Journal of Educational Research and Evaluation

Developing Instruments Assessment of Students' Critical Thinking and Communication Skills in Biology Learning Using Hybrid Learning Models in 3T Areas

Rafsan Wakano[1]✉, Wiwi Isnaeni[2], Farid Ahmadi[3]

[1,2,3]Universitas Negeri Semarang, Indonesia

Article Info

Abstract

The availability of instruments for measuring critical thinking and communication skills for class X SMA Negeri 15 Seram Barat is still limited, so it needs to be developed. This study developed an essay model assessment instrument consisting of 10 questions. Using the Mardapi development model consists of 10 steps. The results of the validity and reliability analysis using the Ikens'V and TwoWayAnnova formulas, the average score obtained is 0.73 for critical thinking skills and 0.64 for communication skills where the score exceeds the standard coefficient of 0.3, then it can be declared valid . While the measurement of reliability with the Eibel formula obtained a score of 0.78 critical thinking skills and 0.82 communication skills, it entered the very high category, so it can be concluded that the critical thinking and communication skills assessment instrument can be said to be valid and reliable. Field analysis data seen from the KMO score of 0.835 indicates that the KMO value is >0.5 so that the instrument items can be analyzed further. The results on the RotatedComponentMatrix[a]form 2 factors which are named 1) the ability to analyze and solve problems 2) the ability to convey ideas concretely. Furthermore, the results of reliability testing with the Cronbachs alpha get the results of 0.654 or >0.6. From the results of these tests, it can be concluded that the instrument for assessing critical thinking and communication skills has good validity and reliability, so this instrument is expected to be used later by teachers as a reference or guide for teachers to measure critical thinking and communication skills.

✉Correspondence Address :
Postgraduate, Universitas Negeri Semarang
Jalan Kelud Utara III, Kel. Petompon Kec. Gajah Mungkur Kota
Semarang 50237
E-mail : Rafsnwakano333@gmail.com

INTRODUCTION

The development of Science and Technology in the 21st Century provides new challenges in the world of education. Which requires each individual or student to have hard and soft skills (Isnaeni et al., 2019) . Students are required to equip themselves with these 4 skills which are usually abbreviated as 4C which includes: communication, collaboration, critical thinking, problem solving, and creativity and innovation (Indraswati *et al*, 2020)**.**

Based on the 4C skills that students must have nowadays, critical thinking and communication skills are very important skills that students must possess. As stated by Isnaeni et al., (2021), students' critical thinking skills and communication skills are important to develop in the era of globalization. Critical thinking which includes knowledge of applying concepts, analyzing opinions, synthesizing, evaluating information, and making conclusions (Lestari et al., 2020). While communication includes speakers, listeners, communication channels, and feedback both orally and in writing (Wildan et al., 2019).

In 21st century learning, having good critical thinking skills can lead one to have cognitive competence to reach the desired objective (Umam & Susandi, 2022). Critical thinking skills are not only developed in the family but also in education, and do not come naturally to most students. So it is very necessary to be empowered in learning (Sutama et al., 2022). Meanwhile, communication skills are important to be developed in learning, because every student must effectively analyze and process communication in his life in various fields (Mursidah, et all, 2019).

Biology is a learning that requires students to have critical thinking and communication skills (Jailan et all, 2021). The critical thinking components, according to Wijayanti et al., (2019), is imaginative, has broad interests, is independent in thinking, is full of energy, is confident, dares to take risks, and is brave in convictions and convictions. Meanwhile, communication is a component of connecting tools between individuals in adapting, socializing, and establishing good relationships with other people and the environment (Rosdianti, Wuryandani & Retnawati, 2020).

Learning process is an interaction between students and educators, as well as the use of learning resources in a learning environment. In the learning process, many aspects affect the quality of a learning process (Saraswati & Mertayasa, 2020) After the Covid-19 outbreak in the hemisphere, the education system carried out reforms in the teaching and learning process (Ulfadhilah, 2021). To reduce the risk of transmission of COVID-19 in educational institutions, the government took a radical policy, namely by deciding to carry out a face-to-face learning process (Subagtio, 2020). Online learning was chosen as a solution for learning activities, because physical learning has stalled due to social restrictions (Odeh & Keshta, 2022). Online learning is a learning model that utilizes available technology, such as computers or smart phones, where the learning process brings together students and teachers through an internet connection internet (Nissa & Haryanto, 2020). Renewal of the learning process from offline to online is a challenge for teachers in Indonesia, especially in the Indonesian Border area which is included in the 3T zone (Outermost, Disadvantaged and Frontier) where internet signals are difficult to reach (Nawawi & Niken E, 2021). Where teachers are required to be more creative and innovative in carrying out the learning and assessment process.

