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The Implementation of TPACK-Based Metacognitive Listening Strategies in Improving Students' Critical Listening Skills

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***Abstract*—Not all students can effectively absorb and process the information they receive, highlighting the need for metacognitive listening strategies and appropriate technology to enhance their critical listening skills. Hence, this study aimed to investigate the implementation of TPACK-based metacognitive listening strategies in improving students' critical listening skills. This quantitative descriptive study utilized observation, questionnaires, and tests for data collection. The study sample comprised 88 first-semester students from the Indonesian Language Education Study Program at the University of Bengkulu. Regression test results demonstrated a positive correlation between the implementation of TPACK-based metacognitive listening strategies and students' critical listening skills, indicated by an x coefficient of 0.86 and an R^2 value of 0.228 (22.80%). While TPACK implementation was primarily at the levels of knowledge and concepts, listening tests were focused on recognizing and accepting. Conversely, critical listening practice was carried out at the adapting, exploring, and advancing levels, making technology usage easier for students (96.2%). Therefore, the higher the use of TPACK-based metacognitive listening strategies by students, the more their critical listening skills improve.**

***Index Terms*—Metacognitive Listening Strategies (MLS), TPACK, critical listening skill**

I. Introduction

Technology is advancing rapidly in today's world, making information widely accessible. This situation necessitates self-control and selectivity in receiving information to prevent being easily provoked, especially by content from social media platforms like Facebook, WhatsApp, Instagram, YouTube, and television shows. The significance of technology has grown even more during the global COVID-19 pandemic (Mishra & Koehler, 2006; Adnan & Anwar, 2020), particularly in education. Teaching and learning activities have primarily shifted to virtual formats during the outbreak. Consequently, listening skills have become a priority for both teachers and students. With adequate listening skills,

students can fully comprehend their lessons. Therefore, they need to develop listening as a learning skill and apply it in real life.

Learning to listen using audiovisual materials is engaging and can improve students' listening skills in language acquisition. Moreover, listening involves capturing sound symbols and processing information and visual symbols, which allows for critical evaluation of the material. This requires effective listening strategies, practice, and habituation. This aligns with research by Mahdavi and Miri (2016), which examines the impact of metacognitive strategies based on process-based and product-based learning on improving listening comprehension and metacognitive awareness. Process-based learning emphasizes that language skills (writing, reading, speaking, and listening) vary among students based on their second language (L2) proficiency (Ruiz-Funes, 2015; Sahragard & Mallahi, 2014; Soureshjani & Naseri, 2012). Listening skills are particularly challenging for many English as a Foreign Language (EFL) learners, who are constantly seeking solutions to improve (Graham, 2006). Thus, different learning contexts result in varying L2 performance levels (Ehrman et al., 2003). EFL teachers must consider this variation to create enjoyable learning experiences for students with diverse preferences (Chang, 2005). In contrast, learning Indonesian as a second language differs since it is not foreign. Recent research on L2 listening focuses on the correlation between metacognitive listening strategies and other EFL-related factors. Correspondingly, the present study specifically examined students' metacognitive listening strategies integrated with Technological Pedagogical Content Knowledge (TPACK) in their learning (Bozorgian, 2014; Cross, 2011; Latifi et al., 2014; Rahimi & Katal, 2013; Vandergrift & Goh, 2012; Vandergrift et al., 2006).

Several studies in educational research have integrated technology with TPACK-based teaching. One such study is a survey-based approach for TPACK measurement developed by Archambault and Crippen (2009), aimed at enhancing teachers' competence. Other significant studies by Mishra and Koehler (2006), Archambault and Crippen (2009), and Schmidt et al. (2014) offer triangulation on successful survey approaches using different methodologies (factor analysis) and populations (pre-service teachers), measuring teachers' understanding in various content areas. Research on integrated listening learning strategies using technology has shown that it can improve students' critical listening skills. Arono (2014, 2015) suggests that performance in listening strategies and interactive multimedia listening enhances students' listening skills.

Additionally, research by Armstrong and Ferrari-Bridgers (2020) on medical staff students demonstrated positive and significant results in critical listening without involving technology. This research, conducted through blended learning, without technology, and through face-to-face classes, contrasts with the current study, which focused on synchronous and asynchronous online learning using metacognitive listening strategies. Therefore, this research described the implementation of TPACK-based metacognitive listening strategies in improving students' critical listening skills.

