

An Analysis On The Concept Comprehension Skill Through The Two-Tier Multiple Choice In Online Assessment

Yuni Pantiwati^{1*}), Wahyu Prihanta²⁾, Endrik Nurrohman³⁾

¹⁾Biology Education, Faculty of Teacher Training and Education, University of Muhammadiyah Malang, Indonesia

²⁾Biology Education, Faculty of Teacher Training and Education, University of Muhammadiyah Malang, Indonesia

³⁾Biology Education, Faculty of Teacher Training and Education, University of Muhammadiyah Malang, Indonesia
yuni_pantiwati@yahoo.co.id

ABSTRACT

The corona virus outbreak has an impact on learning activities. Indonesia establishes online or online learning so that learning activities continue and are safe. Assessment and evaluation must continue to be carried out. One way of assessing authenticity can be using Two Tier Multiple Choice (TTMC). This study aimed to analyze the ability to understand the concept of Biology education students through Two-Tier Multiple Choice in online assessment. This type of research is descriptive qualitative. The research was conducted for one semester. The research subjects were semester 3 students who program and attend lectures on Media and Learning Resources at the Biology Education Study Program, FKIP-UMM. The academic year 2020/2021. The number of students is 85 people. The sampling technique used is the saturation sampling. The data were collected utilizing a multiple-choice test in the form of TTMC. Aspects that are measured include aspects of understanding and analyzing. The qualitative descriptive analysis was conducted to classify the data collection. The result showed that 37.6% of students entered the criteria for learning outcomes under the minimum standard mastery (MSM), 31.7% were according to the MSM standards, and 30.6% were in the criteria above the MSM. In the aspect of understanding (C2), 63.5% of students can answer questions correctly, and 36.5% of students have not answered correctly, in the aspect of analyzing (C4), as many as 41.4% of students can answer questions correctly and 58.6% of students not correct in answering the questions of the total evaluated student population.

Keywords : 2TMC; Analysis; Diagnostic test; Online Assessment; Understanding concepts



This is an open access article distributed under the Creative Commons 4.0 Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited. ©2022 by author and Universitas Negeri Padang.

INTRODUCTION

The World Health Organization (WHO), on March 11, 2020, declared the Coronavirus a global pandemic (*World Health Organization*, 2019). Indonesia is one country that suffers from the pandemic, which has affected the country in many sectors. One of the significant effects affects the educational sector and the students that include Early Childhood, Elementary Schools, Junior High Schools, Senior High Schools, and Higher Educations which comprise undergraduate, graduate and post-graduate programs. Therefore, on Monday, March 16, 2020, the government issued a policy on the online learning program (Kemendikbud, 2020).

Online or online learning is one solution for learning activities in the midst of a pandemic

without compromising the essence and learning resources. However, in the implementation of online learning activities, there are several weaknesses and obstacles, including the availability of the internet, supporting devices, control and assistance to students, and the material delivered by online teachers is not necessarily acceptable to students compared to conventional learning activities. (Asmuni, 2020; Firman & Rahayu, 2020). According to Syarifah et al. (2022) learning during the pandemic and students' understanding of concepts is still not going well.

Online learning is an internet-based learning activity using a laptop or personal computer. The online learning method produces new and challenging experiences for all related parties

compared to conventional (Kuntarto, 2017). The learning competence in both online-based and conventional learning is feasible for improvement through the counselling program in consultancy activities (Dahlia & Supriatna, 2021). Therefore, compared to the conventional learning method, the online one resulted in particular challenges; thus, proper counselling and consultancy programs may improve the learning method.

Any learning method always considers the scoring system a significant component. The issue in online learning regarding the scoring system is that the technique and type of scoring must adjust with the learning model. The scoring instrument used for this purpose is similar to the conventional one, with the presentation technique as the distinctive factor. The correction is in the direct computerized method; therefore, the participants cannot access the score directly. Four computer-based testing models include 1) open test; it allows participants to have direct access to the score; 2) controlled model; it allows only the registered participants to access the score by using user name and its password; 3) supervised model; it allows the supervisor to identify and validate test participants, and 4) managed model; it centralizes the test through particular organization management by appointed operators (Imania & Bariah, 2019).

