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Validity of Mathematical Critical Thinking Ability Assessment Instruments

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Abstract

This study aims to produce an instrument for assessing mathematical critical thinking skills on material derived from algebraic functions that have been tested for validity. The form of research carried out is research and development and the development model used is a 4-D model (Define, Design, Develop, Disseminate). The research location is at SMAN 1 Tembilahan Hulu in the even semester of the 2021/2022 academic year. The object of research is an instrument for assessing mathematical critical thinking skills in class XI class derivatives of algebraic functions. The data collection instrument used an instrument validation sheet. Data analysis shows that the results of the validation of the mathematical critical thinking ability assessment instrument obtained an average value of the Aiken index of 0.811 with a very valid category and content validity with an average of 0.723 with a valid category. In terms of discriminating power, there are 2 questions with poor discriminating power and 6 questions that can be used to measure the level of students' mathematical critical thinking skills. So, it can be concluded that the development of an instrument for assessing mathematical critical thinking skills is to produce an instrument that has been tested for validity.
Keywords: Critical thinking, validity, assessment

Abstrak

Penelitian ini bertujuan untuk menghasilkan instrumen penilaian kemampuan berpikir kritis matematis pada materi turunan fungsi aljabar yang teruji kevalidannya. Bentuk penelitian yang dilakukan adalah penelitian pengembangan (*Research and Development*) dan model pengembangan yang digunakan adalah model 4-D (*Define, Design, Develop, Disseminate*). Lokasi penelitian bertempat di SMAN 1 Tembilahan Hulu pada semester genap tahun ajaran 2021/2022. Objek penelitian berupa instrumen penilaian kemampuan berpikir kritis matematis pada materi turunan fungsi aljabar kelas XI. Instrumen pengumpulan data menggunakan lembar validasi instrumen. Analisis data menunjukkan bahwa hasil validasi instrumen penilaian kemampuan berpikir kritis matematis diperoleh nilai rata-rata indeks aiken sebesar 0,811 dengan kategori sangat valid dan validitas isi dengan rata-rata sebesar 0,723 dengan kategori valid. Ditinjau dari daya pembeda soal, terdapat 2 butir soal dengan daya pembeda buruk, sehingga 6 butir soal dapat digunakan untuk mengukur tingkat kemampuan berpikir kritis matematis siswa. Sehingga dapat disimpulkan bahwa pengembangan instrumen penilaian kemampuan berpikir kritis matematis yaitu menghasilkan instrumen yang telah teruji kevalidannya.
Kata kunci: Berpikir kritis, validitas, penilaian

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INTRODUCTION

Mathematics is a scientific discipline that relies more on thinking processes and contains important aspects that lead students to think logically based on patterns and rules that have been standardized (Khaliq et al., 2017; Nurazizah & Nurjaman, 2018). Complex mathematical material makes students understand it cannot only be limited to knowledge of formulas, concepts, and principles. Instead, it takes a critical thinking process to understand mathematics. With these characteristics, mathematical concepts must be applied through a series of processes and not presented as a finished product (Muslimahayati, 2020). Mathematics and critical thinking skills are two things that cannot be

separated because mathematical material can be understood through critical thinking and critical thinking can be trained through learning mathematics (Novitasari, 2015; Shanti et al., 2018). On this basis, critical thinking skills need to receive special attention and be improved in the mathematics learning process (Chasanah, 2019; Kurniawati & Ekayanti, 2020; Setyawan et al., 2020).

Critical thinking is part of higher-order thinking skills that must be mastered by students in the 21st century (Herlina & Dahlia, 2018; Mardhiyah et al., 2021). Students can develop critical thinking skills when dealing with mathematical problems, identify possible solutions, and evaluate the results (Su et al., 2016). Giving questions about critical thinking skills is intended to train students' thinking skills. Critical thinking skills that are continuously trained will improve students' mathematical abilities because students will be motivated to carry out various activities such as facing various challenges in learning, finding new things and solving non-routine problems (Wahyuni & Angraini, 2019). Critical thinking skills are not only focused on the ability to solve problems but teach how students can evaluate the truth of solving a problem (Ariawan & Zetriuslita, 2021).

