Lecturers at Higher Education Institutions

Based on the results of the questionnaire given to lecturers, it can be concluded that, in general, lecturers have a high level of understanding of integration technology and critical thinking skills in teaching. The majority of lecturers demonstrated a strong understanding of the concept of critical thinking, its role in the learning process, and the characteristics of students who think critically.

Lectures' experience to the critical thinking skill in the teaching.

To determine the extent to which lecturers have experience in applying critical thinking skills in the learning process, the researchers distributed questionnaires to a number of lecturers from various study programs. The questionnaire contained several statements designed to describe lecturers' teaching practices related integrating technology to encouraging, developing, and assessing students' critical thinking skills in class. Some lecturers stated that they felt inspired when moderating evidence-based online debates/peer reviews. This was evidenced by their responses, with 38.7% agreed and 6.5% strongly agreed. Then there were some lecturers who disagreed (35.5%), and 14.5% were undecided or neutral.

A survey of 62 lecturers was conducted regarding the statement that structured debates on the LMS with the requirement to include counterarguments and citations can make it difficult for lecturers to apply in integration technology and critical thinking-based approach. The findings show that 35.5% of lecturers disagreed with the statement. 6.5% strongly disagreed, and 22.6% were undecided. In practice, lecturers stated that they provided feedback based on the CT rubric and requested substantive revisions, not just grammatical corrections. Based on their responses, 64.5% agreed, 21% strongly agreed, and 1.6% disagreed. I understand the contribution of social annotation to critical reading and knowledge construction. This can be seen from the lecturers' responses, with 67.7% agreed, 25.8% strongly agreed, and 6.5% undecided. In addition, based on the results of a questionnaire given to 62 lecturers from various disciplines, data was obtained that they understand when and how argument mapping is used to clarify the structure of reasoning. 74.2% of lecturers stated that they agreed, 22.6% stated that they strongly agreed, and 3.2% stated that they are undecided.

The majority of lecturers who participated in a questionnaire of 62 lecturers stated using technology to help students develop their critical thinking skills. 64.5% of the respondents agreed, 19.4% strongly agreed, 12.9% were undecided, and 3.2% disagreed, indicating that using technology in the classroom such as online discussion boards, analytical tests, and artificial intelligence platforms is something that they are enthusiastic about. The fact that 12.9% of respondents were neutral and 3.2% disagreed could be attributed to a lack of instruction on how to use technology for critical thinking, facility constraints, or digital abilities. These results suggest that while there is still opportunity for lecturers' digital proficiency to be improved and equalized, the majority of them have started incorporating technology as part of a 21st-century learning style that emphasizes the development of critical thinking. The data processing results for the experience dimension based on integration technology and critical thinking scores in college lecturers' teaching can be seen in Table 4 below:

Table 4. Distribution of Experience Dimension Scores

Score	Category	Frequency	Percentage
% - 100%	Very Good	10	16
% - 85%	Good	42	68
% - 69%	Fairly Good	10	16
< 55%	Poor	0	0
		62	100

Based on table 4, it can be seen that the scores of respondents regarding integration technology and critical thinking in college teaching at the observed institutions show that the experience dimension is categorized as poor at 0%, sufficient at 16%, good at 68%, and very good at 16%. In addition, when looking at the total score obtained by all respondents, which is 2167, and the maximum total score from 62 respondents with 9 statement items is 2790, the level of mastery score is as follows:

$$\frac{\text{Total Responden Score} \times 100\%}{\text{Total maximum Score}} = \frac{2167 \times 100\%}{2790} = 78$$

It can be concluded that the respondents' scores on integration technology and critical thinking in college teaching, as observed, indicate a good level in the experience dimension. The results of the critical thinking experience questionnaire in college teaching, based on the respondents' scores in this study, can also be illustrated as in Figure 3 below:
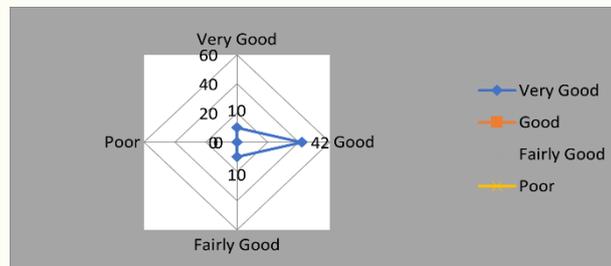

Figure 3. Distribution of Experience Dimension Scores in integration technology and Critical Thinking in Lecturer Teaching Higher Education Institutions

Discussion

The discussion results show that faculty perceptions of technology integration to develop critical thinking skills in higher education are in the positive category across three main aspects: feelings, understanding, and experience.

1. Lecturers' Personal Feelings to the Critical Thinking Skill in the Teaching

From an emotional aspect, the lecturers showed a positive emotional attitude toward the implementation of critical thinking and technology-based learning. They felt that technology could improve the quality of academic interactions, encourage student participation, and strengthen analytical skills. Nevertheless, some lecturers still believe that not all students are ready to engage in technology-supported critical thinking activities. Integrating various technologies enhances critical thinking abilities within targeted English language skills (Rungsawang & Pookcharoen, 2023).

