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### The Quality of E-Student Worksheet on the Concept of Vertebrate Based on Critical Thinking Skill in Senior High School Level

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**Abstract:** This study aims to describe the quality of E-student worksheet on the concept of vertebrate based on critical thinking in senior high school. The development research used the Tessmer formative evaluation design, namely: 1) self-evaluation; 2) expert reviews; 3) one-to-one evaluation; 4) small group evaluation; and 5) field test evaluation, but in this study only up to small group evaluation. The validity test subjects were three experts, the individual test subjects were three students of class X Senior High School and the small group test subjects were four students in the same class. Expectancy practicality data is obtained from student responses using the expectation practicality assessment sheet instrument. Expected effectiveness data is obtained from the results of the assessment of students' critical thinking skills through the E-student worksheet. The effectiveness of expectations based on the assessment of critical thinking skills in the interpretation aspect obtained a good category, while other aspects including analysis, inference, explanation and self-regulation obtained a very good category. Thus, the quality E-student worksheet on the concept of vertebrate based on critical thinking in senior high school has a very good category.

**Keywords:** Critical Thinking Skills, E-Student Worksheet, Development Research, Vertebrates

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## INTRODUCTION

The 21<sup>st</sup> century is called the century of information technology, knowledge, globalization and the 4.0 industrial revolution. Changes occur very quickly and are difficult to predict in every aspect of life in this century, including the direction and goals of education. According to Trilling & Fadel (2009) 21<sup>st</sup> century education is digital era education with the aim of forming a generation that is skilled at using technology and life skills (hard skills and soft skills).

21<sup>st</sup> century skills are skills that everyone needs to be able to face the challenges and problems of life. (Zubaidah et al., 2017) explains that these skills are in line with the 4 pillars of life, namely learning to know, learning to do, learning to be and learning to live together. These pillars contain specific skills that need to be empowered in learning, such as critical thinking, problem solving, metacognition, communication, collaboration, innovation and creation, information literacy, and various other skills. In this case, critical thinking skills are one of the demands of 21<sup>st</sup> century learning.

Critical thinking is a skill to facilitate the right decision making. Facione (1990) suggests critical thinking indicators which include interpretation, analysis, evaluation, inference, explanation, and self-regulation. The learning theory that underlies critical thinking skills is constructivism theory. According to Suparno (1996) constructivism learning is intended so that students are active and constructive in learning. During constructivism learning, students construct their own understanding of the knowledge they have learned so that they can develop critical thinking skills.

One of the efforts to improve critical thinking skills is by providing learning tools, such as curriculum, lesson plans, learning media, teaching materials and student worksheets. The covid-19 pandemic adds new problems in the world of education. A well-designed 2013 curriculum was forced to not be implemented optimally and learning had to be done online (online). Teachers can select essential knowledge and core skills and then embed critical thinking into the curriculum, unit, or lesson plan (Greenstein, 2012),

Teachers must be smart in choosing the media that will be used in the learning process so that students do not miss the material during the covid-19 pandemic. Sari (2019) explains that learning media in the form of E-student worksheets can be used to optimize teaching and learning activities that cannot be done face-to-face in class. E-Student worksheets known as teaching materials can function as learning media because they not only present material, but

are also equipped with media to strengthen students' understanding. The advantage of E-student worksheets compared to printed E-student worksheets is that they are able to display video, audio and image features that will help students visualize abstract material.

According to Haqsari (2014) E-student worksheet or hereinafter abbreviated as E-student worksheet is a work guide that can be viewed through computers, notebooks and smartphones. There are many platforms that can be used to create E-student worksheets, one of which is Liveworksheets. Amtari et al. (2017) states liveworksheets as an E-worksheet website that contains information in the form of digital data in the form of text, images, video, audio, and other animations. Students can access the material that has been provided on this website without being limited by space and time so that learning is more flexible.

