

**FOUR-TIER DIAGNOSTIC TEST AS A TOOL TO ASSESS  
STUDENT MISCONCEPTIONS ABOUT THE HUMAN  
CIRCULATORY SYSTEM**

**RESEARCH PAPER**

Submitted as Requirement to Obtain Degree of *Sarjana Pendidikan* in  
International Program on Science Education (IPSE) Study Program



Arranged by:

Tesa Ihutmarito Ambarita

NIM 2004111

**INTERNATIONAL PROGRAM ON SCIENCE EDUCATION  
FACULTY OF MATHEMATICS AND SCIENCE EDUCATION  
UNIVERSITAS PENDIDIKAN INDONESIA**

**2024**

# **FOUR-TIER DIAGNOSTIC TEST AS A TOOL TO ASSESS STUDENT MISCONCEPTIONS ABOUT THE HUMAN CIRCULATORY SYSTEM**

Oleh

Tesa Ihutmarito Ambarita

Sebuah skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Pendidikan pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

© Tesa Ihutmarito Ambarita 2024

Universitas Pendidikan Indonesia

Juli 2024

Hak cipta dilindungi Undang-Undang

Skripsi ini tidak boleh diperbanyak seluruhnya atau sebagian, dengan cetak ulang, difotokopi, atau cara lainnya tanpa izin dari penulis

**APPROVAL SHEET**  
**FOUR-TIER DIAGNOSTIC TEST AS A TOOL TO ASSESS STUDENT**  
**MISCONCEPTIONS ABOUT THE HUMAN CIRCULATORY SYSTEM**

By:

Tesa Ihutmarito Ambarita

2004111

Approved:

Supervisor I



Dr. Lilit Rusyati, S.Pd., M.Pd.

NIP. 198704202012122001

Supervisor II



Marry Margaret Thomas, M.Sc. Ph.D.

Perceived by,

Head of Science Education Study Program



Prof. Dr. Ida Kaniawati, M.Si.

NIP. 196807031992032001

## DECLARATION

I hereby declare that what I wrote in my thesis **entitled FOUR-TIER DIAGNOSTIC TEST AS A TOOL TO ASSESS THE STUDENT MISCONCEPTIONS ABOUT THE HUMAN CIRCULATORY SYSTEM** is my work written independently. The use of quotations in this work has been written correctly based on all available sources. The research carried out in this thesis is original and has not been made available in any other form as a requirement for any degree, qualification or qualification. By signing this statement, I acknowledge that I have read and understand the ethical policies relating to research and have complied with relevant guidelines throughout the research process.

Bandung, July 20<sup>th</sup>, 2024

Declarant,



Tesa Ihutmarito Ambarita

2004111

## ACKNOWLEDGEMENTS

Praise and thanks are expressed to God Almighty, because of His blessing, the writing of this thesis can be completed. On this occasion, the author would like to express his deepest gratitude to:

1. Dr. Lilit Rusyati, S.Pd., M.Pd. and Marry Margaret Thomas, M.Sc., Ph.D., as the supervisor, who has been very patient and consistent in providing innovation, time, direction, guidance and enthusiasm from the beginning until the writing of this thesis was completed.
2. Prof. Dr. Ida Kaniawati, M.Si. as Head of the Science Education Study Program and Dr. Eka Cahya Prima, S.Pd., M.T. as Secretary of the Science Education Study Program. Thank you for providing the best encouragement and dedication.
3. All lecturers, assistants, and administrators of IPSE Program Study and UPI, especially Mrs. Diana, Mrs. Margi, Mrs. Lilit, Mrs. Eli, Mrs. Rika, Prof. Ari, Prof. Yayan, Mr. Eka, Mr. Ikmanda, Mr. Nanang, Mrs. Resik, Mr. Latief, and Mrs. Dhea, thank you very much for your love, help, dedication and support, and knowledge to the author while studying this study program.
4. Thank you to the people who were directly or indirectly involved, to Mr and Mrs who have allowed the author to gain, develop and apply the knowledge through KKN program, P3K and activities that the author cannot mention.
5. Thank you to the junior high school teachers and principals who have permitted, provided support, and taken the time for the author to conduct research at school. Also thank you for all the students who have been involved who gave their time, enthusiasm and best results during this research.
6. With great love, the author gives special thanks to her parents, beloved Mama, Werna Ritonga, and beloved Bapak, Karel A.H. Ambarita as the best teacher who always provides the best support, in the form of love, patience, support, attention and prayers that always flow to the author throughout the day. And thank you for siblings, Debora Dellaocto Melati Ambarita, who introduced this study program in the final moments of determining majors, Hana Febrina Ronauli Ambarita, and Maruahal Samuel Arief Pangihutan Ambarita. Thank