Most lecturers expressed positive feelings about the importance of critical thinking in higher education. They felt that this skill was a fundamental part of shaping students who were able to think logically, reflectively, and independently. Many of them feel motivated and enthusiastic when they successfully stimulate critical questions from students. The findings support the previous studies Lopez et al., (2023) Interactive, dynamic, and student-centered learning enhances critical thinking development in technical and vocational education contexts, facilitating teacher work and enhancing classroom efficiency. As Indrasiene et al., (2021) also stated in their research, the study shows that the

development of critical thinking is influenced by teachers' understanding, their attitudes towards it, and the special attention they give to its development. Several facets of critical thinking, including academic research, theory evaluation, and other areas, can be significantly improved with the use of artificial intelligence (AI) (Darwin et al., 2024).

2. Lectures' understanding to the critical thinking skill in the teaching.

Regarding the aspect of understanding, the majority of lecturers have a good understanding of the concepts, characteristics, and urgency of critical thinking in 21st-century learning. They realized that integrating technology – such as social annotation, argument mapping, and AI – could strengthen students' ability to analyze, evaluate, reason, and construct evidence-based arguments. In critical pedagogy, STEM-PBL integrated engineering design processes can enhance students' STEM literacy and thinking skills, promoting cognitive development and broadening perspectives compared to conventional teaching methods (Abdurrahman et al., 2023). Understanding critical thinking is crucial for students' learning and integration into advanced education. Despite many students valuing critical thinking, their perceptions vary significantly. They view critical thinking as a tool for analyzing, evaluating, and synthesizing information, which is essential for students to make informed decisions, effectively address problems, and connect with deeper knowledge. Humphreys & Brookfield, (1989) argues that recognizing, questioning, and evaluating assumptions for validity are necessary.

Lecturers emphasize the importance of critical thinking in academics, linking it to logical reasoning, questioning assumptions, identifying biases, and forming evidence-based arguments. They differentiate between critical and normal thinking, viewing it as a cognitive skill that requires structured dialogue and reflective learning activities. Simpson (1996) suggested that the process of critical thinking requires active argumentation, initiative, reasoning, visualization, complex alternative analysis, and value-based decision-making related to emergency situations.

3. Lectures' experience to the critical thinking skill in the teaching.

From an experience perspective, lecturers have tried various technology-based strategies to train critical thinking skills, ranging from online discussions, analytical quizzes, peer reviews, to rubric-based feedback. They realized that technology serves as a medium to help students construct arguments, make more meaningful revisions, and develop their metacognition. However, some lecturers also face obstacles, such as limited training, digital readiness, and infrastructure. This special issue emphasizes the significance of developing and assessing thinking skills in higher education and highlights the necessity for ongoing research and innovation in educational technology (Dori & Lavi, 2023). Furthermore, some lecturers still struggle to support critical thinking-based learning, particularly if they have not had enough training in critical thinking-based teaching techniques. Lecturers from disciplines that historically placed more emphasis on technical than on contemplative features frequently experience this emotion. They are generally unsure if the strategies that they employ are successful in fostering students' capacity for critical thinking.

Lecturers' experiences in teaching critical thinking skills demonstrate the diversity of approaches and strategies they encounter in the classroom. The questionnaire results revealed that some lecturers have actively integrated critical thinking skills into the learning process, either through the use of case studies or approaches such as online discussion forums, analysis quizzes, or AI platforms. They felt that experience encouraged students to not only conceptually understand the material but also to put it into practice. Gelder, (2005) proposes that critical thinking be taught explicitly and practiced consciously as an essential component of the curriculum. Nowadays, students are exposed to a vast amount of information, including the Internet, making it difficult to cultivate critical thinking abilities (Klimova, 2013).In the current world, where the complexity of knowledge and information is changing at an accelerating rate, the capacity for critical thinking is one of the most important skills for success (Arviani et al., 2023).

Several lecturers revealed that their experience in teaching critical thinking began slowly and developed over time. Initially, they found it challenging to design learning activities that could stimulate critical thinking among students. However, through a process of reflection and

experimentation with various strategies, the lecturers began to discover approaches that were more suitable for the context and characteristics of their students. Students may be able to enhance their critical analysis and comprehension of texts by asking questions and discussing answers in small groups (Simpson, 1996). This experience demonstrates that the development of critical thinking instruction is a dynamic process that requires continuous adaptation. According to Abrami (2008), critical thinking objectives should be specifically included in training programs and courses for effective instruction. Critical thinking in language teaching and learning is evident in instructional methods, learning materials, and assessment strategies (Saleh, 2019), thus the training framework developed by (Duron et al., 2006) addresses key areas for fostering critical thinking in instructors, making it suitable for programs focused on this skill development.