Vertebrates sub concept is one of the important Biology material to be developed. Alfiyah (2018) states that vertebrate material is material that is often included in exam questions so that every student must be able to master it. Objects of vertebrate material are easy to find in the surrounding environment, but in studying it an effective and efficient media is needed with complete information and can visualize the material. Currently, the Vertebrates E-student worksheet material is still limited and has the opportunity to be developed.

Previous studies about E-student worksheet on the concept of vertebrate based on critical thinking have been done. These studies include the development of E-student worksheet on environmental pollution to improve critical thinking skills of junior high school students (Wahyuni et. al., 2021), worksheets on environmental pollution E-student development for middle schoolers to improve their critical thinking (Haron et al., 2022), development of e-student worksheets in the form of picture stories using live worksheets in primary schools (Pulungan et al., 2022), and developing interactive electronic student worksheets through discovery learning and critical thinking skills during pandemic era (Subekti & Prahmana, 2021). These studies generally discuss how E-student worksheets improve students' critical thinking skills. While the E-student worksheet research conducted in this study was to find out how the quality of E-student worksheets based on critical thinking.

Based on this background, the researcher was interested in examining the quality of the vertebrate concept based critical thinking E-student worksheet in senior high school by using the practical expectations assessment sheet instrument. This study aims to describe the quality of the vertebrate concept-based E-student worksheet in high school. The quality of the E-

student worksheet on the concept of vertebrates based on critical thinking in this study was known through student responses using the practical expectations assessment sheet instrument.

## METHOD

This type of research includes development research using the Tessmer (1993) design with formative evaluation steps, namely: 1) self-evaluation; 2) expert review; 3) individual test (one-to-one); and 4) group test smallgroup, but in this study only up to smallgroup evaluation.

The research was carried out for five months (February 2021-June 2021). The research was conducted at Senior High School 1 Sungai Tabuk Jl. Guerrilla, Gudang Hiranng, RT. 3 Keramat, Kec. Sungai Tabuk, Kab. Banjar, South Kalimantan 70653. This school was chosen by considering the application of advanced information and communication technology, the network to access the internet is smooth, and the use of learning applications such as Google Meeting is well known by students.

The research subjects were small group test subjects which included four students of class X Mathematics and Science 1 at Senior High School Sungai Tabuk in the even semester of 2020/2021. Research subjects were determined based on different academic abilities and were taken heterogeneously. The research data was obtained from the instrument in the form of a sheet of practical expectations and the effectiveness of expectations. The data collection technique used an assessment sheet. Data analysis was done descriptively.

## FINDING AND DISCUSSION

### Finding

There are five E-student worksheets for vertebrate sub-concepts produced with each topic, namely: 1) pisces; 2) amphibians; 3) reptiles; 4) aves; and 5) mammals. Research on the development of the vertebrate sub-concept E-student worksheet has produced a pre-prototype with product quality indicators, namely expected practicality and expected effectiveness.

**Figure 1** shows the cover image for E-student worksheets. The cover looks attractive with the

title E-student worksheets and includes pictures of animals, namely fish, amphibians, reptiles, birds and mammals according to the material contained therein.



**Figure 1.** Cover image for E-student worksheets

### *Practicality of Expectations*

The practical expectation test of E-student worksheet draft 3 was carried out by 4 students of class X Mathematics and Science 1 at Senior High School 1 Sungai Tabuk. The practicality of expectations is carried out at the small group evaluation stage. Zulyusri et al. (2017) stated that the small group test aims to determine the practicality of the product being developed. Plomp & Nieveen (2007) explain that a product is said to be practical if the results of the development show that users find the product useful and easy to use. The purpose of the practicality of expectations is that a product is expected to be useful according to the plan when tested. The summary of the practical expectations of the E-student worksheet is presented in **Table 1**.