Online learning utilizes information technology as a learning medium that can be accessed anywhere, such as YouTube, Zoom, E-book and Google Classroom (Sukirman et al., 2022), while offline learning is face-to-face with students, where teachers can provide material in the form of hardcopy assignments (Astini, 2020). To combine these two learning

methods directly, an effective learning model is needed. *Hybrid Learning* can be used to combine these two learning methods (Budhyani et al., 2022).

In the learning process organized by the teacher, to measure the ability of students to understand the learning, a reliable assessment instrument is needed in accordance with the aspects and indicators to be measured (Delsika P.S, & Darhim, 2017). The availability of instruments such as test and non-test instruments in learning assessment is an absolute requirement that must be met by teachers in conducting assessments. Based on the results of interviews through *Whatshap* with biology subject teachers at SMA Negeri 15 Seram Barat, teachers at SMA Negeri 15 still use LKS as an assessment instrument, and some teachers are still subjective in making assessments.

Therefore, the purpose of this research is to develop a valid and reliable assessment instrument in measuring students' abilities, especially critical thinking and communication skills at SMA Negeri 15 Seram Barat. From the results of this research, it is also expected to be a reference material for teachers in developing further instruments in measuring students' abilities and can also be used in other materials and subjects.

METHODS

The model of this research adapted by research developing of Mardapi, (2016: 132), in this study refers to the development of cognitive instruments. There are ten steps that must be taken to develop the instrument, such as (1) compiling the instrument; (2) writing instrument items; (3) determine the scale of the instrument, (4) determine the scoring system (Likert scale); (5) examine the instrument, the instrument that has been prepared is a standard instrument so it is necessary to do a content review by an expert in this case a review by 4 experts (*expet judgment)* to

determine the validity of the content of the instrument developed; (6) revision of the instrument (7) testing was carried out, testing the instrument was carried out with the subject of class X students of SMA Negeri 15 Seram Barat, (8) analyzing the instrument, analyzing the instrument using factor analysis to determine the construct validity and reliability of the instrument; (9) assemble and refine the instrument, and (10) the final of the instrument.

The instrument content validity analysis process is based on expert judgment *(Expert Judgment)* formula *Aiken's V*. The formula for *Aiken's V* is as follows.

$$V = \frac{\Sigma s}{n\,(c-1)}$$

Description:
S = r – lo

lo = the lowest number of validity assessments (in this case = 1)

C = the highest number of validity assessments (in this case = 4)

R = the number given by an evaluator

N = number ofraters

Score sheet results Expert validation is said to meet the valid requirements if the V index score is above 0.3 then it is declared valid. Then, the reliability test was carried out using the ANNOVA formula. The analysis process used IMB SPSS 23.

Furthermore, in the analysis of the construct validity of the instrument, the process of analyzing the construct validity of the instrument was carried out using *explanatory factor analysis (EFA)*. The *exploratory factor analysis* is calculated using the SPSS 23 IMB program tool. The *exploratory* is used to see how many factors are needed to explain the indicator relationship, the confirmatory approach is used to test whether the number of factors obtained empirically corresponds to the number of factors that have been compiled. theoretically. The construct validity test using factor analysis can be run if the KMO value > 0.5, construct validity can be met if the

correlation value > 0.5, *Eigenvalue* 1 and *Factor Loading* 0.3 (Azwar, 2016, p. 123). Then the reliability of the instrument used to analyze the results of the instrument after field trials will use the *Cronbach Alpha formula.* According to Khumaedi (2015, p. 27) the internal consistency method only uses one instrument, so the test is only done once.