Ennis states that there are six basic elements in critical thinking, namely, focus, reason, inference, situation, clarity, and overview. In addition to the formulation from Ennis, other indicators formulated by (Perkins & Murphy, 2006) that critical thinking goes through four important stages, namely clarification, evaluation, conclusion, and strategy. Meanwhile, (Zetriuslita et al., 2016) put forward mathematical critical thinking indicators, namely the ability to identify and justify concepts, the ability to generalize, and the ability to analyze algorithms. The indicators of critical thinking skills used to develop questions in this study are the ability to identify and justify concepts, the ability to identify the assumptions used, the ability to generalize, and the ability to analyze algorithms.

However, in reality learning in schools does not encourage students to think critically (Hendi et al., 2020). In line with this, one of the problems that have occurred from the education review is that thinking skills have not been achieved and optimized (Suripah & Sthephani, 2017). This is supported by the results of the researcher's interview with one of the mathematics teachers in class XI of SMAN 1 Tembilahan Hulu that: (1) Many students only memorize formulas in solving math problems, (2) Teachers often give simple math problems so that students are less familiar with complicated questions, (3) Students are less able to analyze a given mathematical problem if the question requires higher-order thinking skills.

In responding to the problems in learning mathematics, it is necessary to have questions about critical thinking skills and their solutions so that they can be inserted during learning or school exams so that students are accustomed to solving questions that guide the development of critical thinking skills. The development of mathematical critical thinking skills is important because it can prepare students to face the challenges of the 21st century and improve the quality of education.

METHOD

The form of research carried out is development research or what is known as Research and Development (R&D). Development research is a research method to produce certain products and test the validity of the products that have been produced (Sugiyono, 2021), which in this study produced an instrument for assessing mathematical critical thinking skills. The development model used is a 4-D model which includes four stages, namely define, design, develop, and disseminate. The research location is at SMAN 1 Tembilahan Hulu in the even semester of the 2021/2022 academic year. The subjects of this assessment were students of class XI of SMAN 1 Tembilahan Hulu, totaling 30 people, while the object of research was an instrument for assessing mathematical critical thinking skills. The data collection technique used in this study was a written test, while the data collection instrument was in the form of a description of 8 questions and a validity test questionnaire by an expert. The validators in this study consisted of 4 experts, namely 2 lecturers from the mathematics education study program of UIN Suska Riau, 1 lecturer from the mathematics education study program FKIP UIR, and 1 mathematics teacher from SMAN 1 Tembilahan Hulu. Each validator will be given a validity test questionnaire that aims to measure the validity of the developed instrument.

The data collection instrument used is a validation sheet containing statement items that will be assessed by the validator and given suggestions and comments on the critical thinking ability assessment instrument made. The aspects observed by experts can be seen in table 1.

Table 1. Aspects Observed by Validators

No	Aspects Observed
1	Suitability of questions with basic competencies
2	The suitability of the question with the question indicator
3	The suitability of the question with the criteria for mathematical critical thinking skills
4	Clarity of instructions for working on questions
5	Clarity of the meaning of the question
6	The possible problem can be solved
7	The question sentence does not contain a double meaning
8	Formulation of sentence questions using simple language for students, easy to understand and using language that is known to students

The data analysis technique in this research is descriptive analysis, which is giving a quantitative value to the validated instrument. After the product has been reviewed by the experts, then the experts fill out the questionnaire that has been given by using a checkmark in the assessment column by the criteria in the developed instrument and provide suggestions and comments to improve the questions.

After being assessed by the validator, the researcher then calculated the results of the assessment using the Aiken formula as follows.

$$V = \frac{\sum s}{N(c-1)} \quad (1)$$

Information:

V : Index of expert agreement regarding item validity

$\sum s$: Amount $R - L_0$

L_0 : The lowest validity score

C : The highest validity score

N : Number of experts/validators

R : Numbers given by experts

Number range V which may be obtained between 0 to 1. The higher the number (close to 1 or equal to 1), the value of the validity of an item is also higher, on the contrary, if the lower the number (close to 0 or equal to 0) then the value of the validity of an item is also Getting lower V (Arifin, 2017). The aiken index value obtained is then classified by the level of validity. The level of validity can be seen in the following table.