**Table 1.** Average practicality test results of E-student worksheet

No.	Aspects	E-Student Worksheet					Total	Average
		I	II	III	IV	V		
1	Content is easy to learn and understand.	100	100	100	100	100	500	100
2	Commands given to acquire skills (such as observing, experimenting, etc.) are understandable.	100	100	100	100	100	500	100
3	There is sufficient time to study.	100	100	100	100	100	500	100
	a. Content related to (equipment, method, source of material) is known beforehand.	100	100	100	100	100	500	100
	b. Methods of learning (such as orders/tasks) have been implemented before.	75	100	100	100	100	475	95
	c. Fun learning atmosphere.	100	100	100	100	100	500	100
4	Interesting learning materials to learn.	100	100	100	100	100	500	100
Overall Average of e-Student Worksheets (%)								99,29
Category								Very good
Description:								
1. Category 85.00 - 100.00% (very good), 70.00 - < 85.00% (good), 50.00 - < 70.00% (poor), 00, 00 - < 50.00 (not good) adapted from Akbar (2013)								
2. E-student worksheet I = Pisces, E-student worksheet II = Amphibia, E-student worksheet III = Reptiles, E-student worksheet IV = Aves, E-student worksheet V = Mammals,								

*The Effectiveness of Expectations*

Test of effectiveness of expectations was carried out at the *small group evaluation* with the subject of 4 students of class X Mathematics and Science 1 at Senior High School 1 Sungai Tabuk. Effective in the Big Indonesian Dictionary has the meaning of effect, influence, effect or can bring results (Depdikbud, 1990). The most important aspect of effectiveness according to Rochmad (2012) is knowing the level or degree of product application. The effectiveness of a teaching material is usually seen from the potential effects in the form of the quality of learning outcomes, attitudes and motivation of students. In this study, the expected effectiveness of the E-student worksheet was seen based on the value of students' critical thinking skills with 5 aspects based on Facione (1990), namely interpretation, analysis, inference, explanation, and self-regulation. The summary of the results of the effectiveness test of the expectations of the E-student worksheet is presented in **Table 2**.

**Table 2.** Average effectiveness test results expectation of E-student worksheet

No.	Aspect of critical thinking skill	Score Max.	E-Student Worksheet					Average	Score (%)	Category
			I	II	III	IV	V			
			Rt	Rt	Rt	Rt	Rt			
1	Interpretation	14	14.00	11.38	8.00	11.75	12.00	11.43	82	G
2	Analysis	10	8.75	9.25	9.13	10.00	10.00	9.43	94	VG
3	Inference	24	20.75	21.00	21.00	22.17	21.50	21.28	89	VG
4	Explanation	20	18.38	18.50	19.63	20.00	19.00	19.10	96	VG
5	Self-regulation	12	10.50	10.63	10.00	11.00	11.00	10.63	89	VG

Information:

1. Category 85.00 - 100.00% (very good), 70.00 - < 85.00% (good), 50.00 - < 70.00% (poor), 00.00 - < 50.00 (not good) adapted from Akbar (2013)
2. e-Student Worksheet I = Pisces (Fish), e-Student Worksheet II = Amphibia, e-Student Worksheet III = Reptiles, Student Worksheet Electronic Students IV = Aves, e-Student Worksheets V = Mammals
3. VG = very good, G = good, NG = not good



## Discussion

The results of the expected practicality test with an average score of 99.29 indicate that the vertebrate sub-concept E-student worksheet is classified as "very good". All aspects that students respond to, namely content, instructions given, time to study, how to teach, learning atmosphere and learning materials are categorized as very good. This shows that the components in the E-student worksheet are easy to learn, understand, are well known and interesting for students. Thus, the structure of the E-student worksheet is in accordance with the aspects specified in the expected practicality instrument. E-student worksheets that meet the practical aspects of hope will be easier to use and understand the material by students during the learning process. Majid (2011) explains that practical student worksheet will make it easier for teachers (educators) to carry out learning and students can learn independently to understand and do the tasks given.