The computer-based test includes an online assessment accessible for completion at home or any controlled environment; that is, the online assessment still refers to the authenticity of the assessment standard (Sahidu et al., 2020). According to Zahrok (2009), authentic assessment refers to real-life situations using various approaches that enable solving problems by one or more approaches and techniques. Meanwhile, Pantiwati (2016) proposed that assessment is the information collection process on the students' achievement using various procedures. The authentic assessment includes tests, self-assessment, projects, portfolios, etc.

Concept understanding has an important role in learning activities. Research result Wati et al. (2014) shows that in learning activities students tend to memorize the concepts taught so that they become less meaningful. This is one of the causes of student understanding of concepts is still low. This is in line with research Sucahyanti et al. (2018) that students' understanding of concepts in learning biology obtained low results.

Understanding the concepts possessed by students can be used to solve a problem related to a concept. In addition to playing an important role, lack of understanding of concepts can disrupt the process of learning activities (Adhani & Rupa, 2020). The importance of understanding concepts can not be separated from learning media and learning resources. The subject of media and learning resources is one of the courses that play an important role and is a subject that must be taught to students as a provision, so that when students become educators, they have the ability to use media and manage learning resources. (Harfiani & Fanreza, 2019).

An alternative to conducting the authentic assessment is using the Two-Tier Multiple Choice (TTMC) that is similar to the conventional multiple-choice with a distinct difference in the applied technique. TTMC has two sections in a set of questions; the first part is a conventional multiple-choice, providing four options with only one correct answer. The second part is also multiple-choice with four options and one correct answer, yet it explains the concept of the previous sets of problems. Therefore, statement one is a question stem 1 followed by choices. Research by Widiyatmoko & Shimizu (2019) proved the effectiveness of the two-tier multiple-choice in determining the students' misconception and its usage as an alternative for the conventional multiple choice. In conclusion, the two-tier multiple-choice is applicable to assess the students' conceptual comprehension and misconception.

TTMC is applicable as one of the assessment instruments for the conceptual and theoretical comprehension of Learning Source and Media as the compulsory course of the Biology Education study program of the Faculty of Teacher Training and Education of Universitas Muhammadiyah Malang. Since the outbreak of Covid-19, the LSM (Learning Management System) has become one of the alternatives for online learning activity. The issue in online learning is the students' assessment in cognitive, affective, and psychomotor achievement as there is fraud potential that can risk the assessment validity. Therefore, online assessment that meets all criteria of online principles is essential. This research describes university students' comprehension skills on learning media assessed using TTMC during the online assessment.

METHODS

The research approach used is an approach that must be in accordance with the type of research used. For this type of research, the approach used is a qualitative approach with qualitative descriptive research methods. Qualitative research methods are descriptive research methods and tend to use analysis (Hermawan, 2019).

The research subjects were the third-semester students who followed the Learning Source and Media course during 2020/2021 Biology Education Study Program University of Muhammadiyah Malang. At the same time, its population included 85 students who participated in the Learning Source and Media, while the sample was 85 students. The sampling technique used is a saturation sampling (non-probability sampling). Saturation sampling technique is a sampling technique with all populations used as research samples (Saputra et al., 2022).

Data collection was by a multiple-choice test. The students' cognitive result was presented in percentage and classified into three criteria: below the standard of Predetermined Minimum Standard Mastery (MSM), meeting the MSM, and above the MSM, which was 60. The assessment material was the nature of the learning source and media, while the assessed aspects included comprehension and analysis skills. Those aspects then underwent further data processing through the qualitative descriptive method.

The learning strategy applied was active learning referred to the principles of experiencing, communicating, interaction, and reflection. The assessment was by authentic assessment using portfolio, discussion, product assessment, performance assessment, assignments, quizzes, tests, and online assessment through the controlled google form, which required the test participants to use a camera with eye and motion tracking camera sensor. The questions types were C2 and C4, where the C2 type acted as the first question to assess the students' comprehension skill while the C4 assessed the reasoning of the chosen answer for part 1 as the analysis skill assessment. Questions C2 and C4 on the Two Tier Multiple Choice (TTMC) questions are interpreted as a cognitive domain, which focuses on behavior that emphasizes one's intellectuality. This study emphasizes the ability to understand students' concepts.

Data on students' conceptual understanding in media and learning resources courses will be analyzed qualitatively. Data on students' conceptual understanding is presented in the form of

an average percentage in a bar chart. The data presented are described in the form of explanations and provide descriptions in giving meaning according to the research results obtained.

