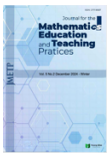

Journal for the Mathematics Education and Teaching Practices, 6(1), 21-32, June 2025
e-ISSN: 2717-8587
dergipark.org.tr/jmetp

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Research Article

Mathematics novice teacher readiness in implementing 21st century learning

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Article Info

Received: 16 December 2024
Accepted: 8 April 2025
Available online: 30 June 2025

Keywords:
21st century skill
Critical thinking
Novice math teacher
Teacher development

Abstract

Teachers have a vital role in teaching 21st century skills to students. This study focuses on analyzing the readiness of novice teachers with less than five years of teaching experience in implementing learning to stimulate critical thinking skills after references of implementing this skill was given to them. This research was descriptive research with a sample of 23 novice mathematics teachers in Mataram City, Indonesia. The instrument used was a critical thinking skill test, questionnaire, and interview guidelines. The results of the study showed that after given the study references and discussion was conducted, more than 95% of novice teachers were ready enough to teach critical thinking in class. In the view of duration of teaching service year, more than 50% of novice teacher were in high level readiness to teach critical thinking in all category of year service after the intervention conducted. It was recommended to provide the teacher with references about implementing critical thinking in class to maintain teacher professional quality in teaching.

To cite this article

Sarjana, K., Kertiyani, N.M.I., Luluil'maknun, U., and Kurniawan, E. (2025). Mathematics novice teacher readiness in implementing 21st century learning. *Journal for the Mathematics Education and Teaching Practices, 6*(1), 21-32. DOI: https://doi.org/10.5281/zenodo.15780854

Introduction

Education has to provide the students with skills that beneficial for life. Many national and international educational institution have put agenda for their student skill output. Among the multiple skills essential for students, "21st century skills" have been advocated for success in both professional and academic fields. (Ball et al., 2016).

Kennedy & Odell (2014) characterize 21st-century skills as critical thinking, global awareness, creativity, technology proficiency, and media literacy. Align with that, Motallebzadeh et al. (2018) also agree that these skills also including critical thinking and creativity, aside from other competencies in problem solving, collaboration, and digital literacy. Other scholar abbrev this 21st century skill as "4Cs" (creativity, critical thinking, communication, and collaboration) (Thornhill-Miller et al., 2023). All the studies mention critical thinking as key component of this century skill.

Numerous well-known definitions of critical thinking were mentioned by scholars. One of them is the definition of critical thinking as reflective thinking which reasonable and focused on take the decision on what to believe or do (Ennis, 2018). Specifically in mathematics, critical thinking is defined as the skill in combining knowledge, provide reasons, and methods of cognitive to reflectively make generalization, prove, and assessment unexpected mathematical issues (Fidaus

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et al., 2015). Critical thinking contains some primary competencies include interpretation, analysis, inference, evaluation, explanation, and self-regulation (Facione, 2015).

The ability to think critically could be developed from processes which facilitating that skill. One of that process is from active learning provided by school teacher so that students can experience solving problems from diverse perspectives and deal with complicated issues in society. Thus, teacher competence in teaching critical thinking become important to support student.

Teacher readiness in teaching critical thinking started in their university classes. Previous studies from Ronfeldt & Reininger (2012) propose that if student teachers are able to learn a clear set of measurable, essential, current, and cohesive teacher competencies during their initial teacher education, it is truly possible to assess their level of preparation for the job. This implies the exposure to one of this 21st century skill in educational institution become crucial. The studies by Kirbas & Bulut (2024) found that , teacher candidates who have heard about this 21st century talent before have better competencies than those who haven't, making it imperative that educational institutions expose their students to it. In line with that, Aizenkot & David (2023) explained that mastery of 21st century abilities was stronger in advanced years as opposed to freshman years suggests that students get better at this competency the more they study about it.

Numerous studies have focused on exploring knowledge of prospective mathematics teacher about critical thinking. In Saudi Arabia, there was a study revealing that many teacher students had inadequate knowledge about critical thinking skills although they believed this skill important for their future student (Gashan, 2015). Furthermore, study from As'ari et al. (2017) in one of Indonesia's cities revealed that the majority of prospective mathematics teachers' critical thinking dispositions are at the level of non-critical thinker yet, only few of them are at the emergent critical thinker and in level of developing critical thinker. This study supported by study from Siahaan et al. (2023) who did literature review about several studies in critical thinking area and concluded that critical thinking skills of pre-service teacher education teachers Mathematics in Indonesia is still categorized as low according to results of the tests given.