Table 2. Instrument Validity Criteria

Aiken Index	**Validity**
$0{,}80 < V \leq 1{,}00$	Very valid (high)
$0{,}40 < V \leq 0{,}80$	Fairly valid (medium)
$V \leq 0{,}40$	Less valid (low)

In addition, to prove construct validity, the product-moment correlation formula was used which was assisted by the IBM SPSS 25 software. Meanwhile, the instrument reliability was estimated using an internal consistency technique using the Cronbach's Alpha formula which was also assisted by the IBM SPSS 25 software. The Cronbach's Alpha value was 0.60 and less than 1 indicates that the instrument has met the reliable criteria, whereas if the Cronbach's Alpha value is less than 0.60 it means that the instrument is not reliable (Nugroho et al., 2016; Yusup, 2018).

Furthermore, the calculation is carried out, for the level of difficulty the items are categorized into easy, medium, or difficult items. The categorization criteria used are as follows.

Table 3. Difficulty Level Criteria

Difficulty Level	**Criteria**
$TK = 0{,}00$	Too Difficult
$0{,}00 < TK \leq 0{,}30$	Hard
$0{,}30 < TK \leq 0{,}70$	Medium
$0{,}70 < TK \leq 1{,}00$	Easy
$TK = 1{,}00$	Very easy

Meanwhile, the discriminatory power index is interpreted according to the discriminatory criteria according to the following table.

Table 4. Distinguishing Power Criteria

Distinguishing Power	**Criteria**
$0{,}70 < DP \leq 1{,}00$	Very good
$0{,}40 < TK \leq 0{,}70$	Well
$0{,}20 < TK \leq 0{,}40$	Enough
$0{,}00 < TK \leq 0{,}20$	Bad
$DP < 0{,}00$	Very bad

RESULTS AND DISCUSSION

The instrument for assessing mathematical critical thinking skills was developed using a 4-D model, namely define, design, develop, and disseminate. Here's a further explanation.

Define

The definition in this case is to set and define needs in the learning process. This stage is the first step to obtaining information related to this research, namely the test instrument for students' mathematical critical thinking abilities. Based on the results of interviews, SMAN 1 Tembilahan Hulu has competent mathematics teachers in their fields so with these qualified skills, mathematics teachers at SMAN 1 Tembilahan Hulu should already have a collection of questions that refer to mathematical critical thinking skills, but the problem is the lack of cooperation in making the questions and the limited time that the teacher has so that a feasibility analysis has not been carried out after the questions are made, namely the validity, reliability, level of measurement, and distinguishing power so that the teacher does not have a question bank that collects questions to measure students' mathematical critical thinking skills.

Design

The design stage in this research is to design an instrument by setting indicators for the development of an instrument for assessing mathematical critical thinking skills and their grid. Researchers chose four indicators of mathematical critical thinking, namely identifying and justifying concepts, namely the ability to give reasons for mastery of concepts, the ability to identify the assumptions used, the ability to generalize, namely the ability to complete supporting data or information, and the ability to analyze algorithms, namely the ability to evaluate or check an algorithm. The instrument consists of 8 questions from the four selected indicators. Each indicator of mathematical critical thinking ability will be represented by 2 items. The following are the four indicators of mathematical critical thinking and the details of the items that represent them.

Table 5. Critical thinking indicators and questions

No	Mathematical Critical Thinking Indicator	Question Points
1	Identify and justify concepts, namely the ability to give reasons for the master draft	1
2		8
3	Ability to identify assumptions used	3
4		7
5	The ability to generalize is the ability to complete supporting data or information	4
6		5
7	The ability to analyze algorithms is the ability to evaluate or check an algorithm.	2
8		6

Develop

At this stage, in addition to post-guidance revisions, the assessment instrument was also validated by experts (validators) to determine the feasibility of the mathematical critical thinking ability assessment instrument to be used. This study involved 4 validators including three lecturers and 1

mathematics teacher. The results of the instrument review indicate that the initial instrument made by the researcher still needs to be improved. For this reason, researchers make improvements or revisions to the maximum extent possible according to the suggestions and input are written by the validator on the validation sheet. Products that have been validated and then revised by suggestions and comments from the validator so that the deficiencies contained in the developed questions can be corrected. The results of the comments/suggestions of the validators and their revisions can be seen in table 6.