The results of the practical expectation test with an average score of 99.29 indicate that the vertebrate sub-concept E-student worksheet is classified as "very good". The results of this study are supported by previous studies (Andriyani, 2018; Hariati et al., 2020; Hidayati et al., 2020; Rahimah et al., 2020). This research developed an E-student worksheet with excellent small group test results. The developed E-student worksheet product can be used in the learning process because it gets a positive response from teachers and students.

The results of the expected effectiveness test show that all E-student worksheets developed meet the expected effectiveness aspect because students are able to obtain a final score of critical thinking skills with good and very good categories. The results of this study are in line with the results of previous studies that the effective application of e-Student Worksheets can make students' critical thinking better (Angkowiati et al., 2018; Arafah et al., 2012; Hariati et al., 2020; Hidayati et al., 2020; Mardhatillah et al., 2020; Rahimah et al., 2020; Yani & Ruhimat, 2018; Zaini & Jumirah, 2016). This achievement was obtained because the e-Student Worksheet contains questions with indicators that direct students to perform these skills. Student Worksheet based on critical thinking skills must include indicators of critical thinking skills in it (Sari, 2019),

In this study, the effectiveness of the expectations of the E-student worksheet is seen based on the results of students' critical thinking skills with 5 aspects based on Facione (1990), namely interpretation, analysis, inference, explanation, and self-regulation. The results of the research for each aspect of critical thinking skills are described as follows:



### 1. Interpretation

The calculation results from the interpretation get a score of 82% in the "good" category. This achievement was obtained because on the E-student worksheet there are questions with indicators that direct students to interpret, namely observing the morphology and anatomy of vertebrate animals through video and understanding the observed images to determine the names of the morphology and anatomy sections of vertebrate animals that are a problem in question. According to (Nurichah et al., 2012) interpretation is the ability to interpret and understand the meaning of a problem. Interpretation is related to the ability of students to describe the observed object. From the results of data calculations, there is a score with a less good category, namely 57%. These results were obtained because students had difficulty finding internet literacy to answer interpretation questions on the E-student worksheet III. This difficulty is due to the fact that most of the internet literacy found does not provide an explicit explanation.

### 2. Analysis

The calculation results from the analysis get a score of 94% in the "very good" category. This achievement was obtained because on the E-student worksheet there are questions with indicators that direct students to carry out analysis, namely analyzing the morphological and anatomical characteristics of vertebrate animals based on the functions of the identified morphological and anatomical parts. According to Susilowati et al. (2017) analysis is the ability to identify true intentions and conclusions between statements, questions, concepts, descriptions based on beliefs, decisions, experiences, reasons, information or opinions.

### 3. Inference

The calculation results from inference get a score of 89% in the "very good" category. This achievement was obtained because the E-student worksheet contains questions with indicators that direct students to make inferences, namely finding, recognizing and assessing information as accurate evidence that supports answers. Susilowati et al. (2017) state inference as the ability of students to identify and select the elements needed to form reasonable conclusions or to form hypotheses by paying attention to relevant information and reducing the consequences arising from data, statements, principles, evidence, and judgments. opinions, descriptions, beliefs, or other forms of representation.

#### 4. Explanation

The calculation results of the explanation get a score of 96% in the "very good" category. This achievement was obtained because the E-student worksheet contains questions with indicators that direct students to explain, namely explaining the function of the morphology and anatomy of the observed vertebrate animal. According to Anggiasari et al. (2018) explanations are based on the ability of students to explain or express their thoughts based on evidence, methodology and context.

#### 5. Self-regulation

The results of the calculation of self-regulation get a score of 89% in the "very good" category. This achievement was obtained because on the E-student worksheet there are questions with indicators that direct students to self-regulate, namely correcting the answers that have been given, reflecting on themselves and revealing errors or deficiencies in the answers by correcting them. Agnafia (2019) suggests that the self-regulation aspect is related to the ability of students to control themselves when facing a problem by analyzing and evaluating or comparing the results of their thoughts with data and facts from the thoughts of others.