you for providing support, taking the time to listen to the writer's complaints, and even making sure the writer is always patient and enjoys the process.

7. Very deep thanks to Ayu Kamila Tiarani, who is always willing and patient to be a place for the author to share in any condition. Thank you for the support, prayers, suggestions and attention given in the midst of your busy life. Finally, I did it, right?
8. Thank you to all IPSE 2020, Adinda, Aina, Alnafa, Anidya, Assyifa, Denissa, Fitriyyatul, Ghevira, Irma, Jihan, Luthfiyah, Mediana, Muji, Nadira, Nindyra, Hanum, Nisrina, Pramudita, Rahma, Reihan Inezia, Rofi, Saila, Salma, Syifa, Winata, and Yusika, for their togetherness during the educational process, thank you for providing encouragement and support, as well as being part of the writer's life.
9. Thank you to the Assessment team, Anidya, Irma, Nindyra, Nisrina, Syifa, and Winata who have been part of the authors to tell stories, study thoughts, and provide innovation and support for the completion of this thesis.
10. Thank you to Bella, Devi, Natalia, Jesika, Gutri, and Yakob who took the time to listen to the author's complaints, in the midst of his super busy schedule, hahaha.
11. Thank you to all the IPSE batch who have been part of the author's life both academically, non-academically and organization. Thanks to you, because I have gained a lot of valuable knowledge and experience.
12. *Last but not least, I thank myself for being responsible, persistent and consistent in completing this writing, even though a lot of energy, tears and other things were sacrificed. Thank you for fighting, until finally the long-awaited "finally" arrived.*

## TABLE OF CONTENTS

<b>APPROVAL SHEET .....</b>	<b>ii</b>
<b>DECLARATION.....</b>	<b>iii</b>
<b>ACKNOWLEDGEMENTS.....</b>	<b>iv</b>
<b>TABLE OF CONTENTS.....</b>	<b>vi</b>
<b>LIST OF TABLES .....</b>	<b>viii</b>
<b>LIST OF FIGURES .....</b>	<b>ix</b>
<b>LIST OF APPENDICES .....</b>	<b>x</b>
<b>ABSTRACT .....</b>	<b>xi</b>
<b>CHAPTER I.....</b>	<b>1</b>
1.1 Research Background.....	1
1.2 Research Problem.....	5
1.3 Operational Definition.....	5
1.4 Limitation of Research .....	6
1.5 Research Objective .....	7
1.6 Research Benefit.....	7
1.7 Organizational Structure of Research Paper.....	8
<b>CHAPTER II.....</b>	<b>9</b>
2.1 Students' Understanding of Science.....	9
2.2 Student Misconceptions in Science .....	10
2.3 Four-Tier Diagnostic Test as the Assessment Tool.....	13
2.4 Content Analysis of Topic in Junior High School .....	17
<b>CHAPTER III .....</b>	<b>20</b>
3.1 Research Design .....	20
3.2 Participants .....	21
3.3 Research Instrument .....	21
3.3.1 Preliminary Study .....	23
3.3.2 Validation Test.....	25
3.3.3 Reliability Test.....	31
3.4 Research Procedure .....	32
3.5 Data Analysis .....	35
<b>CHAPTER IV.....</b>	<b>37</b>