Ismail et al. (2022) revealed that critical thinking skill has enhanced the pedagogical quality of teachers, especially in meeting the needs of 21st century learning in the classroom. However, according to our preliminary study, more than 50% of teacher reported that they had limited teaching resources about implementing critical thinking lesson in class and attending the training about teaching critical thinking. Therefore, providing them the suitable references and training are necessary for prospective teacher as well as novice teacher to enhance their professionals. Online training has been proved as one of the effective teaching methods for training teacher and prospective teacher critical thinking (Sutoyo et al., 2023).

As critical thinking becomes pivotal for student and also affect the pedagogical quality of teacher, the investigation of the critical thinking of novice teacher which have been teaching less than five year is necessary to conduct. This study focused on exploring the novice teacher readiness in teaching critical thinking after they study about critical thinking in learning resource provided by us. We conceptualize their preparedness in terms of their knowledge of teaching critical thinking, as this knowledge serves as the foundation for effectively implementing instructional practices aimed at fostering critical thinking skill. The research question formulated for this study is as follows 1) how novice teacher readiness in teaching critical thinking in the terms of their knowledge of teaching critical thinking? 2) how novice teacher readiness in teaching critical thinking according to their year of services?

Method

Research Model

This descriptive research explored novice teacher readiness in teaching critical thinking. The population was novice teacher in Mataram City, Indonesia with less than 5 years teaching experience. The prospective teachers who have done the teaching practice at school for more than 6 months were included in this population since they already have the experience teaching the real students at school. The sample was 23 people choose by purposive sampling.

The flowchart of our research is presented in Figure 1. In Figure 1, this research was started by constructing the research instruments, namely test to measure teacher readiness in teaching critical thinking, questionnaire, and interview guidelines, and then validating them. After that, we choose the sample for the research. Data collecting was done in 4 weeks. In first two weeks, we asked the novice teacher to study independently using our learning resource. The learning resource was from our previous research in Sarjana et al. (2024). In the third week, we conducted one session of blinded learning to discuss about how to teach critical thinking skill in class. In fourth week, the test to measure teacher readiness in teaching critical thinking was conducted. The teacher also filled the questionnaire about their background, namely the duration of teaching at school, the professional certification as teacher, and the frequency joining the workshop about critical thinking skill.

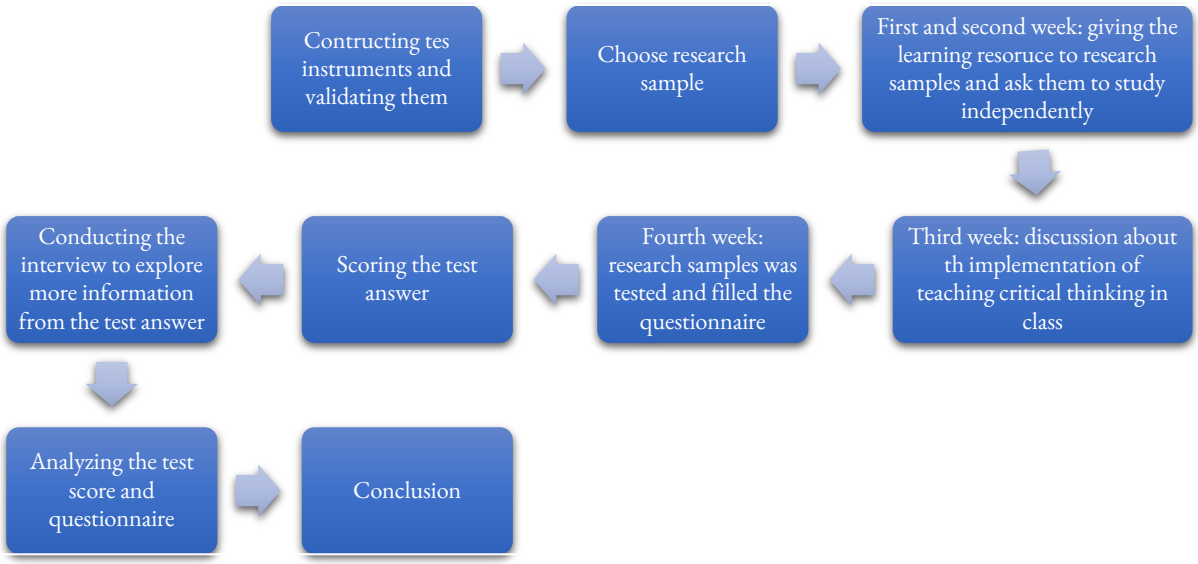


Figure 1. Flowchart of the reseach

Data Collection Tools

The instrument used in this research was test to measure teacher readiness in teaching critical thinking, questionnaire, and interview guidelines.