II. Literature Review

A. Metacognitive Listening Strategies

The learning strategy for listening consists of two main parts: metacognitive and cognitive strategies. According to Oxford (2011), metacognitive strategies are considered "construction managers". Vandergrift et al. (2006) classify metacognitive strategies into five categories: (1) planning and evaluation, (2) directed attention, (3) person knowledge, (4) mental translation, and (5) problem solving. These strategies facilitate task-based learning, helping learners develop their metacognitive knowledge about listening (Goh, 2002; Vandergrift & Goh, 2012; Vandergrift, 1999). Metacognitive strategies involve techniques that improve listening skills through a person's knowledge of cognitive processes, active monitoring, regulation, and integration (Flavell, 1979). Metacognition is also defined as awareness and control of one's cognition, knowledge, and regulation (Wenden, 1998).

B. Technological Pedagogical Content Knowledge (TPACK)

Technological Pedagogical Content Knowledge (TPACK) extends the Pedagogical Content Knowledge (PCK) concept by incorporating technology as a specific type of lecturer knowledge. According to Koehler and Mishra (2008), there are three main components of lecturer knowledge in applying TPACK: material content, technology, and pedagogy. The integration of these three components is referred to as TPACK. Integrating technology into teaching and learning activities can enhance the quality of student learning outcomes. This finding is consistent with Shulman (1986) and Niess et al. (2009), who identify five levels of technology integration in learning: 1) Recognizing: lecturers can use technology and identify its alignment; 2) Accepting: lecturers form a favorable attitude toward learning content with appropriate technology; 3) Adapting: lecturers engage in activities leading to the adoption or rejection of learning with appropriate technology; 4) Exploring: lecturers actively integrate learning with relevant technology; 5) Advancing: lecturers evaluate the outcomes of decisions regarding the integration of learning with appropriate technology.

C. Critical Listening Skills

Critical listening skills involve the advanced assessment of information being listened to. It implies evaluating whether a message is presented accurately, not just understanding it (Wolvin & Coakley, 1985; Treasure, 2011; Talalakina, 2012; Ferrari-Bridgers et al., 2017). In critical listening, the assessment allows listeners to compare and determine the information's value, quality, and validity (Wolvin & Coakley, 1996). Critical listening skills are built on

appreciative listening, which increases awareness, wisdom, and the capacity for objective evaluation (Purdy, 2008; Corey, 2016). Critical listening prioritizes continuous understanding of the information received, maintaining details that fit this filter while discarding what does not contribute to structure, discipline, and clarity (Treasure, 2011; Couper, 2011). The indicators for students' critical listening skills include determining answers to specific problems, identifying similarities and differences, selecting objectives and evaluating, choosing new and additional information, and generalizing and hypothesizing (Anderson, 1972; Arono, 2014, 2015).

III. METHODOLOGY

A. Research Design

This study was descriptive quantitative research employing survey methods. Data were collected using questionnaires and tests. Descriptive quantitative research numerically explains activities and learning outcomes, describing each stage and learning level. Survey and questionnaire techniques were used to assess students' critical listening skills and the improvement of TPACK-based metacognitive listening strategies. Meanwhile, tests were employed to measure the enhancement of students' critical listening skills. Furthermore, the study described trends, behaviors, and generalized opinions or claims from a population or sample (Creswell, 2009). The survey was conducted online or on websites (Nesbary, 2000; Sue & Ritter, 2007).

B. Participants and Context

Participants in this study were students from the Indonesian Language Education Study Program at the University of Bengkulu. The sample included 44 students from Class A and Class B in Semester 1 of the 2020/2021 academic year. They were selected because their course prioritized technology in both audio and audiovisual learning practices. The TPACK model was deemed relevant for integration into listening courses. At the beginning of the semester, the students were expected to develop critical listening skills by prioritizing technology in their learning.

C. Data Collection Procedures

Data were collected through observations, interviews, close- and open-ended questionnaires, and online tests. Observations and interviews were used to monitor the development of learning activities in each cycle, the level of TPACK integration, and students' metacognitive listening strategies through virtual meetings (Zoom and Google Meet), e-learning, and written assignments completed online. Interviews via video calls and Zoom meetings revealed students' challenges in critical listening and technology use. Close- and open-ended questionnaires were used to observe the development and improvement of students' metacognitive listening strategies and technology use. Tests conducted at the end of each lesson measured students' critical listening skills. The tests were administered four times after implementing TPACK-based metacognitive listening strategies, yielding satisfying results.