RESULT AND DISCUSSION

Results of developing critical thinking and communication skills assessment instruments which include the form of test instruments, number of questions, criteria and assessment procedures. The assessment instrument is in the form of an essay/ description test consisting of 10 questions for environmental pollution material. The number of students in the test was 204 students, which was carried out at SMA Negeri 15 Seram Bagian Barat. The time limit for the test is 90 minutes. Instrument validation by 4 experts, namely 2 theorists in instrument development, 2 practical experts or class X teachers who teach and learning biology. The results of the validation by 4 validators were analyzed through the criteria of the assessed aspects. The critical thinking test criteria consist of 6

questions, while the communication test consists of 4 questions. Critical thinking ability with 5 indicators, such as: (1) explaining in simple terms, (2) developing basic skills, (3) making conclusions, (4) explaining further, and (5) making strategy and tactical rules (Ennis, 1985 in Marzano, et al., 1988). Communication skills with 3 indicators, such as: (1) The ability to express ideas. (2) The ability to understand, interpret. (3) Ability to use terms.

The instruments that have been developed, before being tested in the field, must go through the content validation stage first carried out by experts. The assessment of critical thinking and communication skills assessment instruments developed includes the suitability of items with indicators, grids, scoring rubrics. Instrument validation was carried out by 4 experts. The analyzed of the validation using *Aiken's V* formula, to calculate the *content validity coefficient.* The item is declared valid if the *Aiken's V* is 0.3. From the results of the analysis for critical thinking skills, it is known that the score of each item has an average value of 0.73 meaning the item is declared valid with the validity coefficient of *Iken's V* 0 ,3.

Table 1. Coefficient of Expert Agreement for critical thinking skills

Number of items	Aiken's V Index	Criteria	Conclusion
1	0.83	Valid	Eligible
2 and 5	0.66	Valid	Eligible
3	1	Valid	Eligible
4	0.5	Valid	Eligible
6	0.75	Valid	Eligible

Reliability calculations based on the assessment of four experts to get the *mean square* with MKB = 1.042 and MKN = 0.264 then re-analyzed using the *Ebel* , the coefficient or criteria R_{xx} = 0.78. It is included in the very high category.

Then in the analysis of the validity of communication skills using the *Aiken's V*, to calculate the *content validity coefficient, it* is known that the score of each item has an average value of 0.64 meaning that the item is declared valid with the validity coefficient of the *Iken's V* 0.3.

Table 2. Coefficient of Agreement of Communication Ability Experts

Number of items	Aiken's V Index	Criteria	Conclusion
7. 8 dan 9	0.66	Valid	Eligible
10	0.58	Valid	Eligible

For reliability calculations based on the assessment of four experts to get the *mean square* with MKB value = 1.042 and MKN = 0.264 then analyzed by using the *Ebel*, the coefficient or criteria R_{xx} = 0.82 was obtained.

Meanwhile, the results of the construct validity test were analyzed according to the *confirmatory factor analysis* through IBM SPSS 23, on the data from field trials. The construct validity test was carried out for all items of the instrument in measuring critical thinking and communication skills. The results of the confirmatory factor analysis on the results of the instrument trial are seen through the results of the KMO obtained. Based on the confirmatory analysis that the KMO value for 10 items is 0.835, for the coefficient level of the KMO value ≥ 0.50, it can be interpreted that the 10 items on the developed critical thinking and communication skills instrument can be analyzed further. The result of analyze could seen in the Table 3.

Table 3. Nilai KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.835
Bartlett's Test of Sphericity	Approx. Chi-Square	346.030
	Df	45
	Sig.	.000

After extraction, the items were divided into two groups. The grouping of the results of the round after the assessment has two factors, namely in factor 1 there is a value of item 4 = 0.746, item 7 = 0.636, item 6 = 0.608, item 2 = 0.579, item 9 = 0.565, item 10 = 0.485 and item 3 = 0.446. While in factor 2 there is a value at item 1 = 0.783, item 5 = 0.569, and item 8 = 0.553. With the naming of factors, such as : 1) the ability to analyze and solve problems, 2) the ability to convey ideas concretely. The resoult could seen in Table 4.

Table 4. Rotated Component Matrixa

	Component	
	1	2
But4	.746	
But7	.636	
But6	.608	.145
But2	.597	.161
But9	.565	.308
But10	.485	.364
But3	.446	.366
But1	-.208	.783
But5	.409	.569
But8	.312	.553

The process of testing the reliability of the instrument for assessing students ' critical thinking and communication skills was developed using the *Cronbach Alpha* with the help of the IBM SPSS 23. The instrument reliability test is based on a large-scale test that is carried out directly. The results of the analysis of the reliability test data on the tests that have been carried out, the reliability coefficients are obtained in Table 5 as follows:

Table 5. Cronbach's Alpha Cronbachs

Reliability Statistics	
Cronbach's Alpha	N of Items
.654	10

Table 5, shows that the field test reliability coefficient with the *Cronbachs alpha* with 10 essay questions has a value of 0.654 or greater than 0.6. Where according to Dewi & Sudaryanto, (2020) if a variable shows Cronbach's Alpha value > 0.60, it can be concluded that the variable can be said to be reliable or consistent in measuring.