RESULTS AND DISCUSSION

1. Results

The research result shows that the students' cognitive skills on the Learning Source and Media course after the online assessment are varied. The skill result is classified into three criteria based on the MSM score that is 1) under the MSM, 2) meeting the MSM, and 3) above the MSM. The cognitive assessment result is presented in Figure 1.

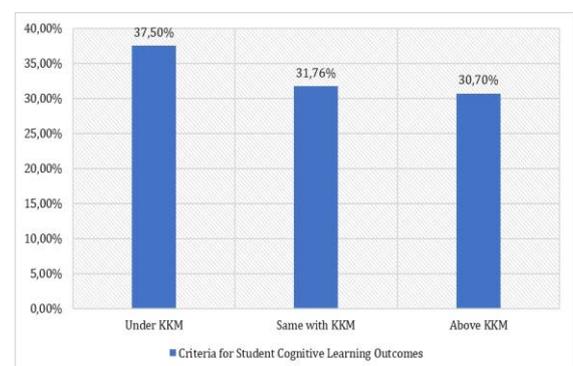


Figure 1. The Percentage of Students' Cognitive Learning Result

The percentage result of the three criteria over the total population (85 students) is 37.6% is under the MSM (equals to 32 students), 31.7% is meeting the MSM (equals to 27 students), and 30.6% above the MSM (equals to 26 students). The result of this analysis indicates that 62.3 % of students have achieved MSM and above MSM. Thus, the MSM level of students can be classified into the medium category.

The assessed aspects of cognitive skill include the C2, the comprehension skill, and C4, the analysis skill. Several question types in the online assessment and the students' cognitive learning result in percentage is presented in detail in the following Figure 2.

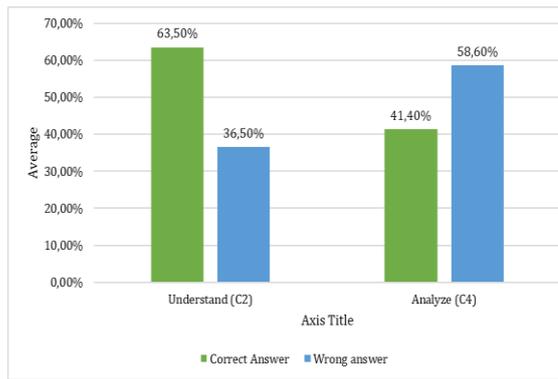


Figure 2. The Average Percentage of Students' Answers

Two criteria used for the online assessment are suitable for students' achievement indicators. The research result shows the number of correct answers for the C2 is 63.5% or equals 54 students, and 36.5% for incorrect answers, equal to 46 students. As for C4, the correct answers is 41.4% or equal to 35 students, and 58.6% for incorrect answers, which is equal to 65 students.

Students' ability to answer the TTMC questions during the online assessment through the google form by focusing on the number of correct answers for statements 1 and 2 is presented in Figure 3.

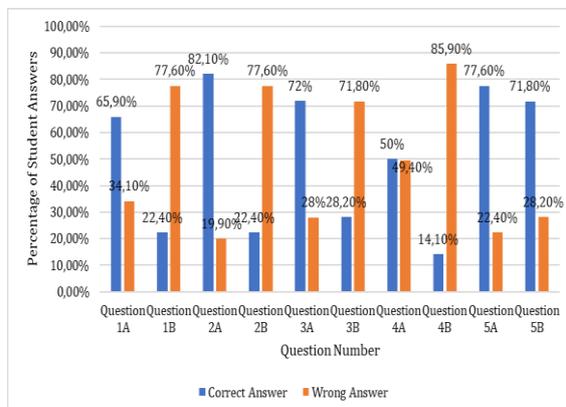


Figure 3. Students Skill Percentage in Answering TTMC Questions

Based on Figure 3, the number of students who liked part one or part a is greater than those who liked type b. The average is 64.1 to 31. The greater number of students who liked type a is because the questions are similar to the conventional multiple-choice compared to type b's, which required students to think harder in answering the questions to assess the analysis skill. Students must analyze the questions in part one and demonstrate the relationship between the questions.