D. Instruments

Data were collected employing a TPACK instrument developed by Vandergrift et al. (2006). It included 21 statements divided into five aspects of metacognitive listening strategies: planning and evaluation, directed attention, person knowledge, mental translation, and problem solving. The instrument was based on five levels: recognizing, accepting, adapting, exploring, and advancing, each in the form of open questions (Koehler & Mishra, 2008; Niess et al., 2009). Additionally, indicators of students' critical listening skills included determining answers to specific problems, identifying similarities and differences, setting objectives and evaluations, acquiring new and additional information, and formulating generalizations and hypotheses with 10 descriptive questions (Anderson, 1972; Wolvin & Coakley, 1996; Purdy, 2008; Treasure, 2011; Arono, 2014). The metacognitive listening strategies were integrated into every learning activity alongside technology/TPACK in critical listening practice. Students' metacognitive listening strategies and critical listening skills were developed over four meetings with various listening topics.

E. Data Analysis

The metacognitive listening strategies instrument was pre-tested with 40 randomly selected students, resulting in 21 valid statements (r-score > r-table, 0.312). After validation, the instrument was used to gather data on students' metacognitive listening strategies at the beginning, middle, and end of learning sessions. This instrument was linked to students' critical listening skills and the TPACK-based listening metacognitive strategies. The research data analysis occurred in two stages. The first stage involved a descriptive analysis of the implementation and observation of critical listening learning using the five-level TPACK-based metacognitive listening strategies. The second stage comprised a quantitative descriptive analysis of how metacognitive listening strategies improved students' critical listening skills using TPACK. Students' skills in each dimension were described using the following equation.

$$\text{Interval} = \frac{U - L}{I}$$

Notes:
U = Highest score of responses
L = Lowest score of responses
I = Number of interval classes (Sugiyono, 2010).

The Likert rating scale criteria interval is shown in Table 1 below.

TABLE 1
CRITERIA OF SKILLS FOR EACH DIMENSION

Interval	Criteria
1.00 – 1.80	Very Low, Very Less
1.81 – 2.60	Less
2.61 – 3.40	Moderate, Enough
3.41 – 4.20	High, Fine
4.21– 5.00	Very High, Very Good

The research results were analyzed using inferential statistical analysis with multiple linear regression. The correlation between research variables is depicted mathematically as follows.

$$\mathbf{Y = \alpha + \beta X + e}$$
$$\mathbf{Y = \alpha + \beta_1 X_1 + \beta_2 X_2 + e}$$

Notes:
Y: Critical Listening Skills
a: Constant
$\beta_1 - \beta_2$: Regression Coefficient
X_1: TPACK-based metacognitive listening strategies (TPACK MLS)
X_2: non-TPACK-based metacognitive listening strategies (non-TPACK MLS)

TABLE 2
CRITICAL LISTENING SKILLS MEASUREMENT SCALE

Interval	Criteria
10 – 40	Poor
41 – 70	Moderate
71 – 80	Good
81 – 100	Very Good

(Arono, 2020)

To analyze the correlation between TPACK-based metacognitive listening strategies and aspects of critical listening skills, or vice versa, a simple linear test was conducted using current product display data.

$$r_{xy} = \frac{N\sum XY - (\sum X)(\sum Y)}{\sqrt{[N(\sum X^2)(\sum X)^2][N(\sum Y^2)(\sum Y)^2]}}$$

Notes:
r_{xy} = correlation coefficient
X = scores of metacognitive listening strategies
Y = scores of aspects of critical listening skills
N = number of respondents

The interpretation of the test analysis results was conducted using the following criteria.

TABLE 3
INTERPRETATION OF THE CORRELATION COEFFICIENT VALUE (R)

Coefficient Interval	Correlation Level
0.80 – 1.000	Very strong
0.60 – 0.799	Strong
0.40 – 0.599	Moderate
0.20 – 0.399	Low
0.00 – 0.199	Very low

Sugiyono (2010)

IV. FINDINGS

The TPACK-based metacognitive listening strategies were implemented in the Indonesian Language Education Study Program at the University of Bengkulu during the odd semester of the 2020/2021 academic year. Two classes were involved in this study: Class A and Class B. Class A consisted of 44 students (6 males and 38 females), while Class B also consisted of 44 students (8 males and 36 females). The investigation primarily focused on the practice of critical thinking after the final semester exams. However, learning activities before the final exams were also observed, particularly those that implemented TPACK. Until the midterm exam, the material focused on understanding listening skills. General comprehension listening tests were conducted several times, identifying the main components of TPACK: material, technology, and pedagogy. The first component, material, pertained to listening knowledge and skills, both intensive and extensive. The second component, technology, involved the students' use of technology in listening learning, including e-learning (https://elearning.unib.ac.id/), YouTube, Google Forms, WhatsApp groups, email/Google Drive, and Zoom meetings. The final component, pedagogy, encompassed metacognitive listening strategies such as honesty, discipline, criticality, and innovation, which were integrated with the e-learning platform.