Table 6. Results of Instrument Revision Comments and Suggestions

<table>
<tr><th>No Question</th><th>Before Revision</th><th>Revised Result</th></tr>
<tr><td colspan="3">Comments/Suggestions

1) Mana fungsinya? mana nilai maksimumnya?
2) perbaiki indikator s.d. soal sudah OK.
3) Dimana algoritmanya / langkah pada soal? padahal di indikator yg diukur.

Saran Perbaikan :
1. Ukuran/dimensi pada soal tidak jelas, apakah panjang sisi, apakah keliling atau luasnya.
2. Bentuk kotak yg akan dibuat belum disebutkan. Apakah balok, persegi atau prisma
3. Sebaiknya siswa diminta untuk menggambarkan situasi & informasi yg diberikan

Saran Perbaikan :
Dari soal di atas ada dua hal yang harus diperhatikan
1. Pada KD menentukan titik maksimum, sedangkan pada soal menentukan nilai maksimum
2. “Rini akan membuat kotak tanpa tutup dari selembar karton berbentuk persegi yang berukuran 24 cm”. Ukuran 24 cm ini harus diperjelas, misalnya dengan ukuran sisi persegi adalah 24 cm.

Terdapat makna ganda dalam pertanyaan, cari kalimat yang lebih baik.</td></tr>
<tr><td>1</td><td>Rini akan membuat kotak tanpa tutup dari selembar karton berbentuk persegi yang berukuran 24 cm dengan cara menggunting 4 persegi di setiap pojok karton. Tentukanlah strategi yang dapat digunakan untuk menentukan volume maksimum kotak yang dapat dibuat!</td><td>Dinyatakan $f(x) = ax^3 + bx^2 + cx + d$, jika $f(-1) = 4, f(1) = 0,\ f(-1) = 0$ dan $f'(0) = -3$ maka $f'(2) = 6$
Tentukan apakah pernyataan tersebut sudah benar? Jika ya, maka nyatakan prosesnya bahwa $f'(2) = 6$. Jika tidak, maka nyatakan salahnya dimana dan buat jawaban yang benarnya.</td></tr>
<tr><td colspan="3">Comments/Suggestions

Saran Perbaikan :
Sesuaikan s.d. dg indikator.
Misal : Sajikan soal + jawaban, lengkap dg cara / rinciannya (sediakan 1 salah!)
Siswa diminta mengevaluasi kebenaran pada setiap langkah.
Jika ada yg salah, minta benarkan algoritma dan minta tuliskan jawaban yg benarnya. → karena yg diminta "Algoritma" bukan sekadar konsep.
Soal ini lebih cocok utk indikator "kemampuan menerapkan algoritma thdp pengerjaan konsep".
apakah pernyataan = Algoritma ?
↓
langkah !

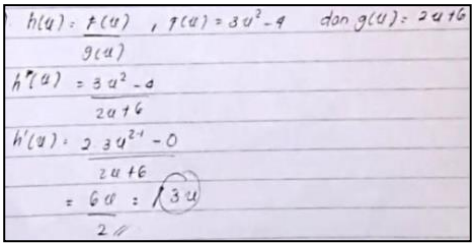
Saran Perbaikan :
Untuk soal dgn pilihan "ya" atau "tidak" tidak perlu membuat soal yang terpisah. Buat contoh: Jika benar ya maka nyatakan prosesnya, Jika salah tunjukkan kesalahannya.

Saran Perbaikan :
Sebaiknya permasalahannya lebih diperjelas</td></tr>
</table>

2	Dinyatakan $f(x) = ax^3 + bx^2 + cx + d$, jika $f(-1) = 4, f(1) = 0,\ f(-1) = 0$ dan $f'(0) = -3$ maka $f'(2) = 6$ Tentukan apakah pernyataan tersebut sudah benar?	Berikut ini adalah hasil pekerjaan seorang siswa dalam menyelesaikan turunan fungsi aljabar bentuk $\frac{f(x)}{g(x)}$ dengan $f(x) = 3x^2 - 4$ dan $g(x) = 2x + 6$.

a. Jika ya, maka nyatakan prosesnya bahwa $f'(2) = 6$
b. Jika tidak, maka nyatakan salahnya dimana dan buat jawaban yang benarnya

Hasil pekerjaannya seperti berikut.