Based on the category of interpretation and analysis aspects that increased from good to very good, it is known that the use of E-student worksheets in learning is proven to improve students' critical thinking skills. Astuti et al. (2017) states that one alternative that can facilitate students to be actively involved in critical thinking is the use of E-student worksheets based on critical thinking skills. According to Suryani et al. (2018) student worksheet is one of the tools that teachers (educators) can use to increase the involvement of students in the teaching and learning process so as to improve critical thinking skills according to the demands of the 2013 curriculum. The 2013 curriculum wants a more student-centered learning process to develop creativity, create conditions that are fun, challenging and contextual (Irmayanti, 2015).

Hidayati (2016) states critical thinking skills when mastered by students in the learning process, it will help determine the accuracy of information and illogical arguments to be effective in critical thinking. Students must be guided in interpreting, analyzing, inferring, evaluating, explaining, and self-assessing as a means of improving critical thinking skills. Efforts to improve critical thinking skills can be done through reading skills, listening skills,

observing skills and analyzing skills. Yani & Ruhimat (2018) define critical thinking as a cognitive process to analyze information intelligently. Critical thinking is one of the high order thinking skills that can be used in the formation of students' conceptual systems through the provision of meaningful experiences.

With this E-student worksheet, students can express their ideas and opinions in critiquing a problem. In general, Adilla (2018) explains that the use of E-student worksheets in learning has an impact on learning activities, for example learning becomes more fun, learning becomes interactive, provides opportunities for students to practice and motivates students in learning.

According to (Haqsari, 2014) the advantages of using E-student worksheets, namely, saving space and time, allowing users to mark important things without fear of making them ugly because scribbles are environmentally friendly, do not use paper, ink, and so on and the font size can be changed. easily available, available in digital form so that it will always be available all the time, small size and capacity so that it can accommodate many e-Student Worksheets. also of course save costs.

From the research that has been done, the characteristics of the e-Student Worksheet are as follows:

1. It can be accessed through electronic devices such as computers, laptops, notebooks, or smartphones.
2. Consists of a cover, a self-identity column that can be filled in by students, work instructions, indicators, subject matter, tools and materials, work steps, assignments and bibliography.
3. Equipped with a powerpoint file link or learning video to add information about the material being studied.
4. In the "assignments" section there is an observation video or learning video that must be watched by students before working on the questions provided.
5. For each question in the E-student worksheet, there is an answer column that can be filled in directly by students.

## **CONCLUSION**

Research on the quality of E-student worksheet on the concept of vertebrate based on critical thinking skills at senior high school level has been carried out. Based on the results of

data analysis, it was found that the practicality of the student worksheets expectations as a result of the development has a score of 99.29 with a very good category. The effectiveness of the expectations of the E-student worksheet developed results in good and very good categories based on 5 aspects of critical thinking skills, namely: 1) interpretation with a score of 82%; 2) analysis with a score of 94%; 3) inference with a score of 89%; 4) explanation with a score of 96%; and 5) self-regulation with a score of 89%. Thus, the quality E-student worksheet on the concept of vertebrates based on critical thinking in senior high school has a very good category.