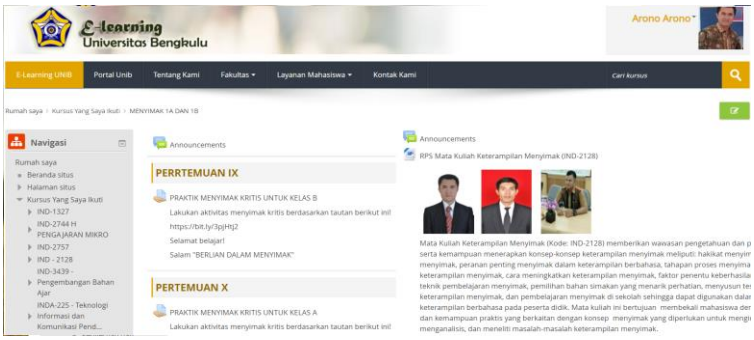
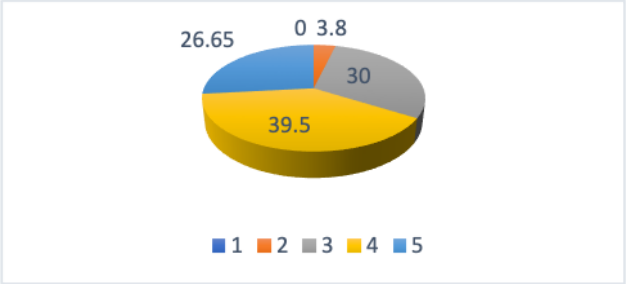


Figure 1. Critical Listening E-Learning

The e-learning process integrated technology with critical listening skills by applying it at five levels: recognizing, accepting, adapting, exploring, and advancing. The researchers grouped these levels into knowledge (recognizing and accepting) and conceptualization (adapting, exploring, and advancing). At the recognizing level, listening was aimed solely at acquiring knowledge and testing students, focusing on audio use and limited technology exploration. In other words, technology was primarily used for testing and delivering materials. At the accepting level, efforts were undertaken to maximize technology for improving listening skills, although many lecturers remained concerned about students' attention and listening skills. During listening tests, students were given limited time to cross-check what they heard, resulting in lectures predominantly being delivered synchronously.

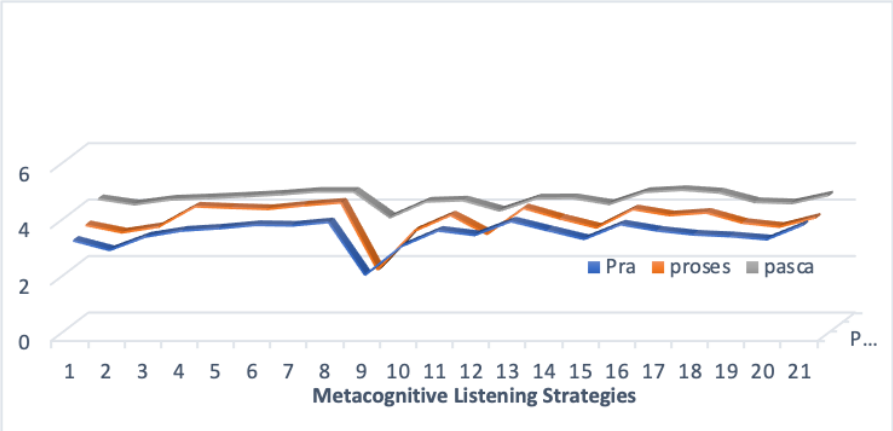
The practice and learning of critical listening carried out by prospective teachers involved three levels: adapting, exploring, and advancing. At the adapting level, lecturers and students began exploring, experimenting, and practicing critical listening skills utilizing technology. For example, students practiced metacognitive listening strategies with technological tools, developing appropriate critical listening skills. However, they encountered challenges in evaluating the integration of listening practice with writing. At the exploring level, lecturers and students maximized technology to facilitate critical listening practice on recent topics. Some students taught critical listening, while others responded using technology for planning, implementing, and reflecting on the teaching and learning process, guiding students in understanding and developing critical listening skills. These practices were evaluated by considering students' learning outcomes and attitudes towards listening activities, managed with various technological tools for both group and independent works.