Test to Measure Teacher Readiness in Teaching Critical Thinking

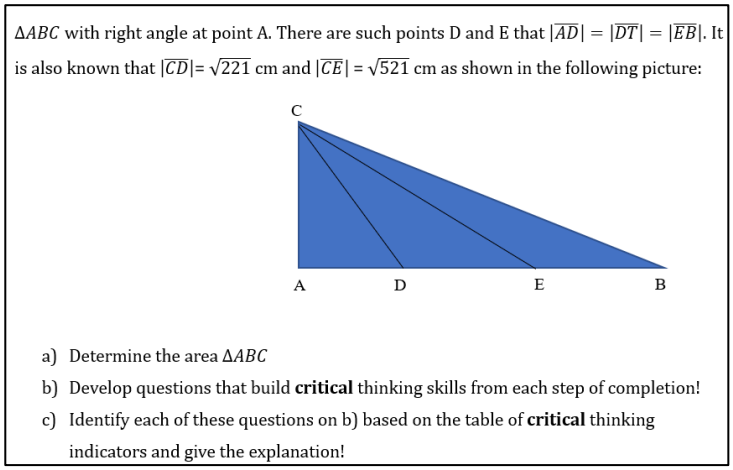


Figure 2. The questions in test to measure the readiness of novice teacher tot each critical thinking skill

Figure 2 presents the questions for the research subject. According to Figure 2, there are 3 question items in the test. The command in the first question is to solve problems related to the area of a triangle, in the second question develop questions that build critical thinking skills, and in the third question identify every indicator of critical thinking in each question that has been created in the second question. The indicator we asked teacher to analyze was critical thinking indicator from Facione (2020), namely interpretation, analysis, inference, evaluation, explanation, and self-regulation as this indicator is suitable for mathematics test.

Test validation was carried out by piloting the test on 23 prospective teachers. The validation results were then analyzed using the Pearson Correlation test. The level of validity was determined based on the criteria outlined in Table 1. Meanwhile, the reliability was analyzed using Cronbach's Alpha test, with the level of reliability determined according to the criteria presented in Table 2.

Table 1. Criteria of Correlation Coefficient Validity (Sugiyono, 2013)

Correlation Coefficient	**Interpretation**
$0{,}90 \leq r_{XY} \leq 1{,}00$	Very High Validity
$0{,}70 \leq r_{XY} < 0{,}90$	High Validity
$0{,}40 \leq r_{XY} < 0{,}70$	Moderate Validity
$0{,}20 \leq r_{XY} < 0{,}40$	Low Validity
$0{,}00 \leq r_{XY} < 0{,}20$	Very Low Validity
$r_{XY} < 0{,}00$	Not Valid

Table 2. Classification of Alpha Cronbach Score (George & Mallery, 2003)

Alpha Cronbach Score	**Classification of Reliability**
$\alpha < 0{,}5$	Unacceptable
$0{,}5 \leq \alpha < 0{,}6$	Poor
$0{,}6 \leq \alpha < 0{,}7$	Questionable
$0{,}7 \leq \alpha < 0{,}8$	Acceptable
$0{,}8 \leq \alpha < 0{,}9$	Good
$0{,}9 \leq \alpha < 1{,}0$	Excellent

Table 3. Piloting result of test to measure teacher readiness in teaching critical thinking

Question Number	1	2	3
Validity			
r_{xy}	0,543	0,504	0,664
Interpretation	Valid	Valid	Valid
Reliability			
$\boldsymbol{\alpha}$ alfa cronbach		0,773	
Interpretation		Acceptable	

The piloting result is presented on Table 3. According to Table 3, all the question are valid in moderate level and also reliable in acceptable evel. It indicated that the test was able to be used to measure the readiness of novice teacher to teach critical thinking.

The evaluation criteria used for scoring the test are presented in Table 4, providing a structured framework to ensure consistency and objectivity in the assessment process.