TTMC questions consist of two parts (Figure 4.). The first part is conventional objective questions which achieved 50% to 82.1% correct answers by test participants compared to the second part, which achieved 14% to 71% of correct answers. This finding aligns with the characteristics of the first part of TTMC, which is conventional multiple-choice that does not require high skill in answering the questions. In contrast, the second part of the multiple-choice questions assesses a more complex learning outcome, mostly done using knowledge, comprehension, and application (Ambiyar, 2012).

First level questions (knowledge)
Find the correct statement...

- 1) Motion pictures is a medium that presents moving figures integrated with audio element
- 2) The audio media is applied for the learning process, emphasizing appreciation, but not the affective aspect.
- 3) Realia is a media that can explain abstract concepts, yet still requires verbal explanation.
- 4) Model is used as information media to describe a process and a complex system or learning object.

Second level questions (reasoning)
Choose the following description that is suitable with the above statement...

- 1) Video can present moving motion and information with motion elements within it.
- 2) Video can present a process in every stage yet serve less security as an observation medium.
- 3) Video is applicable for all skills and competencies learning activities.
- 4) Video as a medium can generate a common experience at the same time.

Figure 4. Example of Two Tier Multiple Choice Questions

2. Discussion

Cognitive learning outcomes are a description of the level of student mastery of a subject taken in learning activities. Cognitive learning outcomes involve the knowledge and development of intellectual skills which include recall or recognition of facts, procedural patterns, and concepts in the development of students' intellectual abilities and skills (Erina & Kuswanto, 2015). According to Yusuf Aditya (2016), the learning result is a skill achieved by students after completing the learning process. Learning achievement due to cognitive learning activity can indicate the assessment result during or after learning (Meita et al., 2018). The learning outcomes also include the learning subjects and the students' achievement after completing a program. The learning process will show students' skills in memorizing, comprehension, explaining, analyzing, assessing, and creating (Umami et al., 2021). This research conducted an online evaluation to determine the cognitive learning result of 85 university students who joined the learning source and media course.

The assessment result on the students' cognitive learning result does not show a thorough completion based on MSM. There are several factors, both internal and external, that caused the finding. The factors include 1) non-social, 2) social, 3) physiological and psychological factors (Anggresta, 2016). Nurlaila (2020) stated that success depends on various factors that include the internal and external ones, which are initial characteristics, as the internal factor, and environmental and social situation of a particular person as the external one. The factors that influence cognitive learning outcomes are very complex. This involves internal and external factors, such as: interests, motivation, attitudes, intelligence, learning environment, learning strategies, physical condition and others (Rijal & Bachtiar, 2015; Syafi'i et al., 2018).

In general cognitive aspects can be grouped into six levels. The six levels of cognitive aspects are: (1) the level of knowledge, instructional objectives at this level require students to remember information that has been received previously; (2) the level of understanding, the category of understanding is related to the ability to explain knowledge, information that has been known in their own words; (3) the level of application, application is the ability to use the information that has been learned in new situations, and solve various problems that arise in everyday life; (4) the level of analysis, analysis is the ability to identify, separate and leave out the components of a fact, concept, opinion and assumption of a hypothesis or conclusion; (5) the level of synthesis, the ability of students to relate and integrate various elements and elements of existing knowledge so as to form a new, comprehensive pattern; (6) level of evaluation, students' ability to make judgments and decisions about the value of product or object method ideas using certain criteria (Ruwaida, 2019; Syafi'i et al., 2018).

The cognitive learning result engages the students in the thinking process activities, such as memorizing, comprehension, application, analysis, synthesis, evaluation, and creation (Ariani & Sesmiwati, 2019). According to Anderson et al., (2001), six fields of Bloom's Taxonomy comprise memorizing (to remember), comprehension (to comprehend), application (to apply), analyzing (to analyze), evaluation (to evaluate), and creation (to create).

Research results by Batubara (2016) found that students responded well to the google

application usage for online assessment purposes. The respondent's percentage includes those with a good response towards the online questionnaire (53.3%), easy accessibility (86.7%), time efficiency is (80%), and stationary efficiency. This is in accordance with the opinion Batubara (2016) the use of Google Forms in learning evaluation activities has an impact and benefit in terms of effectiveness, efficiency, attractiveness and display design.

Several instruments are applicable for the online assessment, such as google form and the TTMC. The TTMC is a two-level multiple choice question that diagnoses students' alternative conceptions of science. The first level in the TTMC questions resemble traditional multiple choice questions, which usually deal with revelation knowledge. In the research, the first level question consists of 1 correct answer and 3 distractors. The second level resembles the traditional multiple choice question format but aims to determine students' higher thinking and reasoning abilities. In this research, there are 1 true reason and 3 distractors (Adodo, 2013).