Assessment instruments are needed to assist teachers in implementing learning assessments in the classroom (Arum et al., 2022). Assessment instruments that are well designed and in accordance with the level of thinking and communication skills can improve students' thinking and communication skills.

The development of an appropriate instrument in measuring critical thinking and communication skills is in the form of an instrument of description. This is in accordance with what was stated by (Putri et al., 2019) that the application of critical thinking skills assessment is often carried out with essay tests (descriptions). Likewise with which communication skills according to (Safitri et al., 2017) to improve students' communication skills need to be trained and checked for understanding by using the right measuring tool in the form of description questions which are expected to provide a significant picture of students' communication skills. So it can be concluded that a good instrument in measuring critical thinking and communication skills is in the form of essay questions.

Before carrying out the assessment process using the developed instrument, the classroom learning process was carried out using the *Hybrid Learning*, where using this learning model is expected to improve critical thinking and communication skills for class X students of SMA Negeri 15 Seram Barat. As stated in research Hasna et al., (2021) which states that the Hybrid Learning model can improve critical thinking skills in science learning, then. Then in research Indriani & Pasaribu, (2022) there is an increase in students' communication skills in using the hybrid learning model. So it can be concluded that the use of the Hybrid learning model in learning can improve students' critical thinking and communication skills.

The learning process using the Hybrid Learning model in class X SMA Negeri 15 Seram Barat, is used in two meetings. Where at the first meeting the teacher explained an outline related to environmental pollution material, then the teacher asked students to look for more references related to environmental pollution material on the internet to add insight to students apart from books. At the second meeting after students received references related to environmental pollution on the internet, the teacher divided students into 5 groups to discuss environmental pollution materials according to the references obtained by students on the internet.

The Hybrid Learning model used by the teacher in this learning is the type of "*Classroom instruction with substantial required online components that extend beyond the classroom and/or the school day*" which is a fairly easy implementation of hybrid learning. This model still uses internet facilities in learning activities, but there are still more face-to-face activities between students and teachers. The internet in this model is used as a support during learning, for example during class discussion activities, the teacher encourages students to look for discussion materials on the internet and then present them.

After the learning process is carried out, the instrument test process is carried out. The instrument that has been developed consists of 10 essay questions, of which 6 essay questions are intended to measure critical thinking skills, while the other 4 questions are to measure communication skills. The instrument questions developed are in accordance with the existing indicators of critical thinking and communication skills.

From the results of student work papers examined, it was found that there was an

increase in students' critical thinking and communication skills that were diverse, some of which reached the high, medium and low categories. The results of student work papers that reach the high category where the answers given by students are in accordance with the indicators of the critical thinking ability assessment instrument, namely: explaining in simple terms, developing basic skills, making conclusions, explaining further, and making rules of strategies and tactics. Likewise for communication skills with indicators, namely: the ability to express ideas, the ability to understand and interpret then the ability to use terms properly and clearly. For the medium category, the answers given by students are still inadequate and complete, for several indicators of critical thinking ability assessment instruments on indicators 3 and 4 for questions number 3 and 4, namely making conclusions and explaining further, the answers given by students are incomplete. On communication skills, namely in indicator 1, namely the ability to express ideas contained in question number 8, the answers given by students are still incomplete, and in indicator 3 for question number 10, namely the ability to use terms well and clearly, students do not answer the question on this question. As for the low category, where in this category the answers given are still inadequate and complete for indicators 1,2,3 and 4 for questions number 1,2,3 and 4 the answers given by students are incomplete, while for number 5 students no answer. On communication skills, namely on indicators 1,2 and 3 for questions number 7, 8, 9 and 10 the answers given by students are not so good and incomplete.