4.1 Profile of Student Conceptions in Human Circulatory System.....	37
4.2 Student misconceptions on Human Circulatory Topics .....	44
<b>CHAPTER V .....</b>	<b>44</b>
5.1 Conclusion.....	62
5.2 Implications .....	63
5.3 Recommendations .....	63
<b>REFERENCES.....</b>	<b>64</b>
<b>APPENDICES .....</b>	<b>75</b>
APPENDIX – A .....	75
APPENDIX – B.....	96
APPENDIX – C.....	117
APPENDIX – D .....	121
<b>AUTOBIOGRAPHY .....</b>	<b>133</b>



## LIST OF TABLES

Table 2.1	The Structure of a Four-Tier Diagnostic Test.....	16
Table 2.2	Content Analysis of Topic in Junior High School .....	17
Table 3.1	The Distribution of Questions.....	21
Table 3.2	A Sample Question .....	22
Table 3.3	Preliminary Questions.....	23
Table 3.4	Aiken Test for Tier 1 Validation Result.....	26
Table 3.5	Aiken Test for Tier 3 Validation Result.....	27
Table 3.6	Result of Validity Test .....	29
Table 3.7	Reliability Test on Second Validity Test Result.....	31
Table 3.8	The Decisions of Four-Tier Test .....	35
Table 4.1	The Highest Percentage of Misconceptions about Heart ....	45
Table 4.2	The Highest Percentage of Misconceptions about Blood Vessels .....	47
Table 4.3	The Highest Percentage of Misconceptions in White Blood Cells .....	48
Table 4.4	The Highest Percentage of Misconceptions about Atherosclerosis and Heart Attacks .....	50
Table 4.5	The Highest Percentage of Misconceptions about Stroke ...	52
Table 4.6	The Highest Percentage of Misconceptions about Hypertension .....	53
Table 4.7	The Highest Percentage of Misconceptions about Maintaining a Healthy Circulatory System.....	55

## LIST OF FIGURES

Figure 1.1	Network Visualization of Students' Misconception .....	3
Figure 3.1	The Flowchart of the Research Procedure .....	34
Figure 4.1	The Overall Student Conceptions About Human Circulatory System .....	38
Figure 4.2	The Profile of Student Conceptions in Subtopic 1 .....	41
Figure 4.3	The Profile of Student Conceptions in Subtopic 2 .....	43
Figure 4.4	Student Misconception on Human Circulatory System .....	44

## LIST OF APPENDICES

Appendix A.1 Preliminary Study of Human Circulatory System.....	76
Appendix A.2 Four-Tier Diagnostic Test on Validity Test .....	84
Appendix A.3 Instrument Judgment Form .....	93
Appendix A.4 Distribution Significance Value 51-100.....	94
Appendix A.5 List of Student on Validity and Reliability on 2nd Test	94
Appendix A.6 Reliability Result of Test 1 and Test 2.....	94
Appendix A.7 Validity Test Result of Test 1 and Test.....	95
Appendix B.1 Percentage of Student Conceptions in Real Test.....	97
Appendix B.2 Documentation .....	115
Appendix B.3 Intervier Sessions with the Teacher.....	116
Appendix C.1 Permission Letter from Faculty .....	118
Appendix C.2 Completion Letter of Research from School.....	119
Appendix C.3 Proof of Journal Submission .....	120
Appendix D.1 Recapitulation of Students Answers of Test .....	122
Appendix D.2 Recapitulation of Student Conceptions Category .....	128

# **FOUR-TIER DIAGNOSTIC TEST AS THE TOOL TO ASSESS STUDENT MISCONCEPTIONS ABOUT THE HUMAN CIRCULATORY SYSTEM**

Tesa Ihutmarito Ambarita  
International Program on Science Education  
Universitas Pendidikan Indonesia  
tesa.ambarita@upi.edu

## **ABSTRACT**

Misconceptions continue to be an issue in the field of education, obstructing the accomplishment of learning objectives. The purpose of this study is to identify and explain issues that arise when students attempt to comprehend the circulatory system concept. A multiple-choice questionnaire based on the Four-Tier Diagnostic Test question model that have been validated serves as the instrument. Additionally, students have had the validity of the question instrument tested by distributing it and using the R-Table test to determine its validity is greater than the R-Count. Three experts delivered an average value of 0.73, which was then used in the Aiken's Test. The 28 questions on the second validity test administered to students, 24 questions were found to be valid and represent concepts related to the circulatory system that were utilized as research tools. The data is statistically collected using quantitative research techniques and a survey research design in order to test and characterize hypotheses. The study was carried out in a number of Bandung Regency state junior high schools. Students encounter each category of student understanding in each question item, according to the research's findings. According to this study, the majority of students had a weak grasp of the subject, which contributed to their lack of confidence. In addition, with a percentage of more than 25%, misconceptions among students rank second in terms of conceptual understanding. The proportion of scientific understanding, false positives, and false negatives, on the other hand, all fall between 10 and 15 percent.