Table 4. Rubric for scoring the test

Question Number	Indicator	Answer Criteria	Score
1.	Novice teachers are able to solve problems related to the area of a triangle	No answer	0
		The novice teacher approaches problem-solving by applying a procedural method, following step-by-step instructions or established algorithms to reach a solution	0-18
		Novice teacher give conclusion about the conclusion about the area of triangle	0-2

Question Number	Indicator	Answer Criteria	Score
		Total score for first question	**0-20**
2.	Novice teachers are able to develop questions that build critical thinking skills	No answer	0
		Novice teachers employ clear guiding questions to support students in systematically working through a problem until they reach final answer for triangle area	0-10
		Novice teachers provide minimum five questions as the representation of critical thinking indicators.	0-5
		Total score for second question	**0-15**
3.	Novice teachers are able to identify every indicator of critical thinking in each question that has been created in the second question	No answer	0
		Novice teachers identify that has been created in the second question into critical thinking indicator	0-10
		The novice teacher provides explanations for each indicator they referenced in relation to the questions developed in the second question	0-20
		Total score for third question	**0-30**
		Range for total score	**0-65**

The score obtained then converted into the scale 0-100 using formula in 1 below

$$Final\ score = \frac{total\ score}{65} \times 100 \qquad (1)$$

The final score were interpreted to analyze the level of novice teacher in teaching critical thinking using Table 5.

Table 5. The formula to classify module's category (Widoyoko, 2016).

Formula	Classification
$\boldsymbol{X > \bar{X}_i + 1,8 \times sb_i \Leftrightarrow X > 79,88}$	Very High
$\boldsymbol{\bar{X}_i + 0,6 \times sb_i < X \leq \bar{X}_i + 1,8 \times sb_i \Leftrightarrow 59,96 < X \leq 79,88}$	High
$\boldsymbol{\bar{X}_i - 0,6 \times sb_i < X \leq \bar{X}_i + 0,6 \times sb_i \Leftrightarrow 40,04 < X \leq 59,96}$	Enough
$\boldsymbol{\bar{X}_i - 1,8 \times sb_i < X \leq \bar{X}_i - 0,6 \times sb_i \Leftrightarrow 20,12 < X \leq 40,04}$	Low
$\boldsymbol{X \leq \bar{X}_i - 1,8 \times sb_i \Leftrightarrow X \leq 20,12}$	Very Low

Note:

$\bar{X}_i = {}^1/_2$ (maximal ideal score + minimal ideal score) $= \frac{1}{2} \times (100 + 0) = 50$

$sb_i = {}^1/_6$ (maximal ideal score - minimal ideal score) $= \frac{1}{6} \times (100 - 0) = 16{,}67$

X = the sum of the score

Questionnaire

The questionnaire collect the information about a) the novice duration of teaching at school in four categories, namely 0-1 year, 1-3 years, and 3-5 years, b) the professional certification as teacher categorized as have the certification or not, c) the frequency joining the workshop about critical thinking skill in Likert scale 1 to 5, d) how many times they had teaching ti foster student critical thinking, e) the open question about challenge in implementing learning activities that effectively stimulate critical thinking if the novice teachers had implemented it before, and f) other questions about the effectiveness about teaching resources from our team.

As the questionnaire contain open question, we validate the questionnaire validity using face validity from two lecturer from mathematics education department. The validators validated the test in three aspects, namely content, construct, and language. The validation score was analyzed using Aiken V with formula in 2 (Aiken, 1980).

$$V = \frac{\sum s}{n(c-1)} \qquad (2)$$

$$S = \mathrm{r} - l_0$$

Information:

V : Aiken content validity index

n : A lot of ratings

l_0 : lowest rating figure

c : highest rating

R : the number given by the assessor

(Arikunto, 2010) revealed that the instrument will be considered valid if the results of the validity index meet the values in Table 6 as follows:

Table 6. Criteria for the validity of research instruments

Value	Criterion
0,81-1,00	Very high validity
0,61-0,80	High validity
0,41-0,60	Moderate validity
0, 21-0,41	Low validity
0,00-0, 20	Very low validity

The result of questionnaire validity is presented in Table 7.