Research conducted by Suryani et al. (2016) shows that the TTMC instrument can be used effectively to determine students' conceptual understanding. The TTMC instrument can minimize errors in measuring students' conceptual understanding through two graded questions. TTMC is more effective in determining the level of students' conceptual understanding than using a one tier test (Nabilah et al., 2013). The results of research conducted by Arifin & Aprisal (2020) that the use of the online TTMC instrument can determine the level of individual understanding without using a lot of wasted time, reducing the use of a lot of paper and minimizing the actions of students who just choose answers.

Research results by Batubara (2016) found that students responded well to the google application usage for online assessment purposes. The respondent's percentage includes those with a good response towards the online questionnaire (53.3%), easy accessibility (86.7%), time efficiency is (80%), and stationary efficiency. This is in accordance with the opinion Batubara (2016) that the use of Google Forms in learning evaluation activities has an impact and benefit both in terms of effectiveness, efficiency, attractiveness and display design.

There are several advantages of the assessment carried out through Google Form, such as (1) The display provided is quite attractive. This

application provides facilities for users to enter and use photos. This application also has many more attractive and colorful display templates. 2) Has various types of tests that are freely chosen. This application provides a test selection facility that is free to use according to user needs. 3) Respondents can provide immediate response anywhere; and 4) The results are immediately compiled and analyzed automatically (Batubara, 2016; Sianipar, 2019).

The C2 question type is a skill to develop and integrate a meaning based on the students' knowledge. This field includes the cognitive activities to interpret, indicate, classify, summarize, infer, compare, and explain (Iqbal et al., 2021). Further, Ambiyar (2012) explained the comprehension aspect to assess the students' skill in comprehending the translation, interpretation, and extrapolation. The aspect of understanding is a level of thinking ability that is at a higher level than memory or memorization. This ability not only requires memorizing but students must be able to understand the concept. Students are asked to prove that they understand simple relationships between facts or concepts (Amelia et al., 2016).

The C4 type is the skill to outline a problem and comprehend the relationship among the elements. This field includes the cognitive aspect to differentiate, organize, and symbolize (Anderson et al., 2001). The analysis skill includes analyzing a wide range of information into small parts. The analysis skill includes 1) element analysis, 2) relationship analysis, and 3) organized-principles analysis (Ambiyar, 2012). Type C4 questions include HOTS type questions. The presence of HOTS category questions is needed by students to practice critical, logical, reflective, metacognitive, and creative thinking. HOTS questions train students to transfer knowledge, think critically, and solve problems (Haryati, 2020).

Statement one describes that a motion picture is a live picture, while the video is a moving motion completed with audio or sound; thus, the motion picture is a part of the video. Based on the question type, the multiple-choice has only one correct or the most correct answer, and students are required to choose only one answer, which is easier than an essay quiz (Butler, 2018) thus, it only evaluates the content knowledge without considering the students' reasoning (Brassil & Couch, 2019). Despite being a simple test instrument to undergo, the multiple-choice test is also

applicable in many-objective sample assessment (Hudson & Treagust, 2013), and also for knowledge-based thinking skill (Rohmi, 2017).

The second part of the test is the strengthening skill by analyzing the statement from the previous question. The analytical question is more complex than the comprehension one it is an essay test (Mania et al., 2018). The essay test requires students to review, redescribe, and reconstruct the ideas into a complete written sentence or oral review containing ideas and concepts (Saraswati & Agustika, 2020). The review whose description uses words is essentially according to the question type (Arikunto, 2010). The benefit of the analytical question is providing the freedom for students to elaborate and describe their ideas and answer review (Ambiyar, 2012).

Concerning the review requirements for the TTMC test based on online test principles, according to Palloff & Pratt (2010), there are seven principles to fulfill: 1) using a variety of learning designs based on many learning styles, 2) using student-based assessment design that is according to the activities and assignments, 3) using assessment design that reduces the fraud and plagiarism potentials, 4) promoting students to engage in discussions, 5) using assessment rubric for self-performance and evaluation, 6) developing online tests and quizzes by considering the cheating potential, 7) including other assessment instruments such as performance, project, portfolio, self-assessment, peer-assessment, discussion group assignments, and other learning objectives-related instruments.