## REFERENCES

- Adilla, T. N. (2018). *Pengembangan Elektronik Lembar Kerja Peserta Didik (LKPD-e) Berbasis Guided Inquiry Materi Kelarutan dan Hasil Kali Kelarutan*. 53(8), 911–912.
- Agnafia, D. N. (2019). Analisis Kemampuan Berpikir Kritis Siswa dalam Pembelajaran. *Florea: Jurnal Biologi dan Pembelajaran*, 6(1), 45–53. <https://doi.org/http://doi.org/10.25273/florea.v6i1.4369>
- Akbar. (2013). *Instrumen Perangkat Pembelajaran*. Bandung: Rosdakarya.
- Alfiyah, S. (2018). *Pengembangan Media Pembelajaran Biologi Berbasis Permainan Biodakon Materi Vertebrata Kelas X MA Matholi'ul Huda Troso Jepara (Doctoral Dissertation)*. Semarang: UIN Walisongo.
- Andriyani, E. Y. (2018). *Pengembangan Lembar Kerja Peserta Didik Elektronik Berbasis Proyek pada Materi Termokimia di Kelas XI SMA*. Pendidikan Kimia.
- Anggiasari, T., Hidayat, S., & Harfian, B. A. A. (2018). Analisis Keterampilan Berpikir Kritis Siswa SMA di Kecamatan Kalidoni dan Ilir Timur Ii. *Bioma : Jurnal Ilmiah Biologi*, 7(2), 183–195. <https://doi.org/10.26877/bioma.v7i2.2859>
- Angkowati, J., Zaini, M., & Badruzsaufari. (2018). The Effectiveness of Learning Module to Train Critical Thinking Skill. *European Journal of Education Studies*, 4(12), 118–129. <https://doi.org/10.5281/zenodo.1341388>
- Arafah, S. F., Ridlo, S., & Priyono, B. (2012). Pengembangan LKS Berbasis Berpikir Kritis pada Materi Animalia. *Unnes Journal of Biology Education*, 1(1), 47–53. <https://doi.org/https://doi.org/10.15294/jbe.v1i1.378>
- Depdikbud. (1990). *Kamus Besar Bahasa Indonesia*. Jakarta: Balai Pustaka.
- Facione, P. (1990). *Critical thinking: A Statement of Expert Consensus for Purposes of Educational Assessment and Instruction*. California: The California Academic Press..
- Greenstein, L. (2012). *Assessing 21st Century Skills: A Guide to Evaluating Mastery and Authentic Learning*. Corwin, A Sage Company.
- Haqsari, R. (2014). *Pengembangan dan Analisis LKPD-e (Elektronik–Lembar Kerja Peserta Didik) Berbasis Multimedia pada Materi Mengoperasikan Software Spreadsheet*. Yogyakarta: Universitas Negeri Yogyakarta.

- Hariati, M., Zaini, M., & Kaspul, K. (2020). The Effectiveness of High School Biology Students Worksheets Based on Critical Thinking Skills on the Protista Concept. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, 2(1), 1–6. <https://doi.org/10.20527/bino.v2i1.7855>
- Haron, A., Ishak, N. A., Osman, S. Z. O. G. a/ K. T. N., Nawal, Z. N. Z., Rajoo, M., & Aziz, N. A. (2022). Worksheets on Environmental Pollution E-Student Development for Middle Schoolers to Improve Their Critical Thinking. *Computer Integrated Manufacturing Systems*, 28(12).
- Hidayati, H., Zaini, M., & Kaspul, K. (2020). Effectiveness of Worksheets of Biology Students of High School Based On Critical Thinking Skills in Virus Concept. *Bio-Inoved: Jurnal Biologi-Inovasi Pendidikan*, 2(1), 41–46. <https://doi.org/https://doi.org/10.20527/bino.v2i1.7966>
- Hidayati, N. (2016). Hasil Belajar dan Keterampilan Berpikir Kritis Siswa Madrasah Tsanawiyah dalam Pembelajaran IPA Melalui Kerja Ilmiah. *Proceeding Biology Education Conference*, 13(1), 118–127.
- Irmayanti. (2015). *Pengaruh Penilaian Portofolio dalam Model Pembelajaran Advanced Organizer dan Kemampuan Awal terhadap Pemahaman Konsep dan Motivasi Belajar Kimia Peserta Didik Kelas XI SMA Negeri 12 Makassar*. Makassar: Program Pascasarjana Universitas Negeri Makassar.
- Majid, A. (2011). *Perencanaan Pembelajaran*. Bandung: Remaja Rosdakarya.
- Mardhatillah, A., Zaini, M., & Putra, A. P. (2020). Development of Worksheets for Biology High School Student-Based on Critical Thinking Skills on the Concept of Biodiversity. *Bio-Inoved: Jurnal Biologi-Inovasi Pendidikan*, 2(1), 31–35. <https://doi.org/10.20527/bino.v2i1.7903>
- Pulungan, M., Maharani, S.D., Waty, E.R. K., Safitri, M. L. O., Suganda, V. A., & Husni, F. T. (2022). Development of E-Student Worksheets in the Form of Picture Stories Using Live Worksheets in Primary Schools. *Jurnal Iqra': Kajian Ilmu Pendidikan*, 7(2), 157–167. <https://doi.org/10.25217/ji.v7i2.1759>
- Nurichah, E., Susantini, E., & Wisanti. (2012). Pengembangan Lembar Kegiatan Siswa Berbasis Keterampilan Berpikir Kritis pada Materi Keanekaragaman Hayati. *BioEdu*, 1(2), 45–49.
- Plomp, T., & Nieveen, N. (2007). *An Introduction to Educational Design Research*. Proceedings of The Seminar Conducted at The East China Normal University, Shanghai (PR China), November 23-26, 2007.
- Rahimah, W., Zaini, M., & Halang, B. (2020). Work Sheet Development of High School Students Biology Based on Critical Thinking Skills on the Motion Systems Concept. *BIO-INOVED: Jurnal Biologi-Inovasi Pendidikan*, 2(2), 100–105. <https://doi.org/10.20527/bino.v2i2.8474>
- Sari, Y. P. (2019). *Pengembangan LKPD Elektronik dengan 3D Pageflip Professional Berbasis Literasi Sains pada Materi Gelombang Bunyi (Doctoral Dissertation)*. Lampung: UIN Raden Intan Lampung.
- Subekti, M. A. S., & Prahmana, R. C. I. (2021). Developing Interactive Electronic Student