Periksa apakah hasil pekerjaan tersebut sudah benar? Jika tidak, berikan alasan yang jelas dimana letak salahnya dan buatlah penyelesaian yang benar.

After completing the repair, the instrument is given back to the validator to be assessed for each item. The results of the assessment were analyzed using the Aiken formula to determine the validity of each item.

Table 7. Results of Item Validation by Validator

No	Score *V* Aiken	Category
1	0.789	Medium
2	0.805	Medium
3	0.805	Medium
4	0.789	Medium
5	0.766	Medium
6	0.852	High
7	0.828	High
8	0.852	High
Average	0.811	High (Very Valid)

Based on the results of the assessment presented in Table 7, it can be concluded that the test instrument is valid because the value VAiken on all items close to 1 with details the validity category is 5 questions (items 1, 2, 3, 4, 5) quite valid or medium and 3 questions (items 6, 7, 8) are very valid or high. Meanwhile, all items, it is included in the very valid category with an average score of 0.811. Because each item of the instrument has met the valid criteria, the instrument is ready to be tested. This statement is corroborated by the results of research (Arifin & Retnawati, 2017) that the valid instrument is feasible to continue with the trial.

Disseminate

After completing the test questions in the field, the researchers then carried out scoring activities. This is done to prove the validity of the construct using the product moment correlation formula. The results of the analysis of questions using the product moment correlation formula can be seen in Table 8.

Table 8. Result of Problem Analysis with Product Moment Correlation Formula

No Question	r count	r table	Decision
1	0,732	0,361	Valid
2	0,705		Valid
3	0,772		Valid
4	0,854		Valid
5	0,886		Valid
6	0,495		Valid
7	0,851		Valid
8	0,486		Valid

From Table 8 it can be seen that each item has a value $r_{count} \geq r_{table}$ with an average value is 0.723. So, it can be concluded that the critical thinking ability test instrument is valid.

The results of reliability of the developed test instrument showed good results. Based on the results of the estimation of the reliability of the instrument, Cronbach's Alpha coefficient value for the test instrument is equal which means the test instrument is reliable at 0.871.

The next step of the analysis activity is to determine the level of difficulty for each item which can be seen in Table 9.

Table 9. Item Difficulty Level

Question Number	Difficulty Level	Information
1	0,3	Hard
2	0,35	Medium
3	0,493	Medium
4	0,25	Hard
5	0,258	Hard
6	0,568	Medium
7	0,408	Medium
8	0,542	Medium

Based on the results of the analysis of the level of difficulty of the items presented in Table 9, information was obtained that most of the questions were distributed at a medium level of difficulty, namely 5 questions. There are only 3 questions that are included in the difficult category. The next step in the analysis activity is to determine the distinguishing power for each item.

Table 10. Distinguishing Power

Question Number	Distinguishing Power	Information
1	0,3	Enough
2	0,233	Enough
3	0,55	Well
4	0,467	Well
5	0,483	Well
6	0,1	Bad
7	0,55	Well
8	0,183	Bad

Based on table 10, it can be seen that as many as 4 questions have good discriminating power, 2 questions have sufficient discriminating power, and 2 questions have poor discriminatory power. After testing the validity, reliability, level of difficulty, and distinguishing power of each item, the recapitulation of the results of item analysis for students' mathematical critical thinking skills can be seen in table 11.

Table 11. Test Instrument Analysis Recapitulation

No Question	Validity test	Reliability	Difficulty Level	Distinguishing Power	Information
1	0.732	0.871	Hard	Enough	Used
2	0.705		Medium	Enough	Used
3	0.772		Medium	Well	Used
4	0.854		Hard	Well	Used
5	0.886		Hard	Well	Used
6	0.495		Medium	Bad	Thrown away
7	0.851		Medium	Well	Used
8	0.486		Medium	Bad	Thrown away

The results of data analysis show that not all items have good discriminating power, so some items that need to be revised or discarded. The complete details of the researcher are presented in table 11. After the analysis has been carried out, it is necessary to revise the questions that have been tested. Things that need to be revised include items that cannot be used because they are included in the category of poor discriminating power, namely questions number 6 and 8.