Giving the TTMC test to students in the class has several effects based on the benefits of using the TTMC test. Through the TTMC test students find out the level of understanding of individual understanding in each concept taught through patterns of answers and reasons (Arifin & Aprisal, 2020). The use of TTMC trains students on higher-order thinking skills, critical thinking skills, and deeper understanding of students' concepts or not just memorizing (Laksono, 2019; Ratnasari et al., 2017). The TTMC test questions consist of 2 layers of answers, namely answers and reasons. The purpose of the second layer is to encourage students to think at higher levels and have reasoning skills. The first level of questions deals with knowledge statements while the second level of questions facilitates testing students' learning at higher levels of thinking. The use of answer patterns and reasons can reduce student actions as long as they choose

answers (Shidiq et al., 2015). The online-based TTMC evaluation provides several advantages, namely saving paper, using a short time, and reducing student actions that only choose answers (Arifin & Aprisal, 2020).

CONCLUSION

The results showed that there were variations in students' skills in understanding a concept and cognitive learning outcomes using online assessments. For comprehension skills (C2), 63.5% of students gave correct answers, and 36.5% could not give correct answers, while the analysis aspect (C4) showed 41.4% of students were able to answer questions correctly, and the remaining 58.6% did not. The results of the study can be used as a follow-up to students who are unable to answer questions correctly, so that the cause of the condition is known. Moreover, understanding concepts in media learning is quite important and supportive for prospective educators in the future.

REFERENCES

- Adhani, A., & Rupa, D. (2020). Analisis Pemahaman Konsep Mahasiswa Pendidikan Biologi Pada Matakuliah Fisiologi Tumbuhan. *Quantum: Jurnal Inovasi Pendidikan Sains*, 11(1), 18.
- Adodo, S. O. (2013). Effects of two-tier multiple choice diagnostic assessment items on students' learning outcome in Basic Science Technology (BST). *Academic Journal of Interdisciplinary Studies*, 2(2), 201–210.
- Ambiyar. (2012). *Pengukuran & tes dalam pendidikan*. UNP Press.
- Amelia, D., Susanto, S., & Fatahillah, A. (2016). Analisis hasil belajar matematika siswa pada pokok bahasan himpunan berdasarkan ranah kognitif taksonomi bloom kelas VII-A di SMPN14 Jember. *Jurnal Edukasi*, 2(1), 1.
- Anderson, W. L., & Krathwohl, D. R. (2001). *A taxonomy for learning, teaching, and assessing (A revision of bloom's taxonomy of educational objectives)*. Addison Wesley Longman.
- Anggresta, V. (2016). Analisis faktor-faktor yang mempengaruhi prestasi belajar mahasiswa fakultas ekonomi Universitas Negeri Padang. *Economica*, 4(1), 19–29.
- Ariani, V., & Sesmiwati. (2019). Studi tentang faktor-faktor yang mempengaruhi hasil program studi teknik ekonomi konstruksi (Studi kasus: angkatan 2016). *Jurnal Pendidikan Teknik Bangunan Dan Sipil*, 5(2), 73–81.
- Arifin, S., & Aprisal, A. (2020). Analisis tingkat pemahaman konsep statistika mahasiswa calon guru menggunakan two tier test berbasis online. *Delta: Jurnal Ilmiah Pendidikan Matematika*, 8(2), 201.
- Arikunto, S. (2010). *Dasar-dasar evaluasi Pendidikan*. Bumi Aksara.
- Asmuni. (2020). Problematika pembelajaran daring di masa pandemi COVID-19 dan solusi pemecahannya [The problems of online learning during the COVID-19 pandemic and the solutions]. *Jurnal Paedagogy*, 7(4), 281–288.
- Batubara, H. H. (2016). Penggunaan google form sebagai alat penilaian kinerja dosen di prodi PGMI UNISKA Muhammad Arsyad Al Banjari. *Jurnal Pendidikan Dasar Islam*, 8(1).
- Boyd, M., Chai, C., & Vitzelio, T. (2010). A guidebook to student learning outcomes and administrative unit outcomes. In *Mt. San Antonio Collage*. Mt. San Antonio Collage.
- Chandrasegaran, A. L., Treagust, D. F., & Mocerino, M. (2007). The development of a two-tier multiple-choice diagnostic instrument for evaluating secondary school students' ability to describe and explain chemical reactions using multiple levels of representation. *Chemistry Education Research and Practice*, 8(3), 293–307.
- Chang, C. Y., Yeh, T. K., & Barufaldi, J. P. (2010). The positive and negative effects of science concept tests on student conceptual understanding. *International Journal of Science Education*, 32(2), 265–282.
- Dahlia, I., & Supriatna, U. (2021). Persepsi orang tua terhadap pembelajaran online masa pandemi COVID-19. *Jurnal Ilmiah Pendidikan*, XII(2), 170–180.
- Erina, R., & Kuswanto, H. (2015). Pengaruh model pembelajaran instad terhadap keterampilan proses sains dan hasil belajar