**Keyword:** Four-Tier Diagnostic Test, Human Circulatory System, Misconception

# **TES DIAGNOSTIK EMPAT TINGKAT SEBAGAI ALAT UNTUK MENILAI MISKONSEPSI SISWA TENTANG SISTEM PEREDARAN DARAH**

Tesa Ihutmarito Ambarita  
International Program on Science Education  
Universitas Pendidikan Indonesia  
tesa.ambarita@upi.edu

## **ABSTRAK**

Miskonsepsi terus menjadi permasalahan dalam bidang pendidikan sehingga menghambat tercapainya tujuan pembelajaran. Tujuan penelitian ini adalah untuk mengidentifikasi dan menjelaskan permasalahan yang muncul ketika siswa mencoba memahami konsep sistem peredaran darah. Instrumen yang digunakan berupa angket pilihan ganda berdasarkan model soal Four-Tier Diagnostic Test yang telah divalidasi. Selain itu siswa juga telah menguji validitas instrumen soalnya dengan cara menyebarkannya dan menggunakan uji R-Tabel untuk mengetahui apakah validitasnya lebih besar dari R-Hitung. Tiga orang ahli memberikan nilai rata-rata sebesar 0.73 yang kemudian digunakan dalam Tes Aiken. Dari 28 soal uji validitas kedua yang diberikan kepada siswa, 24 soal valid dan mewakili konsep-konsep terkait sistem peredaran darah yang digunakan sebagai alat penelitian. Data dikumpulkan secara statistik dengan menggunakan teknik penelitian kuantitatif dan desain penelitian survei untuk menguji dan mengkarakterisasi hipotesis. Penelitian dilakukan di sejumlah Sekolah Menengah Pertama Negeri di Kabupaten Bandung. Ditemukan setiap kategori pemahaman siswa pada setiap item pertanyaan, sesuai dengan temuan penelitian. Berdasarkan penelitian ini, sebagian besar siswa memiliki pemahaman yang lemah terhadap mata pelajaran sehingga menyebabkan mereka kurang percaya diri. Selain itu, dengan persentase lebih dari 25%, miskonsepsi siswa menduduki peringkat kedua dalam hal pemahaman konsep. Sebaliknya, proporsi wawasan ilmiah, hasil positif palsu, dan negatif palsu semuanya turun antara 10 dan 15 persen.