Based on the results of the study, the product was obtained in the form of an instrument for assessing mathematical critical thinking skills on the material derived from algebraic functions. The product resulting from the development of this assessment instrument is six essay questions to measure students' mathematical critical thinking skills in the material derived from algebraic functions for class XI. The product criteria produced in this study are very valid. The results of the validity of the items from the validator as a whole show a value of 0.811 with a very valid category. Suggestions and comments given by the validator to the items include adjusting questions with basic competencies, adjusting questions with indicators of mathematical critical thinking skills used, clarifying problems, and improving the language used. Furthermore, the researchers made improvements to the questions by the suggestions given by the validator

The questions that have been validated are then tested on students. Then, the researcher scored the answers given by the students. Based on the results obtained from the trial, all questions are included in the valid category with an average of 0.723 and the reliability is 0.871 with a reliable category. As for the level of difficulty, there are five questions in the medium category and three questions in the difficult category. Furthermore, there are four questions with good discriminating power, two questions with moderate discriminating power and two questions with poor discriminating power. Furthermore, questions with poor discriminating power were not used, so six questions that could be used to measure students' mathematical critical thinking skills.

After all the development steps along with item analysis have been carried out, the final product is an instrument for assessing mathematical critical thinking skills that have been tested for validity, reliability, level of difficulty, and distinguishing power. This product can be used as a teacher's question bank in learning mathematics on algebraic function derivative materials.

CONCLUSION

Based on the results of research and analysis conducted, it can be concluded that the eight items developed have a very valid category with an average 0.723 for content validity while the construct validity of the eight items included in the valid category because of the value is 0.811 and having $r_{count} \geq r_{table}$ Cronbach's Alpha value is 0.871 which is categorized as fixed/reliable. In terms of discriminating power, there are 2 items with poor discriminating power, so that 6 items can be used to measure the level of students' mathematical critical thinking skills.

REFERENCES

Ariawan, R., & Zetriuslita. (2021). Kemampuan Berpikir Kritis Matematis Mahasiswa ditinjau dari Gaya Kognitif (Studi Kasus pada Mata Kuliah Persamaan Differensial). *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *05*(02), 1410–1426.

Arifin, Z. (2017). Kriteria instrumen dalam suatu penelitian. *Jurnal Theorems (the Original Research of Mathematics)*, *2*(1), 28–36.

Arifin, Z., & Retnawati, H. (2017). Pengembangan Instrumen Pengukur Higher Order Thinking Skills Matematika Siswa SMA Kelas X. *PYTHAGORAS: Jurnal Pendidikan Matematika*, *12*(1), 98–108.

Chasanah, A. N. (2019). Cognitive Growth Learning Model to Improve the Students' Critical Thinking Skills. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *4*(2), 112–123. https://doi.org/10.23917/jramathedu.v4i2.8127

Hendi, A., Caswita, C., & Haenilah, E. Y. (2020). Pengembangan Media Pembelajaran Interaktif Berbasis Strategi Metakognitif untuk Meningkatkan Kemampuan Berpikir Kritis siswa. *Jurnal Cendekia : Jurnal Pendidikan Matematika*, *4*(2), 823–834. https://doi.org/10.31004/cendekia.v4i2.310

Herlina, S., & Dahlia, A. (2018). Analisis Kemampuan Berpikir Kritis Matematis Mahasiswa Calon Guru Ditinjau Dari Cognitive Style Berdasarkan Field Independent Dan Field Dependent Di Universitas Islam Riau. *AdMathEdu : Jurnal Ilmiah Pendidikan Matematika, Ilmu Matematika Dan Matematika Terapan*, *8*(1), 35. https://doi.org/10.12928/admathedu.v8i1.11118

Khaliq, I., Azzahra, A., Safitri, A., & Muthmainnah, Nurul, R. (2017). Upaya Meningkatkan Daya Berpikir Kritis Matematis Siswa dengan Menggunakan Metode Socrates Kontekstual. *Fibonacci Jurnal Pendidikan Matematika Dan Matematika*, *3*(1), 23–30.