Table 7. The validity of questionnaire item

Item Number	Validator Score		S1	S2	S	n(c-1)	V	Interpretation
	1	2						
Item 1	5	5	4	4	8	8	1	Very high validity
Item 2	5	5	4	4	8	8	1	Very high validity
Item 3	5	5	4	4	8	8	1	Very high validity
Item 4	5	5	4	4	8	8	1	Very high validity
Item 5	4	4	3	3	6	8	0.75	High validity
Item 6	4	4	3	3	6	8	0.75	High validity
Item 7	5	4	4	3	7	8	0.875	Very high validity
Item 8	4	4	3	3	6	8	0.75	High validity
Item 9	5	5	4	4	8	8	1	Very high validity
Item 10	5	5	4	4	8	8	1	Very high validity

In Table 7, seven items (Items 1–4, 7, 9, and 10) achieved a coefficient of 0.875 or higher, indicating a high degree of expert agreement. The remaining three items (Items 5, 6, and 8) had V values of 0.75, which still fall within an acceptable range. Overall, the results suggest that the instrument demonstrates strong content validity and is suitable for further application.

Interview Guidelines

The interview was also conducted to explore the participant answer if their test answer were not clear enough. We validated this instrument using face validity with two validators in their capacity as mathematics education lecturer and analyze it using V Aiken. Table 8 elucidated the validity result of every item in the instrument.

Table 8. The Validity Result for Interview Guidelines Item

Item Number	Validator Score		S1	S2	S	n(c-1)	V	Interpretation
	1	2						
Item 1	5	5	4	4	8	8	1	Very high validity
Item 2	5	5	4	4	8	8	1	Very high validity
Item 3	5	5	4	4	8	8	1	Very high validity
Item 4	5	5	4	4	8	8	1	Very high validity
Item 5	5	4	4	3	7	8	0.875	Very high validity

According to Table 8, all the items reach coefficient above 0,8 which indicate that every item have very high validity and can be employ to further implementation.

Result and Discussion

Novice Teacher Readiness to Teach Critical Thinking in The Terms of Their Knowledge

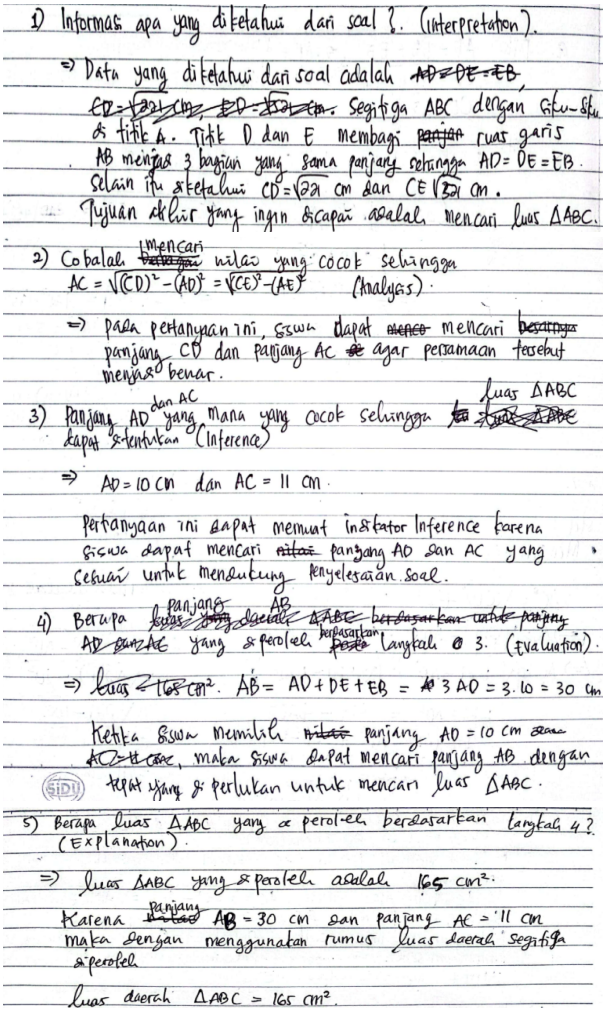
There were 100% of teachers who could answer the first question about solving problem about triangle area, but in the second and third questions related to knowledge of the implementation of critical thinking, some teachers could not fully explain it

Table 9. The Test Score Result of Second and Third Question

Category	Quantity of Novice Teacher(s)	Percentage (%)
Very High	10	43
High	7	30
Moderate	5	22
Low	1	4

Table 9 presents the test score result of second and third questions. According to that table, 22 of 23 novice teachers or 95,6 % of them were ready enough to teach critical thinking. Only one teacher who was in low category. This indicates that majority of novice teachers were ready to implementing critical thinking learning to their student after intervention involving giving learning resources and discussion given by us. This finding in line with research from Rusdin (2018) and Qasserras & Qasserras (2023), suggesting that teachers generally recognize the importance of critical thinking skill and demonstrate high readiness to implement 21st-century learning approaches.