- kognitif fisika di SMA. *Jurnal Inovasi Pendidikan IPA*, 1(2), 202.
- Firman, F., & Rahayu, S. (2020). Pembelajaran online di tengah pandemi COVID-19 [Online learning in the midst of the COVID-19 pandemic]. *Indonesian Journal of Educational Science*, 2(2), 81–89.
- Harfiani, R., & Fanreza, R. (2019). Implementasi Model Pembelajaran Lesson Study Praktikum Wisata Dalam Upaya Meningkatkan Pemahaman Konsep dan Berpikir Kreatif Mahasiswa Pada Mata Kuliah Media. *Jurnal Agama Dan Pendidikan Islam*, 11(1), 135–154.
- Haryati, M. (2020). Analisis soal UN biologi SMA/MA berdasar dimensi proses kognitif, karakteristik HOTS, dan bentuk stimulus. *Jurnal Education and Development*, 8(2), 91–94.
- Hudson, R. D., & Treagust, D. F. (2013). Which form of assessment provides the best information about student performance in chemistry examinations? *Research in Science and Technological Education*, 31(1), 49–65.
- Imania, K. A., & Bariah, S. K. (2019). Rancangan pengembangan instrumen penilaian pembelajaran berbasis daring. *Jurnal Petik*, 5(1), 31–47.
- Iqbal, A. M., Asfar, A., Ahmad, M. A., & Anshari. (2021). *Model pembelajaran active knowledge sharing and intellectually untuk meningkatkan high order thinking skills*. Media Sains Indonesia.
- Kemendikbud. (2020, February 22). Kemendikbud dorong pembelajaran daring bagi kampus di wilayah terdampak COVID-19. *Bersama Hadapi Korona*.
- Kuntarto, E. (2017). Keefektifan model pembelajaran daring dalam perkuliahan bahasa indonesia di perguruan tinggi. *Journal Indonesian Language Education and Literature*, 1(2), 207–220.
- Laksono, P. J. (2019). Pengembangan dan penggunaan instrumen two-tier multiple choice pada materi termokimia untuk mengukur kemampuan berpikir kritis. *Orbital: Jurnal Pendidikan Kimia*, 2(2), 80–92.
- Muhadjir, N. (1983). *Kapita selekta metode riset lanjut*. Rake Press Sarasin.
- Nabilah, Andayani, Y., & Laksmiwati, D. (1907). Analisis tingkat pemahaman konsep siswa kelas XI IPA SMAN 3 Mataram menggunakan one tier dan two tier test materi kelarutan dan hasil kali kelarutan. *Jurnal Pijar*, VIII(2), 64–69.
- Nurlaila, N. (2020). Keberhasilan pembelajaran bahasa: Perspektif intake factors. *Jurnal Kependidikan: Jurnal Hasil Penelitian Dan Kajian Kepustakaan Di Bidang Pendidikan, Pengajaran Dan Pembelajaran*, 6(3), 557.
- Palloff, R. M., & Pratt, K. (2010). Assessing the online learner: Resources and strategies for faculty. In *Teaching Theology & Religion* (Vol. 13, Issue 2). Jossey Bass.
- Pantiwati, Y. (2016). Hakekat asesmen autentik dan penerapannya dalam pembelajaran biologi. *Jurnal Edukasi Matematika Dan Sains*, 1(1), 18.
- Putra, E. A. (2015). Anak Berkesulitan Belajar di Sekolah Dasar Se-Kelurahan Kalumbuk Padang. *Jurnal Ilmiah Pendidikan Khusus*, 1(3), 71–76.
- Ratnasari, D., Sukarmin, & Suparmi. (2017). Analisis implementasi instrumen two-tier multiple choice untuk mengukur keterampilan proses sains. *Jurnal Pendidikan Dan Kebudayaan*, 2(2), 166–179.
- Rijal, S., & Bachtiar, S. (2015). Hubungan antara sikap, kemandirian belajar, dan gaya belajar dengan hasil belajar. *Jurnal Bioedukatika*, 3(2), 15.
- Rohmi, P. (2017). Peningkatan domain kompetensi dan pengetahuan siswa melalui penerapan levels of inquiry dalam pembelajaran IPA terpadu. *Edusains*, 9(1), 14–23.
- Sahidu, H., Gunawan, Suranti, N. M. Y., & Nisrina, N. (2020). *Model e-assessment dan implikasinya dalam pembelajaran*. Literasi Nusantara.
- Saputra, D. N., Listyaningrum, N., Leuhoe, Y. J. I., Apriana, Asnah, & Rokhayati, T. (2022). *Buku ajar metodologi penelitian*. Feniks Muda Sejahtera.
- Saraswati, P. M. S., & Agustika, G. N. S. (2020).