Kurniawati, D., & Ekayanti, A. (2020). Pentingnya Berpikir Kritis Dalam Pembelajaran Matematika.

Jurnal Penelitian Tindakan Kelas Dan Pengembangan Pembelajaran, *3*(2), 107–114.

Mardhiyah, R. H., Aldriani, S. N. F., Chitta, F., & Zulfikar, M. R. (2021). Pentingnya Keterampilan Belajar di Abad 21 sebagai Tuntutan dalam Pengembangan Sumber Daya Manusia. *Lectura: Jurnal Pendidikan*, *12*(1), 29–40.

Muslimahayati. (2020). Pengembangan Soal Kemampuan Berpikir Kritis Berbasis Kearifan Lokal Sumatera Selatan pada Materi Trigonometri. *AKSIOMA*, *9*(1), 12–20.

Novitasari, D. (2015). Penerapan Pendekatan Pembelajaran Creative Problem Solving (CPS) sebagai Upaya Meningkatkan Kemampuan Berpikir Kritis Matematis Siswa. *Jurnal Pendidikan Matematika & Matematika*, *1*(1), 43–56. https://jurnal.umj.ac.id/index.php/fbc/article/view/1627/1380

Nugroho, B. S., Djuniadi, & Rusilowati, A. (2016). Pengembangan Penilaian Kinerja Menggambar Teknik Potongan Di SMK Pada Kurikulum 2013. *Journal of Research and Educational Research Evaluation*, *5*(1), 01–07.

Nurazizah, S., & Nurjaman, A. (2018). Analisis Hubungan Self Efficacy Terhadap Kemampuan Berpikir Kritis Matematis Siswa Pada Materi Lingkaran. *JPMI (Jurnal Pembelajaran Matematika Inovatif)*, *1*(3), 361. https://doi.org/10.22460/jpmi.v1i3.p361-370

Perkins, C., & Murphy, E. (2006). Identifying and Measuring Individual Engagement in Critical Thinking in Online Discussions: An exploratory case study. *Educational Technology and Society*, *9*(1), 298–307.

Setyawan, F., Prasetyo, P. W., & Nurnugroho, B. A. (2020). Developing complex analysis textbook to enhance students' critical thinking. *JRAMathEdu (Journal of Research and Advances in Mathematics Education)*, *5*(1), 26–37. https://doi.org/10.23917/jramathedu.v5i1.8741

Shanti, W. N., Sholihah, D. A., & Abdullah, A. A. (2018). Meningkatkan Kemampuan Berpikir Kritis Melalui CTL. *Jurnal Elektronik Pembelajaran Matematika*, *5*(1), 98–110.

Su, H. F. H., Ricci, F. A., & Mnatsakanian, M. (2016). Mathematical teaching strategies: Pathways to critical thinking and metacognition. *International Journal of Research in Education and Science*, *2*(1), 190–200. https://doi.org/10.21890/ijres.57796

Sugiyono. (2021). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. ALFABETA.

Suripah, S., & Sthephani, A. (2017). Kemampuan Berpikir Kreatif Matematis Mahasiswa dalam Menyelesaikan Akar Pangkat Persamaan Kompleks Berdasarkan Tingkat Kemampuan Akademik. *Pythagoras: Jurnal Pendidikan Matematika*, *12*(2), 149–160.

Wahyuni, A., & Angraini, L. M. (2019). Kemampuan Berpikir Kritis Matematis dalam Concept Attainment Model. *JNPM (Jurnal Nasional Pendidikan Matematika)*, *3*(2), 281. https://doi.org/10.33603/jnpm.v3i2.2395

Yusup, F. (2018). Uji Validitas dan Reliabilitas Instrumen Penelitian Kuantitatif. *Jurnal Tarbiyah: Jurnal Ilmiah Kependidikan*, *7*(1), 17–23. https://doi.org/10.21831/jorpres.v13i1.12884

Zetriuslita, Ariawan, R., & Nufus, H. (2016). Analisis Kemampuan Berpikir Kritis Matematis

Mahasiswa dalam Menyelesaikan Soal Uraian Kalkulus Integral Berdasarkan Level Kemampuan Mahasiswa. *Infinity*, *5*(1), 56–65.