At the advancing level, the process included planning, implementing, and reflecting on teaching and learning to improve students' independent critical listening skills. This level incorporated programmed critical listening practice with integrated and maximized technology. For instance, teachers used e-learning platforms to present materials, exercises, assignments, and discussions. Immediate discussions and information were handled via WhatsApp groups. Critical listening activities were facilitated through e-learning tools like Google Forms and YouTube links, with lectures delivered synchronously or face-to-face. Group discussions were conducted via Zoom meetings, while extensive teaching materials were shared via email/Google Drive. For evaluation, technology also played a crucial role, addressing initial difficulties students faced with e-learning platforms by providing tutorial links and operator contacts. Technological issues were discussed during virtual classes to enhance student achievement, as depicted in the graph below.



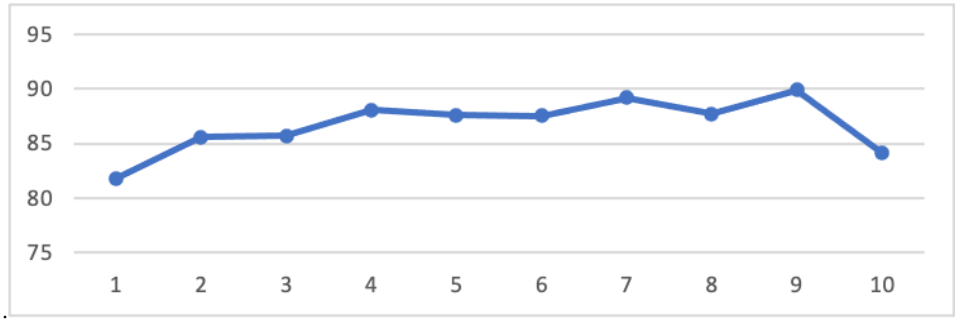
Graph 1. Students' Mastery of Technology

Graph 1 demonstrates that students' proficiency in using e-learning platforms and Google Forms to enhance critical listening skills was classified into favorable categories. This is evidenced by the levels of difficulty students experienced with the technology, which were categorized into five levels: very easy (26.7%), easy (39.5%), quite easy (30%), and difficult (3.8%). The total percentage for the easy category amounts to 96.2%. The primary reason for these findings was that students were introduced to technology usage both individually and in groups from the start of their Listening course. Besides, the COVID-19 pandemic has accustomed learners to using technology for learning, not only in Listening but also in other courses. This situation was further supported by the ease with which students accessed YouTube for learning materials, with findings showing very easy (47.6%), easy (29.5%), quite easy (15.2%), difficult (5.7%), and very difficult (1.9%). Despite the general ease, some students did encounter difficulties, primarily due to poor internet connections, as revealed in the interviews. For instance, watching YouTube videos often proved challenging during listening courses due to playback issues. The critical listening materials covered various topics: education (40%), social (20%), economy and health (15%), technology (8%), arts and culture (7%), environment (5%), defense and security (3%), and agriculture (2%). These themes were predominantly used in students' critical listening activities and designing listening materials using Google Forms. Beyond the technological aspects, pedagogical implementation is illustrated in the following graph.



Graph 2. Metacognitive Listening Strategies (MLS)

Graph 2 demonstrates that the TPACK-based metacognitive listening strategies enhanced various aspects: planning and evaluation, directed attention, person knowledge, mental translation, and problem solving. Among these five aspects, directed attention still required improvement to balance the metacognitive listening strategies with other areas. This need for balance was evident from the questionnaires administered to learners before, during, and after learning sessions. Students completed questionnaires about their metacognitive listening strategies before learning, resulting in a score of 3.66. After the final semester exams, during or in the middle of learning, students were given another questionnaire, which yielded good (3.82) and very good (4.23) scores. These results indicated an increase of 0.16% in the first cycle and 0.41% in the second cycle, exhibiting an overall growth of 0.57% in students' metacognitive listening strategies from the beginning to the end of the learning period. This suggests that learning with TPACK-based metacognitive listening strategies effectively improved students' critical listening skills, as reflected in their very good scores (86.7) in the graph below.