In the process of analyzing validity and reliability tests based on the results of the assessment and opinions of four experts (*Expert Judgment*). The results of the validator's assessment were then analyzed for content validity using the *Aiken's V* The instruments developed were 6 essay questions to measure critical thinking skills and 4 essay questions to measure communication skills which can be seen in Tables 1 and 2. In the content validity analysis of thinking ability assessment instruments The critical score has an average value of 0.73 while for communication skills it has an average value of 0.64 and has exceeded the specified coefficient standard, which is > 0.3. This is in accordance with what was stated by Mirdamiwati et al., (2016; Azwar 2014 :143) that if the validity coefficient > 0.3 means it can be said to be adequate (valid) otherwise if the validity coefficient is < 0.3 then it is declared inadequate (invalid).

After knowing the results of content validation, the next step is to see the results of the reliability of the critical thinking and communication skill assessment instrument through the *two way ANOVA* using IBM SPSS 23 which is then calculated by the *Ebel*. Based on the results of the analysis conducted by the researcher, it was obtained a value of 0.78 in the assessment of critical thinking skills while the communication ability had a value of 0.82, so that the data can be said to be valid and reliable. In accordance with what was stated by Sahrul et al., (2022); Azwar, (2016) that if the reliability coefficient value is > 0.6, then the data is considered valid and reliable. Meanwhile, according to Fraenkel, Wallen & Hyun, (2012: 157) an instrument is said to be reliable when the Spearman-Brown reliability coefficient value is more than 0.70 already in the very high category. The results of the analysis conducted by the researchers show that the instrument for assessing critical thinking and communication skills developed has been tested for validity and reliability. The instrument developed is appropriate and meets the validity and reliability requirements so that the instrument can be used in the field.

In the results of the analysis of the construct validity test in accordance with the *confirmatory factor* if 10 items of the instrument have a KMO value of more than 0.5, then the 10 items of the instrument can be analyzed further. In accordance with what was stated by Hariono, (2021) that if the results of the

analysis show that the KMO value > 0.05 then the sample used is sufficient for factor analysis. From the results of the analysis, it was found that the KMO value was 0.835, so the value obtained was > 0.05 and further analysis could be carried out. It can be seen in table 3.

In table 4, from 10 questions formed 2 factors consisting of factor 1 as many as 7 items, namely But4, But7, But6, But2, But9, But10 and But3 while for factor 2 consists of 3 items, namely But1, But5, and But8. The results obtained in table 4.12, that 10 instrument items have a fairly high loading factor. If the factor value > 0.3 then the factor value can be said to be high.

While the results of the analysis of reliability testing with the *Cronbach alpha* in Table 5, show that the reliability coefficient of the field test using the *Cronbach's Alpha* with 10 essay questions has a value of 0.654 or greater than 0.6. Where according Dewi & Sudaryanto, (2020) if a variable shows Cronbach's Alpha value > 0.60, it can be concluded that the variable can be said to be reliable or consistent in measuring.

CONCLUSION

Based on research findings, the development of critical thinking and communication skills assessment instruments. It was found that there was an increase in students' critical thinking and communication skills that varied from high, medium and low categories according to the results of student work papers.

In the process of analyzing the content validity of the instrument formula *Aiken's V* for the critical thinking ability assessment instrument, the average value is 0.73 while the communication skill has an average value of 0.64. Then the results of the instrument reliability assessment of critical thinking and communication skills through the *two way ANOVA* using IBM SPSS 23 which is then calculated by the *Ebel*. Based on the results of

the analysis carried out, the value of 0.78 was obtained in the assessment of critical thinking skills while the communication ability had a value of 0.82. In the results of the analysis of the construct validity test in accordance with the *confirmatory factor* with 10 instrument items, it was found that the KMO value was 0.835.formula *Cronbach alpha* with 10 essay questions have a value of 0.654.

From the results of the analysis of the validity and reliability of the instrument for critical thinking and communication skills in learning biology, environmental pollution material for students of class X SMA Negeri 15 Seram Barat can be said to be valid and reliable, so that the instrument can be used to measure critical thinking and communication skills of high school students in class X. Suggestions to the next researcher, so that research can be carried out with research subjects from more than one school, both public and private.

REFERENCES

Arum, A. E., Khumaedi, M., & Susilaningsih, E. (2022). Validity and Reliability of Development of Self-confidence Assessment Instruments for Students on Chemistry Subject. *Journal of Research and Educational Research Evaluation*, *11*(1), 62–69.