Figure 2 elucidates one of the novice teacher answers whom his readiness categorized as high.



1) Informasi apa yang diketahui dari soal ?. (Interpretation).

⇒ Data yang diketahui dari soal adalah ~~AD=DE=EB~~, ~~CD=√221 cm, ED=√321 cm~~. Segitiga ABC dengan siku-siku di titik A. Titik D dan E membagi ~~panjang~~ ruas garis AB menjadi 3 bagian yang sama panjang sehingga AD=DE=EB. Selain itu diketahui CD=√221 cm dan CE=√321 cm. Tujuan akhir yang ingin dicapai adalah mencari luas ΔABC.

2) Cobalah ~~menentukan~~ mencari nilai yang cocok sehingga $AC = \sqrt{(CD)^2-(AD)^2} = \sqrt{(CE)^2-(AE)^2}$ (Analysis).

⇒ Pada pertanyaan ini, siswa dapat ~~mencari~~ mencari panjang CD dan panjang AC ~~agar~~ agar persamaan tersebut menjadi benar.

3) Panjang AD dan AC yang mana yang cocok sehingga luas ΔABC dapat ~~ditentukan~~ (Inference)

⇒ AD = 10 cm dan AC = 11 cm.

Pertanyaan ini dapat memuat indikator Inference karena siswa dapat mencari ~~nilai~~ panjang AD dan AC yang sesuai untuk menentukan penyelesaian soal.

4) Berapa ~~luas~~ panjang ~~yang~~ dari ~~ΔABC~~ AB ~~berdasarkan untuk panjang~~ AD dan AC yang diperoleh ~~dari~~ berdasarkan langkah 3. (Evaluation).

⇒ ~~Luas = 165 cm²~~. AB = AD + DE + EB = 3 AD = 3 . 10 = 30 cm

Ketika siswa memilih ~~nilai~~ panjang AD = 10 cm dan AC = 11 cm, maka siswa dapat mencari panjang AB dengan tepat yang ~~di~~ perlukan untuk mencari luas ΔABC.

5) Berapa luas ΔABC yang ~~di~~ peroleh berdasarkan langkah 4? (Explanation).

⇒ luas ΔABC yang diperoleh adalah 165 cm².

Karena ~~panjang~~ AB = 30 cm dan panjang AC = 11 cm maka dengan menggunakan rumus luas daerah segitiga diperoleh

luas daerah ΔABC = 165 cm².

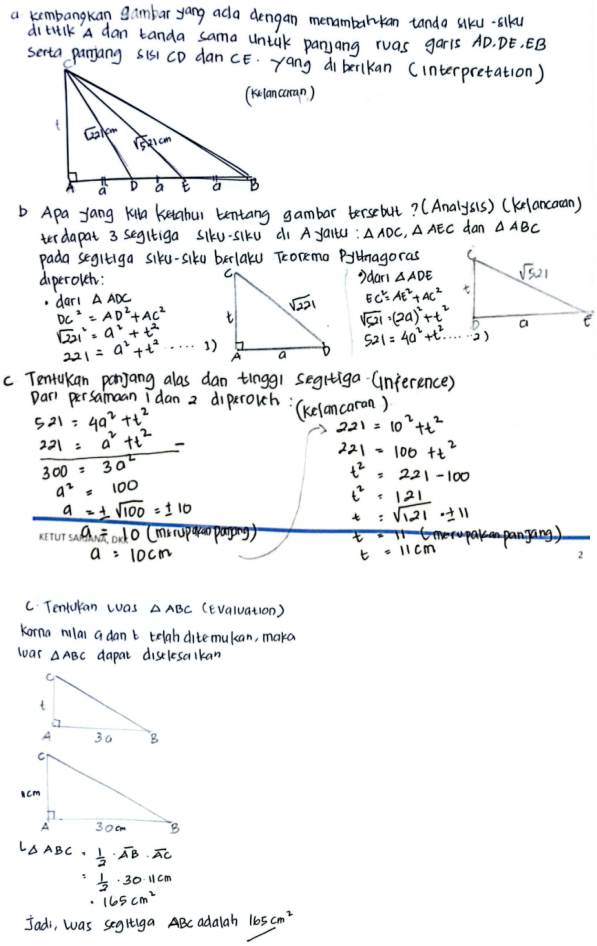
1. What kind information which we get from the problem given? (interpretation)
   ➔ The information from the problem given are Triangle ABC, the right triangle is at point A. Point D and E divide line segment AB into three parts with the same length, so that AD=DE=EB. Furthermore, given that CD=$\sqrt{221}$ cm and CE=$\sqrt{321}$ cm. The purpose is to count the area of triangle ABC.
2. Try to find the equation from information given so that $AC = \sqrt{CD^2 - AD^2} = \sqrt{CE^2 - AE^2}$ (Analysis)
   ➔ In this question, student can search for the length of line segment CD and AC so that the equation is true.
3. Which length of AD and AC that is right, so that we can calculate the area of triangle ABC. (Inference)
   ➔ $AD = 10\ cm$ and $AC = 11\ cm$
   This question contains inference because student can decide the length of AD and AC which suitable to solve the problem.
4. What is the length of AB that you got according to question number 3? (Evaluation)
   ➔ $AB = AD + DE + EB = 3\ AD = 3\ .10 = 30$ cm
   When student choose the length of AD = 10 cm, student can evaluate the suitable length of AB in order to evaluate the area of triangle ABC.
5. Evaluate the area of triangle ABC from question number four! (Explanation)
   ➔ The area of ABC is 165 cm^2