Graph 3. Students' Critical Listening Skills

Based on Graph 3, students' critical listening skills were categorized as very good (86.7), evaluated on aspects such as determining answers to specific problems, identifying similarities and differences, setting objectives and evaluations, acquiring new and additional information, and formulating generalizations and hypotheses. Among these aspects, determining answers to specific problems (83.7) and formulating hypotheses (84) scored slightly lower than others but remained in the very good category. The scores for identifying similarities and differences (86.8), setting objectives and evaluation (87.56), acquiring new and additional information (88.4), and formulating generalizations (89.9) were higher. These skills improved after four sessions of critical listening learning on various topics via Google Forms: the topic of politics achieved a sufficient score (64); the topics of economics and defense and security accomplished good scores (73 and 78.93, respectively); the topic of health achieved very good score (81.71). The final topic discussed was the relationship between health and education. The difference in students' critical listening skills before and after implementing TPACK-based metacognitive listening strategies is further detailed below.

TABLE 4
TEST RESULTS OF DIFFERENCES IN METACOGNITIVE LISTENING STRATEGIES BEFORE AND AFTER TPACK-BASED IMPLEMENTATION

Learning model	t_{score}	Significance	Information
Non-TPACK-based MLS learning	5.98	0.00	Different

The table above shows that the t-score was 5.98 with a significance of 0.00, less than the alpha level of 0.05. This indicates statistically significant differences between non-TPACK-based and TPACK-based metacognitive listening strategies learning. An N-gain analysis was conducted to assess the effectiveness of non-TPACK-based learning versus TPACK-based learning on students' metacognitive listening strategies. The results of the N-gain test for both classes are displayed in the following table.

TABLE 5
THE AVERAGE N-GAIN OF NON-TPACK-BASED AND TPACK-BASED MLS LEARNING

Class	N-gain	Information
TPACK-based MLS learning	60.53 %	Moderately effective
Non-TPACK-based MLS learning	18.81%	Ineffective

Criteria: >76: effective; 56-75: moderately effective; 40-55: less effective; <40: ineffective

The results of the N-gain analysis show that the average for metacognitive listening strategies in TPACK-based learning was 60.53%, categorized as "moderately effective." However, in the class using non-TPACK-based learning, the gain value was 18.81%, categorized as “ineffective.” This statistical analysis concluded that TPACK-based learning was more effective in improving students' metacognitive listening strategies (MLS).

A regression test was carried out to examine the effect of non-TPACK-based learning on students' critical listening skills. The following table presents the statistical test results.

TABLE 6
REGRESSION TEST RESULTS FOR THE EFFECT OF NON-TPACK-BASED METACOGNITIVE LISTENING STRATEGIES LEARNING ON STUDENTS’ CRITICAL LISTENING SKILLS

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant) Non-TPACK-based MLS learning	91.85	2.635	.208	34.857	.000
	.064	.032		1.968	.052

a. Dependent variable: Non-TPACK-based MLS learning; R^2= 0.208, f-score=3.87

The regression test results indicated that the non-TPACK-based metacognitive listening strategies (MLS) positively affected students' critical listening skills. However, this effect did not significantly improve students' critical listening skills, as evidenced by a t-score of 1.996 with a significance level of 0.052 (greater than alpha = 0.005). Statistically, the effect of critical listening skills on the learning of non-TPACK-based metacognitive listening strategies was not significant. The analysis also revealed the regression equation: y = 91.85 + 0.064 x. This indicates a positive correlation

between students' critical listening skills and non-TPACK-based metacognitive listening strategies, with an x coefficient of 0.064. The R2 value of 0.208 suggests that 20.80% of the variation in students' critical listening skills could be attributed to the statistical influence of the non-TPACK-based metacognitive listening strategies.

A regression test was performed to assess the effect of TPACK-based learning and its correlation with students' critical listening skills. The following are the statistical test results.

TABLE 7
REGRESSION TEST RESULTS FOR THE EFFECT OF TPACK-BASED METACOGNITIVE LISTENING STRATEGIES LEARNING ON STUDENTS' CRITICAL LISTENING SKILLS

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant) TPACK-based MLS learning	79.081	3.532		22.387	.000
	.086	.039	.228	2.126	.033

a. Dependent variable: TPACK-based MLS learning; R^2= 0.228, f-score =4.705

The regression test results indicated that the non-TPACK-based metacognitive listening strategies (MLS) positively affected students' critical listening skills. Nevertheless, the effect did not significantly improve students' critical listening skills, as indicated by the t-score of 1.996 with a significance level of 0.052 (greater than alpha = 0.005). This suggests that, statistically, the effect of critical listening skills on the learning of non-TPACK-based metacognitive listening strategies was not significant. The analysis also revealed the regression equation: y = 91.85 + 0.064 x. This implied a positive correlation between the non-TPACK-based metacognitive listening strategies and students' critical listening skills, as indicated by an x coefficient of 0.064. Additionally, the test results revealed an R^2 value of 0.208, suggesting that the non-TPACK-based metacognitive listening strategies could explain 20.80% of the variation in students' critical listening skills.