- Kemampuan berpikir tingkat tinggi dalam menyelesaikan soal HOTS mata pelajaran matematika. *Jurnal Ilmiah Sekolah Dasar*, 4(2), 257.
- Shidiq, A. S., Masykuri, M., & Susanti, E. (2015). Analisis Higher Order Thinking Skills (HOTS) menggunakan instrumen two-tier multiple choice pada materi kelarutan dan hasil kali kelarutan untuk siswa kelas XI SMAN 1 Surakarta. *Prosiding Seminar Nasional Pendidikan Sains, November*, 2015–2159.
- Sianipar, A. Z. (2019). Penggunaan google form sebagai alat penilaian kepuasan pelayanan. *Journal of Information System, Applied, Manegement, Accounting and Reserach*, 3(1), 16–22.
- Sucahyanti, K. N., Adnyana, B., & Santiasa, A. (2018). Pengembangan Instrumen Asesmen Mind Mapping Untuk Menilai Pemahaman Konsep Biologi. *Jurnal Pendidikan Biologi Undiksha*, 5(2), 113–122.
- Suryani, E., Rusilowati, A., & Wardono, W. (2016). Analisis pemahaman konsep IPA siswa SD menggunakan two-tier test melalui pembelajaran konflik kognitif. *Journal of Primary Education*, 5(1), 56–65.
- Syafi'i, A., Marfiyanto, T., & Rodiyah, S. K. (2018). Studi tentang prestasi belajar siswa dalam berbagai aspek dan faktor yang mempengaruhi. *Jurnal Komunikasi Pendidikan*, 2(2), 115.
- Syarifah, S., Lestari, A., Anggraini, Y., Wahyudi, H., & Zatrachadi, M. F. (2022). Pembelajaran daring dan motivasi belajar peserta didik ditengah wabah COVID-19. *Jurnal Penelitian Sosial Keagamaan*, 22(1), 1–18.
- Umami, R., Rusdi, M., & Kamid, K. (2021). Pengembangan instrumen tes untuk mengukur higher order thinking skills (HOTS) berorientasi programme for international student assesment (PISA) pada peserta didik. *JP3M (Jurnal Penelitian Pendidikan dan Pengajaran Matematika)*, 7(1), 57–68.
- Wati, I. K., Karyanto, P., & Santosa, S. (2014). Pengaruh penerapan model pembelajaran Sains Teknologi Masyarakat (STM) terhadap hasil belajar biologi siswa kelas X SMA Negeri 3 Boyolali tahun pelajaran 2012 / 2013 [The effect of the application of the Social Technology Science (STM) learning model on t. *BIOEDUKASI*, 7(1), 21–25.
- Widiyatmoko, A., & Shimizu, K. (2019). Development of computer simulations to overcome students misconceptions on light and optical instruments. *Journal of Physics: Conference Series*, 1321(3).
- Yusuf Aditya, D. (2016). Pengaruh penerapan metode pembelajaran resitasi terhadap hasil belajar matematika siswa. *SAP (Susunan Artikel Pendidikan)*, 1(2), 165–174.
- Zahrok, S. (2009). Asesmen autentik dalam pembelajaran bahasa. *Jurnal Sosial Humaniora*, 2(2), 166–180.