Astini, N. K. S. (2020). Pemanfaatan Teknologi Informasi dalam Pembelajaran Tingkat Sekolah Dasar pada Masa Pandemi Covid-19 Diterima. *Jurnal Lampuhyang Lembaga Penjaminan Mutu Stkip Agama Hindu Amlapura*, *11*(2), 13–25.

Budhyani, I. D. A. M., Candiasa, M., Sutajaya, M., & Nitiasih, P. K. (2022). The effectiveness of blended learning with combined synchronized and unsynchronized settings on self-efficacy and learning achievement. *International Journal of Evaluation and Research in Education*, *11*(1), 321–332.

Delsika Pramata Sari, Darhim, R. R. (2017). Pengembangan Instrumen Penilaian Untuk Mengukur Kemampuan Representasi Matematis Siswa Smp. *Indonesian Digital*

Journal of Mathematics and Education,*4*,421–429

Dewi, S. K., & Sudaryanto, A. (2020). Validitas dan Reliabilitas Kuesioner Pengetahuan , Sikap dan Perilaku Pencegahan Demam Berdarah. *Seminar Nasional Keperawatan Universitas Muhammadiyah Surakarta (SEMNASKEP) 2020*, 73–79.

Hariono, A. (2021). Validitas dan Reliabilitas Konstruk Instrumen Asesmen Keterampilan Bermain Korfball Menggunakan Analisis Exploratory Factor Analysis dan Confirmatory Factor Analysis. *Jorpres (Jurnal Olahraga Prestasi)*, *17*(1), 84–89.

Hasna, H. R., Fajriyah, K., & Saputra, H. J. (2021). The Effect of Blended Learning Based on The Problem-Based Learning Model Assisted by Puzzle Media on The Critical Thinking Skills of Fifth Grade Students on Ecosystem Themes. *Journal of Education Technology*, *5*(1), 14.

Indraswati, D., Marhayani, D. A., Sutisna, D., Widodo, A., & Maulyda, M. A. (2020). Critical Thinking Dan Problem Solving Dalam Pembelajaran Ips Untuk Menjawab Tantangan Abad 21. *Sosial Horizon: Jurnal Pendidikan Sosial*, *7*(1), 12.

Indriani, W. D., & Pasaribu, L. H. (2022). Peningkatan Kemampuan Komunikasi Matematis Siswa Menggunakan Model Pembelajaran Hybrid Learning. *Jurnal Pendidikan Matematika*, *06*(01), 291–299.

Isnaeni, W., Priyono, A., Prasetyo, B., Ristianafi, D. P., & Setiawan, H. (2019). Unnes Science Education Journal ANALYSING Students' Critical Thinking, Communication, Collabora tion, And Creativity Skills During Animal Physiology Courses. *Journal. Unnes.Ac.Id*, *8*(2), 168–175.

Isnaeni, W., Rudyatmi, E., Ridlo, S., Ingesti, S., & Adiani, L. R. (2021). Improving students' communication skills and critical thinking ability with ICT-oriented problem-based learning and the assessment instruments with HOTS criteria on the immune system material. *Journal of Physics: Conference Series*, *1918*(5).

Jack R. Fraenkel, Norman E. Wallen, H. H. H. (2012). *How to Design and Evaluate Research in Education*.

Jailan Sahil, Said Hasan, Ade Haerullah, N. S. (2021). Implementasi Pembelajaran Abad 21

Pada Mata Pelajaran Biologi Di Sma Negeri Kota Ternate. *Jurnal Inovasi Pembelajaran Biologi*, *2*(2),1–11.

Lestari, F. P., Ahmadi, F., & Rochmad, R. (2020). The Critical Thinking Ability in Watson-Glaser Framework in Fourth Grade Students. *Educational Management*, *9*(2), 234–241. https://doi.org/EM v9 i2, 240

Mirdamiwati, S. M., Supriyadi, & Sarwi. (2016). Pengembangan Instrumen Psikomotor Tari Selendang Pemalang Berbasis Android. *Journal of Research and Educational Research Evaluation*, *5*(1), 72–80.

Mursidah, S., Susilo, H., & Corebima, A. D. (2019). Hubungan Antara Keterampilan Berpikir Kritis Dan Keterampilan Berkomunikasi Dengan Retensi Siswa Dalam Pembelajaran Biologi Melalui Strategi Pembelajaran Reading Practicing Questioning Summarizing and Sharing. *Jurnal Pendidikan: Teori* 1071–1076.