**Keyword:** Miskonsepsi, Sistem Peredaran Darah Manusia, Tes Diagnostik Empat Tingkat

## REFERENCES

- Ahyar, H., Maret, U. S., Andriani, H., Sukmana, D. J., Mada, U. G., Hardani, S.Pd., M. S., Nur Hikmatul Auliya, G. C. B., Helmina Andriani, M. S., Fardani, R. A., Ustiawaty, J., Utami, E. F., Sukmana, D. J., & Istiqomah, R. R. (2020). *Buku Metode Penelitian Kualitatif & Kuantitatif* (Issue March).
- Aiken, L. R. (1980). Content validity and reliability of single items or questionnaires. *Educational and Psychological Measurement*, *40*(4), 955–959. <https://doi.org/10.1177/001316448004000419>
- Alifa, T. F., & Ramalis, T. R. (2018). Karakteristik Tes Penalaran Ilmiah Siswa SMA Berdasarkan Analisis Tes Teori Respon Butir. *Jurnal Inovasi Dan Pembelajaran Fisika*, *5*(1), 80–89. 10.36706/jipf.v5i1.5774
- Ardhi, S. (2022). Pengembangan Alat Peraga Sistem Peredaran Darah Manusia dari Barang Bekas pada Pembelajaran IPA Siswa Sekolah Dasar. *Empiricism Journal*, *3*(2), 399–405. <https://doi.org/10.36312/ej.v3i2.1167>
- Astuti, C. C. (2017). Analisis Korelasi untuk Mengetahui Keeratan Hubungan antara Keaktifan Mahasiswa dengan Hasil Belajar Akhir. *JICTE (Journal of Information and Computer Technology Education)*, *1*(1), 1. <https://doi.org/10.21070/jicte.v1i1.1185>
- Azizah, N. S. R., Nurhayati, B., & Suryani, A. I. (2023). Pengaruh Penggunaan Berbagai Media Pembelajaran Pada Materi Jamur Terhadap Hasil Belajar Siswa . The Influence of Using Various Learning Media on the Topic of Fungi on Learning Outcomes . *Inovasi Sains Dan Pembelajarannya: Tantangan Dan Peluang*, *X*, 337–344.
- Bahriah, E. S., Dewi, L. U., & Irwandi, D. (2021). Pengaruh Media Penilaian Formatif Online Quizizz Terhadap Hasil Belajar Siswa Materi Sistem Periodik Unsur. *JRPK: Jurnal Riset Pendidikan Kimia*, *11*(1), 19–26. <https://doi.org/10.21009/jrpk.111.04>
- Belotto, M. J. (2018). Data analysis methods for qualitative research: Managing the challenges of coding, interrater reliability, and thematic analysis. *Qualitative Report*, *23*(11), 2622–2633. <https://doi.org/10.46743/2160-3715/2018.3492>
- Boccio, D., Kolack, K., & Tawde, M. (2016). Resolving Misconceptions Through Student Reflections. *EDULEARN16 Proceedings*, *1*, 3223–3228. <https://doi.org/10.21125/edulearn.2016.1701>
- Caleon, I. S., & Subramaniam, R. (2010). Do students know What they know and what they don't know? Using a four-tier diagnostic test to assess the nature of students' alternative conceptions. *Research in Science Education*, *40*(3), 313–337. <https://doi.org/10.1007/s11165-009-9122-4>
- Celhay, P., Meyer, B. D., & Mittag, N. (2024). What leads to measurement errors? Evidence from reports of program participation in three surveys. *Journal of Econometrics*, *238*(2), 105581.