To examine the effect of the metacognitive listening approach on students who received TPACK-based learning and to determine the extent to which each cognitive skill dimension affected student learning outcomes, the researchers conducted a regression test with the following results.

TABLE 8
REGRESSION TEST RESULTS FOR THE EFFECT OF TPACK-BASED MLS DIMENSIONS ON CRITICAL LISTENING SKILLS

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	78.763	3.462		22.752	.000
Planning and Evaluation	.332	.108	.325	3.067	.003
Directed Attention	.110	.147	.307	1.068	.046
Person Knowledge	.392	.196	.203	1.996	.049
Mental Translation	.219	.162	.156	1.352	.180
Problem Solving	.277	.101	.307	2.749	.007

a. Dependent variable: Critical listening skills; R^2= 0.487, f-score = 5.10

The regression test results above indicate that each cognitive dimension partially affected students' critical listening skills. This was evidenced by the significance value being less than the alpha level (0.05), indicating that at the 95% confidence level, each dimension affected students' critical listening skills. Nonetheless, the dimension of mental translation did not significantly affect students' critical listening skills. Based on the significance value and t-score, it can be concluded that the planning and evaluation, as well as problem solving dimensions, had higher values and more significance than the other dimensions. This suggests that these dimensions had a more significant effect on students' critical listening skills. Hence, the higher the TPACK-based metacognitive listening strategies of students at this stage, the more it will enhance their critical listening skills.

Statistically, the correlation between metacognitive listening strategies and each dimension of students' critical listening skills was analyzed using the correlation test. The analysis results for each dimension are presented in the following table.

TABLE 9
CORRELATION BETWEEN METACOGNITIVE LISTENING STRATEGIES AND CRITICAL LISTENING SKILLS

Dimensions of Critical Listening Skills	Pearson Correlation	Significance	Conclusion
Determining answers to specific problems	0.275	0.010	Significant
Identifying similarities and differences	0.231	0.030	Significant
Setting objectives and evaluations	0.215	0.044	Significant
Acquiring new and additional information	0.339	0.001	Significant
Formulating generalizations and hypotheses	0.337	0.001	Significant

The test results indicated a significant correlation between metacognitive listening strategies and each dimension of critical listening skills. Based on the Pearson correlation values, all dimensions exhibited positive correlations with p-values significantly less than alpha (0.05). This signifies that at the 95% confidence level, there was a positive

correlation between metacognitive listening strategies and the dimensions of critical listening skills. The results further suggest that higher proficiency in metacognitive listening strategies effectively enhanced students' critical listening skills, specifically in (1) determining answers to specific problems, (2) identifying similarities and differences, (3) setting objectives and evaluations, (4) acquiring new and additional information, and (5) formulating generalizations and hypotheses.

V. Discussion

The application of TPACK in listening learning effectively improved metacognitive listening strategies and students' critical listening skills. This improvement was evident at various levels of learning activities through the interactive implementation of TPACK, encompassing knowledge, concepts, and listening tests at the recognizing and accepting levels, as well as the practice of critical listening at the adapting, exploring, and advancing levels. Students' critical listening skills and metacognitive listening strategies progressively improved in each learning cycle. TPACK positively affected the learning of critical listening. Statistical analysis indicated that TPACK-based learning effectively improved students' metacognitive listening strategies more effectively. The average N-gain score for TPACK-based learning was 60.53%, categorized as moderately effective, compared to 18.81% in non-TPACK-based metacognitive listening strategies learning, which was considered ineffective. This is consistent with research by Schmidt et al. (2014), indicating significant correlations between TPACK and eight subscales at the .001 level and with social study content knowledge (SSCK) at the .05 level. The highest correlations were between TPACK and TPK (r = .71), TPACK and TCK (r = .49), and TPACK and PCK (r = .49). Furthermore, TPACK surveys demonstrated its efficacy in measuring teacher constructs, such as technology skills, technology integration, access to technology, and attitudes about technology (Becker & Riel, 2000; Keller et al., 2005; Knezek & Christiansen, 2004; Mishra & Koehler, 2006; Archambault & Crippen, 2009).