- Worksheets through Discovery Learning and Critical Thinking Skills during Pandemic Era. *Mathematics Teaching-Research Journal*, 13(2), 137–174.
- Suparno, P. (1996). *Filsafat Konstruktivisme dalam Pendidikan*. Yogyakarta: Kanisius.
- Susilowati, Sajidan, & Ramli, M. (2017). Analisis Keterampilan Berpikir Kritis Siswa Madrasah Aliyah Negeri di Kabupaten Magetan. *Prosiding SNPS (Seminar Nasional Pendidikan Sains)*, 223–231.
- Tessmer, M. (1993). Planning and Conducting Formative. In *Routledge*.
- Trilling, B., & Fadel, C. (2009). *21<sup>st</sup> Century Skills Learning for Life in Our Times*. San Francisco: Jossey-Bass A Wiley Imprint.
- Wahyuni, S., Rizki, L. K., Budiarmo, A. S., Putra, P. D. A., & Narulita, E. (2021). The Development of E-Student Worksheet on Environmental Pollution to Improve Critical Thinking Skills of Junior High School Students. *Jurnal Penelitian Pendidikan IPA*, 7(4), 723–728. <https://doi.org/10.29303/jppipa.v7i4.870>
- Yani, A., & Ruhimat, M. (2018). *Teori dan Implementasi Pembelajaran Sainifik Kurikulum 2013*. Bandung: Refika Aditama.
- Zaini, M., & Jumirah, R. (2016). Pengembangan Perangkat Pembelajaran Topik Ekologi terhadap Keterampilan Berpikir Kritis Peserta Didik Madrasah Aliyah. *Jurnal Pendidikan Biologi Indonesia*, 2(1), 39–47.
- Zubaidah, S., Fuad, N. M., Mahanal, S., & Suarsini, E. (2017). Improving Creative Thinking Skills of Students through Differentiated Science Inquiry Integrated with Mind Map. *Journal of Turkish Science Education*, 14(4), 77–91. <https://doi.org/10.12973/tused.10214a>
- Zulyusri, Sumarmin, R., & Miswati. (2017). Pengembangan Soal Biologi Berbasis Literasi Sains untuk Siswa SMA Kelas X Semester 1. *Bioeducation Journal*, 1(1), 88–94. <http://ejournal.unp.ac.id/index.php/bioeducation/article/view/7158>