<https://doi.org/10.1016/j.jeconom.2023.105581>

- Cherly Ana Safira, Agung Setyawan, & Tyasmiarni Citrawati. (2020). Identifikasi Permasalahan Pembelajaran IPA Pada Siswa Kelas III SDN Buluh 3 Socah. *Jurnal Pendidikan Mipa*, 10(1), 23–29. <https://doi.org/10.37630/jpm.v10i1.277>
- Creswell, J. W. (2012). *Educational Research: Planning, Conducting, and Evaluating Quantitative and Qualitative Research* (M. Christina Robb; Buchholtz (ed.); 4th ed.). Pearson Education Inc.
- Cristanto, M., Saptiningsih, M., & Indriarini, M. Y. (2021). Hubungan Aktivitas Fisik Dengan Pencegahan Hipertensi Pada Usia Dewasa Muda: Literature Review. *Jurnal Sahabat Keperawatan*, 3(01), 53–65. <https://doi.org/10.32938/jsk.v3i01.937>
- Dachi, R., & Sarumaha, R. (2021). Persamaan Linear Dua Variabel Kelas VIII Di Desa Idala Jaya Hilisimaetano Tahun Pelajaran 2020/2021. *Journal Education and Development*, 9(3), 589–594. <https://doi.org/https://doi.org/10.37081/ed.v9i3>
- Dangremond Stanton, J., Sebesta, A. J., & Dunlosky, J. (2021). Feature: Evidence-Based Teaching Guide to Four Strategies to Foster Student Metacognition STUDENT METACOGNITION: FOUR STRATEGIES TO IMPLEMENT IN ANY COURSE. *CBE—Life Sciences Education*, 20(2). <https://lse.ascb.org/evidence-based-teaching-guides/student-metacognition/>.
- Dewi, C. R., Abdullah, & Safrida. (2017). Analisis Miskonsepsi Peserta Didik Pada Materi Sistem Peredaran Darah Di Sman 5 Kota Banda Aceh. *Jurnal EduBio Tropika*, 5(1), 17–20.
- Doody, O., & Doody, C. M. (2015). Conducting a pilot study: Case study of a novice researcher. *British Journal of Nursing*, 24(21), 1074–1078. <https://doi.org/10.12968/bjon.2015.24.21.1074>
- Dores ,S.Pd., M.Pd, O. J., Wibowo, D. C., & Susanti, S. (2020). Analisis Kemampuan Berpikir Kritis Siswa Pada Mata Pelajaran Matematika. *J-PiMat : Jurnal Pendidikan Matematika*, 2(2), 242–254. <https://doi.org/10.31932/j-pimat.v2i2.889>
- Ekapti, R. F., & Ahied, M. (2016). Konsepsi Siswa Smp Dalam Pembelajaran Ipa Terpadu Tipe. *Senimar Nasional Pendidikan Sains (SNPS)*, 1(1), 147–154.
- Erizon, E., & Karani, Y. (2020). Hdl Dan Aterosklerosis. *Human Care Journal*, 5(4), 1123. <https://doi.org/10.32883/hcj.v5i4.851>
- Esomonu, N. P.-M., & Eleje, L. I. (2020). Effect of Diagnostic Testing on Students' Achievement in Secondary School Quantitative Economics. *World Journal of Education*, 10(3), 178. <https://doi.org/10.5430/wje.v10n3p178>
- Fadillah, M. A., & Murniawati, N. (2023). Gambaran Kadar Kolesterol Total pada Penikmat Kopi Susu Usia 20-50 Tahun di RT.002 RW.003 Desa Sirnagalih Kota Tangerang. *Journal of Medical Laboratory Research*, 1(2), 55–62.

<https://doi.org/https://doi.org/10.36743/jomlr.v1i2>

- Fajaruddin, S., Retnawati, H., Wijaya, T. T., Ramadhan, S., & Prihatni, Y. (2021). Alhamdulillah, butir pengembangan instrumen penilaian artikel jurnal ilmiah dikatakan valid oleh para rater. *Measurement In Educational Research (Meter)*, 1(2), 89. <https://doi.org/10.33292/meter.v1i2.156>
- Fakhriyah, F., & Masfuah, S. (2021). The Development of a Four Tier-Based Diagnostic Test Diagnostic Assessment on Science Concept Course. *Journal of Physics: Conference Series*, 1842(1), 0–8. <https://doi.org/10.1088/1742-6596/1842/1/012069>
- Fraenkel, J. R., Wallen, N. E., & Hyun, H. H. (2011). How to Design and Evaluate Research in Education. In B. Mejia, V. Malinee, V. Brien, & S. Kiefer (Eds.), *McGraw-Hill* (8th ed.). McGraw-Hill Companies, Inc.
- Golzar, J., & Noor, S. (2022). *Defining Convenience Sampling in a Scientific Research*. 1(November), 72–77.
- Gribbin, J., & Gribbin, M. (2022). Coda: How to do Science. *Out of the Shadow of a Giant*, 283–285. <https://doi.org/10.12987/9780300231540-015>
- Halim, A. S., Finkenstaedt-Quinn, S. A., Olsen, L. J., Gere, A. R., & Shultz, G. V. (2018). Identifying and remediating student misconceptions in introductory biology via writing-to-learn assignments and peer review. *CBE Life Sciences Education*, 17(2), 1–12. <https://doi.org/10.1187/cbe.17-10-0212>
- Hamzah, H., & Alfiat, D. (2020). Penerapan Metode Ceramah Dengan Media Audio Visual Untuk Meningkatkan Minat Belajar Pendidikan Agama Islam. *JKIP: Jurnal Kajian Ilmu Pendidikan*, 1(1), 42–50. <https://doi.org/10.55583/jkip.v1i1.75>
- Handayani, S. (2021). *Anatomi dan Fisiologi Manusia* (R. R. Rerung (ed.)). CV. MEDIA SAINS INDONESIA. <http://repository.stikes-yogyakarta.ac.id/id/eprint/24>
- Handoko, S. B. S. K. (2022). Konsep Pengembangan Sumber Belajar Suryawan. *Jurnal Pendidikan Dan Konseling*, 4(6), 11275–11286.
- Hanipah, A. D., Amalia, T. N., & Setiabudi, D. I. (2022). Urgensi Lingkungan Belajar yang Kondusif dalam Mendorong Siswa Belajar Aktif. *Jurnal Sosial Humaniora Dan Pendidikan*, 2(1), 41–51. <https://doi.org/https://doi.org/10.51903/education.v2i1>
- Hansson, I., Buratti, S., & Allwood, C. M. (2017). Experts' and novices' perception of ignorance and knowledge in different research disciplines and its relation to belief in certainty of knowledge. *Frontiers in Psychology*, 8(MAR), 1–14. <https://doi.org/10.3389/fpsyg.2017.00377>
- Hera, R., & Rita Oktavia. (2023). Miskonsepsi Materi Ilmu Pengetahuan Alam Pada Mahasiswa Calon Guru Di Sekolah Dasar. *Jurnal Bionatural*, 10(2). <https://doi.org/10.61290/bio.v10i2.616>
- Herwina, W. (2021). Optimalisasi Kebutuhan Murid Dan Hasil Belajar Dengan