Integrating technology into learning significantly impacts students' emotional, affective, and psychomotor skills, requiring maximum effort from lecturers to balance these skills. A systematic and comprehensive TPACK-based metacognitive listening strategy can effectively improve students' critical listening skills, though various challenges remain. For example, most in-charge teachers exhibit higher ethical integrity than TPACK proficiency. Gender and background do not significantly affect TPACK (Shun et al., 2018), likely due to limited pre-employment experience and skills among teachers. Likewise, strong TPACK knowledge determines teachers' creativity and effectiveness in developing new ways of representing and delivering learning content (Malubay & Daguploi, 2018). A balanced pedagogical and content technology approach is necessary for more strategic, varied, student-centered learning (Harris & Hofer, 2011; Swan & Hofer, 2011; Voogt et al., 2012).

TPACK-based students' metacognitive listening strategies generally improved, particularly in planning and evaluation, person knowledge, mental translation, and problem solving. However, directed attention still required improvement to balance with other aspects. This improvement was evident from student questionnaires administered before, during, and after learning activities. Regression test results demonstrated that both non-TPACK-based and TPACK-based metacognitive listening strategies positively affected students' critical listening skills. The positive correlation between non-TPACK-based metacognitive listening strategies and critical listening skills was indicated by an x coefficient of 0.064, while the TPACK-based was 0.228, signifying that TPACK could more effectively affect the improvement of students' critical listening skills, increasing from 20.80% to 22.80%. Research by Bozorgian (2014), Rahimirad and Shams (2015), and Maftoon and Alamdari (2016) also found significant increases in students' metacognitive awareness following the implementation of metacognitive listening strategies.

TPACK-based metacognitive listening strategies effectively improved students' critical listening skills from sufficient to excellent after four learning sessions. This increase in critical listening skills was noticed in determining answers to specific problems, identifying similarities and differences, setting objectives and evaluations, acquiring new and additional information, and formulating generalizations and hypotheses. Regression test results indicated that each cognitive dimension affected students' critical listening skills, though the mental translation dimension did not. Planning and problem solving dimensions had a greater significance and impact on students' critical listening skills. Hence, the higher the TPACK-based cognitive listening strategies, the better students perform in determining answers to specific problems, identifying similarities and differences, setting objectives and evaluations, acquiring new and additional information, and formulating generalizations and hypotheses. In this study context, the mental translation dimension was less important as Indonesian is a second language for students, not a foreign language. This aligns with Harbord's (1992) assertion that translating outside the context of a mastered language is more difficult to understand than the reader's or listener's native language.

VI. Conclusion

This study concludes that the implementation of TPACK-based metacognitive listening strategies could effectively improve students' critical listening skills. The metacognitive listening strategies applied in TPACK-based learning demonstrated a significant improvement in critical listening skills, unlike the non-TPACK-based approach, which only increased from 20.80% to 22.80%. TPACK-based learning addresses knowledge, concepts, and listening tests at

recognizing and accepting levels. Critical listening practice was further carried out at adapting, exploring, and advancing levels. Students' metacognitive listening strategies generally improved, particularly planning and evaluation, person knowledge, mental translation, and problem solving. However, the aspect of directed attention still required further portions to ensure balanced development across all aspects of the metacognitive listening strategies. Regression test results indicated that the TPACK-based metacognitive listening strategies positively affected critical listening skills, as indicated by the positive t-score of 2.169 with a significance value of 0.033 (less than alpha, 0.05). The analysis also revealed a regression equation of y = 79.08 + 0.86 x, indicating a positive correlation between the TPACK-based metacognitive listening strategies and students' critical listening skills, with an x coefficient of 0.86. The test results also exhibited an R^2 value of 0.228, suggesting that metacognitive listening strategies could affect the variation in critical listening skills by 22.80%.

Integrating technology into learning is essential for lecturers and students to respond to and manage the pandemic. Correspondingly, audio or audiovisual listening instruction needs to be more creative, dynamic, and interactive to enhance the quality of the learning process. Innovative teaching methods should also be integrated with more complex and up-to-date technology. This approach should extend to other language skills such as reading, speaking, and writing. When properly implemented, students will be comfortable, engaged in learning, and capable of assessing their progress in every technology-based learning activity. Additionally, lecturers must explore and motivate themselves to balance students' creativity by using technology, mainly since the students are millennials who are likely more adept with technology. Adequate facilities, such as free internet access provided by the government and universities, are crucial for the smooth learning process. Future research should delve deeper into factors integrated with TPACK, such as environment, culture, and learners, or TLCK (Technological Learning Content Knowledge), to produce a comprehensive set of studies pointing to various potential research directions (Chai et al., 2013).

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