   Since the length of $AB = 30$ cm and the length of $AC = 11$ cm, from the area of triangle formula we obtain the area of triangle ABC equal 165 cm^2.

Figure 2. Example of novice teacher answer with high readiness

We asked the participant to answer three questions, the second question develop questions that build critical thinking skills, and in the third question identify every indicator of critical thinking in each question that has been created in the second question. According to Figure 2, the novice teacher is able to emerge five sub questions, each of them contained the indicator of critical thinking, namely interpretation, analysis, inference, evaluation and explanation. The participant also explains the reason why each question contains certain indicator. For example, in the sub-question number three, the novice teacher asked "Which length of $\overline{AD}$ and $\overline{AC}$ that is right, so that we can calculate the area of triangle ABC" and categorizing that sub question to measure the inference as the student will be facilitated to decide the length of $\overline{AD}$ and $\overline{AC}$ which suitable to solve the problem from the equations which they obtain from sub question number three.

Figure 3 demonstrated the example of novice teacher answer with moderate level in readiness.



a. Add the right angle in point A and the sign that the $\overline{AD}$, $\overline{DE}$, and $\overline{EB}$ have the same length and $\overline{CD}$ and $\overline{CE}$ also have the same length. (Interpretation)

b. What kind of information that we know from the picture? (Analysis).
There are three right angle triangles with right angle in point A, namely triangle ADC, triangle AEC, and triangle ABC. In right angle triangle the Phytagorean formula can be use in three triangles.
From triangle ADC

$$DC^2 = AD^2 + AC^2$$
$$\left(\sqrt{221}\right)^2 = a^2 + t^2$$
$$221 = a^2 + t^2 \ldots. 1)$$

From triangle ADE

$$EC^2 = AE^2 + AC^2$$
$$\left(\sqrt{521}\right)^2 = (2a)^2 + t^2$$
$$521 = 4a^2 + t^2 \ldots. 2)$$

c. Evaluate the length of base and altitude of triangle (Inference)

$$521 = 4a^2 + t^2$$
$$221 = a^2 + t^2$$
$$300 = 3a^2$$
$$a^2 = 100$$
$$a = \pm\sqrt{100} = \pm 10$$
$$a = 10 \text{ cm}$$

d. Calculate the area of triangle ABC (Evaluation)
As the value of a and t had found, so the area of ABC can be solved.

$$L_{\Delta ABC} = \frac{1}{2} . \overline{AB} . \overline{AC}$$
$$= \frac{1}{2} . 30 . 11$$
$$= 165\ cm^2$$

So, the area of ΔABC is $165\ cm^2$.

Figure 3. Example of novice teacher answer with moderate readiness

According to Figure 3, teachers with moderate level of readiness were able to emerged the sub question of critical thinking indicator. Different with novice teacher with high readiness who could emerged all the critial thinking indicator, moderate level teacher just revealed four indicators of critical thinking. In Figure 3, they had subquestion in interpretation, analysis, inference, and evaluation, but not in indicator of explanation. Besides, they also could not give the reasoning about why certain subquestiin represented certain indicator. According to interview, those novice teacher had difficulties in developing and differentiate the sub-question for crtitical thinking indicator in inference, evaluation, and explanation.

How Novice Teacher Readiness in Teaching Critical Thinking According to Their Year of Services

We also explored novice teacher readiness in term of how long they had been teaching at school. Table 10 presents the result.