- Pembelajaran Berdiferensiasi. *Perspektif Ilmu Pendidikan*, 35(2), 175–182. <https://doi.org/10.21009/pip.352.10>
- Hux, K., Rogers, T., & Mongar, K. (2000). Common Perceptions about Strokes. *Entomologia Experimentalis et Applicata*, 25(47–65), 239–248. <https://doi.org/http://dx.doi.org/10.1023/A:1005140918066>
- Intan Arovah, N. (2015). Penegakan Diagnosis Penyakit Jantung Koroner Dengan Prosedur Uji Latih Jantung. *Medikora*, 1, 23–35. <https://doi.org/10.21831/medikora.v0i1.4703>
- Izza, M., Sukamti, S., & Winahyu, S. E. (2021). Analisis Miskonsepsi Materi Sistem Peredaran Darah Manusia Tema 4 pada Siswa Kelas V SD. *Jurnal Pembelajaran, Bimbingan, Dan Pengelolaan Pendidikan*, 1(8), 660–664. <https://doi.org/10.17977/um065v1i82021p660-664>
- Julianda, R., Saminan, & Halim, A. (2022). Analisis Miskonsepsi Siswa dengan Two Tier Diagnostic Test pada Materi Gerak Lurus di SMA Negeri 3 Banda Aceh. *Journal of Technology and Literacy in Education*, 1(1), 14–20.
- Julianto, O. P. R. dan. (2019). Penggunaan Media Torso untuk Meningkatkan Hasil Belajar Siswa di Sekolah Dasar. *Jpgsd*, 2(2), 3.
- Jumrodah, A'in, L. N., & Firanti, T. (2024). Analysis of Student Learning Outcomes on Biology of The Blood Circulation System in Senior High School. *Islamic Journal of Integrated Science Education (IJISE)*, 3(1), 37–45. <https://doi.org/10.30762/ijise.v3i1.2652>
- Kasiara, S., Kosmidou, N., Manika, K., & Akrivos, P. (2019). Personal Factors Influencing the Understanding of Scientific Text. *Educational Alternatives Journal of Scientific Publications*, 17, 26–33.
- Kemendikbud. (2019). Model penilaian formatif. *Pusat Penilaian Pendidikan*, 64. <https://pusmenjar.kemdikbud.go.id/wp-content/uploads/puspendik-public/MODEL PENILAIAN FORMATIF 2019.pdf>
- Kendek, I. (2023). Study Literatur: Pengaruh Implementasi Media Pembelajaran Berbasis Komik Pada Mata Pelajaran Kimia. *Arfak Chem: Chemistry Education Journal*, 6(1), 495–502. <https://doi.org/10.30862/accej.v6i1.440>
- Kesmodel, U. S. (2018). Cross-sectional studies – what are they good for? *Acta Obstetricia et Gynecologica Scandinavica*, 97(4), 388–393. <https://doi.org/10.1111/aogs.13331>
- Khairaty, N. I., Taiyeb, A. M., & Hartati. (2018). Identifikasi Miskonsepsi Siswa pada Materi Sistem Peredaran Darah dengan Menggunakan Three-Tier Test di Kelas XI IPA 1 SMA Negeri 1 Bontonompo. *Jurnal Nalar Pendidikan*, 6(1), 7–13. <https://doi.org/https://dx.doi.org/10.26858/jnp.v6i1.6037>
- Khan, S., Shiraz, M., Shah, G., & Muzamil, M. (2023). Understanding the factors contributing to low enrollment of science students in undergraduate programs. *Cogent Education*, 10(2). <https://doi.org/10.1080/2331186X.2023.2277032>
- Kiray, S.A., Simsek, S. (2021). *four-tier diagnostic test.pdf* (pp. pages935–955).