Nawawi, Niken E, P. (2021). Analisis Pembelajaran STEM di Daerah Terluar Tertinggal Terdepan Indonesia Selama Masa Pandemi Niken. *Pancasakti Science Education Journal*, *6*(1), 1–8.

Nissa, S. F., & Haryanto, A. (2020). Implementasi Pembelajaran Tatap Muka Di Masa Pandemi Covid-19. *Jurnal Ika*, *8*(2), 402–409.

Odeh, A., & Keshta, I. (2022). Impact of COVID-19 pandemic on education: Moving towards e-learning paradigm. *International Journal of Evaluation and Research in Education*, *11*(2), 588–595.

Putri, O. D., Nevrita, N., & Hindrasti, N. E. K. (2019). Pengembangan Instrumen Penilaian Keterampilan Berpikir Kritis Siswa Sma Pada Materi Sistem Pencernaan. *BIOEDUKASI (Jurnal Pendidikan Biologi)*, *10*(1), 14.

Rosdianti, H., Wuryandani, W., & Retnawati, H. (2020). Teachers' Strategies in Developing and Measuring Students' Communication Skills. *Al Ibtida: Jurnal Pendidikan Guru MI*, *7*(2), 237.

Safitri, E. (Program S. M. P. M. F. U., Suratman, D. (Program S. M. P. M. F. U., & Bistari (Program Studi Magister Pendidikan Matematika FKIP UNTAN). (2017). Pengembangan instrumen untuk mengukur kemampuan representasi dan komunikasi

matematis siswa dalam aspek fonetik materi geometri smp. *Pendidikan Dan Pembelajaran UNTAN*, 1–14.

Sahrul, S., Khumaedi, M., & Masrukan, M. (2022). Development of Instruments to Measure Self-Confidence and Creative Thinking in Mathematics Learning for Vocational High School Students. *Research and Educational Research Evaluation*, *11*(1).

Saraswati, N .L .P .A, Mertayasa, I. N. E. (2020). Pembelajaran Praktikum Kimia Pada Masa Pandemi Covid-19: Qualitative Content Analysis Kecenderungan Pemanfaatan Teknologi Daring. *Jurnal Matematika, Sains, Dan Pembelajarannya*, *14*, 144–161.

Subagtio, M. E. (2020). Perspektif mahasiswa ips terhadap pembelajaran virtual pada masa pandemi covid-19. *Pendidikan Dan Pembelajaran Ilmu Pengetahuan Sosial*, *9*(2),155–168.

Sukirman, S., Masduki, Y., Suyono, S., Hidayati, D., Kistoro, H. C. A., & Ru'iya, S. (2022). Effectiveness of blended learning in the new normal era. *International Journal of Evaluation and Research in Education*, *11*(2), 628–638.

Sutama, S., Fuadi, D., Narimo, S., Hadiyati, S., Hafida, N., & Novitasari, M. (2022). *Collaborative mathematics learning management : Critical thinking skills in problem solving*. *11*(3), 1015–1027.

Ulfa, K., Khumaedi, M., Al, S. M. P., & Kedungwuni, F. (2018). The Developing of Performance Assessment to Calculate Scope and Volume of Cube and Block Competence in The Mathematic Learning of Junior High School. *Journal of Research and Educational Research Evaluation*, *7*(1), 29–36.

Ulfadhilah, K. (2021). Pengaruh Metode Pembelajaran Efektif Di Masa Pandemi Pada Anak Usia Dini. *Pendidikan Islam Anak Usia Dini*, *1*, 1–14.

Umam, K., & Susandi, D. (2022). Critical thinking skills: Error identifications on students' with APOS theory. *International Journal of Evaluation and Research in Education*, *11*(1), 182–192.

Wijayanti, M. D., Rahardjo, S. B., Saputro, S., & Mulyani, S. (2019). Item analysis of critical thinking skills instrument to measure effectiveness of scientific group inquiry learning (SGIL) model. *Jurnal Pendidikan IPA Indonesia*, *8*(4), 538–546.

Wildan, W., Hakim, A., Siahaan, J., & Anwar, Y. A. S. (2019). A stepwise inquiry approach to improving communication skills and scientific attitudes on a biochemistry course. *International Journal of Instruction*, *12*(4), 407–422.