Based on the Discussion section in the article there is a clear conceptual difference between lecturers' perceived competence and their actual competence in integrating technology to enhance students' critical thinking skills. Perceived competence refers to lecturers' subjective beliefs about their understanding, readiness, and ability to apply technology-based learning and critical thinking. This is reflected in the high percentage of lecturers who agree or strongly agree with the statements that they understand the concept of critical thinking, know technology-based learning approaches, and are aware of the importance of these skills in higher education. However, the article's discussion also shows that actual competence, meaning the real ability of lecturers to consistently implement argumentation-based learning practices, is not entirely aligned with this perception. Even though lecturers said they understood and felt good about teaching, the data on their experience revealed that only a small number of them regularly used a complete set of critical thinking activities, like social annotation, argument mapping, evidence-based debate, and metacognitive reflection, in one learning cycle. This perception is evident from the low percentage of lecturers who report fully implementing technology-based argumentative learning pathways in their teaching practices. Perceived competence refers to an individual's belief in their abilities, while actual competence refers to the real capabilities reflected through observable actions, practices, and performance (Bandura, 1997)

In the discussion, the author identifies several factors contributing to a gap in critical thinking pedagogy, including inadequate training, varying digital readiness among lecturers, and infrastructure and policy constraints. The distinction is made between perceived and actual competence in pedagogical practice. The article argues that fostering students' critical thinking skills requires more than positive perceptions; it necessitates systemic support through ongoing training, structured task design, and institutional policies that encourage the pedagogical integration of technology. The framework aims to identify and simplify the complexities faced by teachers and students in forward thinking. It outlines innovative teaching and assessment strategies for forward thinking literacy, including the necessary literacy, cognitive processes, and relevant tasks. The integration of new pedagogical approaches and modifications to the environment support authentic learning (Vidergor, 2023).

Overall, the discussion indicates that faculty perceptions not only reflect support for integrating technology in developing critical thinking skills but also highlight the need for more structured training, institutional policies, and learning design. This aligns with various literature that emphasizes that the successful development of critical thinking depends on educators' understanding, teaching strategies, and a supportive learning environment.

CONCLUSIONS

Based on the findings of this study, it can be concluded that university lecturers generally show a positive attitude toward the integration of technology in developing critical thinking skills. The majority of respondents view critical thinking as an essential competency in higher education and recognize that technology has the potential to support the processes of analysis, evaluation, evidence-based argumentation, and metacognitive reflection in learning. This positive attitude is reflected in the high level of agreement among lecturers regarding statements related to the importance of critical

thinking, the relevance of technology in learning, and the pedagogical value of activities such as online discussions, digital feedback, and rubric-based assessment of critical thinking. From the perspective of pedagogical awareness, the research findings indicate that lecturers have a relatively strong conceptual understanding of the nature of critical thinking and the principles of technology integration aligned with learning objectives. This awareness includes understanding the characteristics of critical thinking students, the structure of the critical thinking process (analysis, evaluation, inference, and reflection), and the role of pedagogical frameworks like TPACK in meaningfully selecting and utilizing technology. Theoretically, this level of awareness indicates that lecturers have moved beyond using technology at the substitution level and are beginning to view technology as a pedagogical tool that has the potential to enrich the learning process.

However, this study also revealed that perceived readiness is not entirely proportional to the consistency of complex pedagogical practices. Although lecturers feel conceptually prepared and competent, the full implementation of technology-based argumentative learning flows including social annotation, argument mapping, evidence-based debate, and metacognitive reflection has not been carried out evenly and sustainably. This finding indicates a gap between perceived competence and actual performance, which can be theoretically explained through the concepts of perceived competence and actual performance. In other words, perceived readiness more reflects beliefs and understanding, while actual readiness demands pedagogical experience, systemic support, and adequate institutional conditions. Additionally, this research highlights several challenges perceived by lecturers, particularly regarding infrastructure limitations, varying digital readiness, and suboptimal institutional policy and training support. Some lecturers stated that platform constraints, time limitations, and a lack of critical thinking-based pedagogical training led to the need to simplify or reduce technology-based argumentative learning activities. This finding confirms that the effectiveness of technology integration is not solely determined by the attitudes and awareness of individual faculty members, but also by the institutional ecosystem that supports sustainable pedagogical implementation. (Prayogi et al., 2018) assert that the best approach to intervene and foster critical thinking abilities is to use learning interventions to foster critical thinking in pre-service teachers throughout university training.

Although the results of this study provide a theoretical indication that argumentatively designed technology integration has the potential to support improved learning quality and critical thinking processes for students, this study has clear limitations. First, the data used is entirely based on faculty perceptions and does not involve direct measurement of student learning outcomes or learning artifacts. Second, the descriptive survey design does not allow for causal conclusions to be drawn regarding the effectiveness of technology in improving critical thinking skills. Third, the research context, limited to a single institution, restricts the generalizability of the findings to the broader context of higher education. Therefore, future research is recommended to use an empirical design involving students as the main subjects, as well as analyze authentic learning artifacts such as digital annotation results, argument maps, revision trails, and students' metacognitive reflections. A mixed methods approach or a quasi-experimental design is also recommended to more robustly test the relationship between technology-based pedagogical models and the improvement of critical thinking skills. Thus, the findings on faculty perceptions obtained in this study can be validated thru more direct empirical evidence and contribute more strongly to the development of technology-based learning practices in higher education.

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