Table 10. Years of service and categories of teacher readiness in implementing critical thinking learning

Year of Service	Level of Readiness and Quantity of Novice Teacher(s)				Total
	Very High	High	Enough	Low	
3-5 years	2 (40%)	2 (40%)	1(20%)	0	5
1 until <3 years	3 (42,8%)	1 (14,3%)	2(28,6%)	1(14,3%)	7
0 until <1 year	5(45,6%)	4(36,4%)	2(18,2%)	0	11
Total	11	7	5	1	23

Table 10 shows the relationship between teachers' years of service and their readiness in implementation critical thinking learning. After intervention from us in giving learning resource and discussion, 22/23 participants were in stage of ready enough to implement critical thinking lesson for their student. There are 20% of teachers with 3-5 years of

service, 28.6% of teachers with 1 until <3 years of service, and 18.2% of teachers with 0 until <1 years has knowledge in the enough category. In all category of year service, more than 50% of novice teacher were ready to teaching critical thinking.

The findings indicate a complex relationship between teaching experience and readiness to implement critical thinking learning. Interestingly, the highest levels of readiness were found among teachers with less than one year of service. According to interview, this is due to their recent exposure to current pedagogical frameworks in teacher training programs in college. The novice teacher with less than one year experience tend to had bachelor thesis with the topic about critical thinking or other skill for 21st century learning. It provided them with more opportunity to learn about this skill. As this research only explore the readiness in knowledge side, they will superior another teacher with longer experience. This finding aligns with study from (Kleickman et al., 2013) suggesting that in some cases, novice teachers who have recently completed rigorous teacher preparation programs may demonstrate more current knowledge of subject matter and innovative instructional methods than their more experienced counterparts, whose professional development may have stagnated over time. This discrepancy is especially apparent in rapidly evolving educational fields, such as critical thinking, where recent graduates are often more attuned to contemporary pedagogical approaches.

However, this early readiness appears to decline or plateau over time. This is particularly due to the absence of sustained professional development opportunities. Sustained engagement professional development is recognized as one of key factor in enhancing teaching competencies and fostering instructional innovation (Darling-Hammond et al., 2017; Desimone, 2009). However, findings from the questionnaire reveal that 57% of participating teachers reported having never received formal training, attended seminars, or participated in webinars specifically focused on the pedagogy of critical thinking. This suggests a significant professional development gap, which likely hinders teachers' ability to deepen their instructional approaches over time. The lack of professional development becomes the major obstacles that may prevent instructors from using this pedagogical element in their instructional practices (Qasserras & Qasserras, 2023).

Interestingly, the only teacher categorized as "Low" in readiness was from the 1 to <3 years of experience group. According to interview, that teacher have different opinion on the meaning of the question given by us. In contrast, during the interview, the teacher could give enough explanation about the sub question need to accommodate five indicators of critical thinking and the reason why those question suitable for each indicator.

The significant improvement following the intervention underscores the value of structured professional development, even when delivered in a relatively short and focused format. Access to relevant resources, combined with peer discussion and reflection, can markedly enhance teacher confidence and readiness. This supports previous literature emphasizing that ongoing, collaborative, and practice-oriented training is essential for equipping teachers with the necessary skills to promote higher-order thinking in students (Brookfield, 2012; Desimone, 2009; Guskey, 2002). This shows that novice mathematics teachers need or need to take part in training activities related to critical thinking learning on a regular basis to maintain their quality in teaching.

Conclusion and Recommendations

The results of the study showed that after given the study references and discussion was conducted, more than 95.6% of novice teachers were ready enough to teach critical thinking in class. In all category of year service, more than 50% of novice teacher were ready to teaching critical thinking and the highest levels of readiness were found among teachers with less than one year of service. According to the conclusion, 90% of the novice teacher were in category of ready to implementing critical thinking in their lesson after we provide them the learning resource, yet more than a half of them never attending critical thinking training before. Our preliminary study also indicates that more than half of teacher had difficulty in finding references for critical thinking implementation suiting their context. Hence, we suggested to provide the teacher with suitable references for stimulating student critical thinking skill and teacher need to engaged in sustainable professional development along their career.

Limitations of Study

In this research, novice teacher readiness was measured according their knowledge in critical thinking concept and their skill in providing question to stimulate student's critical thinking. We suggested to explore the novice teacher readiness also from their skill in practicing the skill in questioning in real class with their student and managing the class when conducting the lesson.

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