- International Journal of Science and Mathematics Education.  
<https://doi.org/https://doi.org/10.1007/s10763-020-10087-5>
- Kleruk, I. D., Muriati, S., & Jamaluddin, J. (2021). Peningkatan Hasil Belajar Ipa Melalui Media Barang Bekas Pada Siswa Kelas Iv Sd Inpres Lanraki 1 Kota Makassar. *Jurnal IPA Terpadu*, 5(1), 85–95.  
<https://doi.org/10.35580/ipaterpadu.v5i1.23922>
- Kurniasih, M. D. (2017). Analisis Miskonsepsi Mahasiswa dengan Menggunakan Certainty of Response Index (CRI) Pada Materi Anatomi Tubuh Manusia. *Edu Sains: Jurnal Pendidikan Sains & Matematika*, 5(1), 1.  
<https://doi.org/10.23971/eds.v5i1.650>
- Laksono, H. Y. (n.d.). *Congestive Heart Failure (CHF)*.
- Larasuci, N. M. D. K. (2018). *PENGARUH PERBEDAAN WAKTU PEMERIKSAAN TERHADAP KADAR GLUKOSA DARAH* [Poltekkes Denpasar]. <https://doi.org/https://doi.org/10.26618/jrpd.v3i2.4078>
- Latifah, U. L. N., Wakhyudin, H., & Cahyadi, F. (2020). Miskonsepsi Penyelesaian Soal Cerita Matematika Materi FPB dan KPK Sekolah Dasar. *Jurnal Riset Pendidikan Dasar*, 3(2), 181–195.  
<https://doi.org/https://doi.org/10.26618/jrpd.v3i2.4078>
- Lestari, S. H. (2021). *Buku Panduan Guru IPA Kemendiknud*.
- Lubis, M. S. (2021). Belajar dan Mengajar Sebagai Suatu Proses Pendidikan yang Berkemajuan. *JURNAL LITERASIOLOGI*, 5(2), 95–105.  
<https://doi.org/https://doi.org/10.47783/literasiologi.v5i2.222>
- Mackean, D. ., & Hayward, D. (2014). Cambridge IGCSE: BIology. In *Cambridge IGCSE: Biology Third Edition*.
- Markhamah, N. (2021). Pengembangan Soal Berbasis HOTS (Higher Order Thinking Skills) pada Kurikulum 2013. *Nusantara: Jurnal Pendidikan Indonesia*, 1(2), 385–418. <https://doi.org/10.14421/njpi.2021.v1i2-8>
- Maryana, O. T. F., Inabuy, V., Sutia, C., Hardanie, B. D., & Lestari, S. H. (2021). *Pengetahuan Alam* (Tansah & Nurdiansyah (eds.)). Pusat Perbukuan Badan Standar, Kurikulum, dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, dan Teknolog.
- Maulana, Y., Sopandi, W., Rosmiati, I., & Agustina, N. S. (2023). Analysis of Prior Knowledge Elementary School Students Using Three-Tier Diagnostic Test to Identify Blood Circular System Misconceptions. *Edu Sains Jurnal Pendidikan Sains Dan Matematika*, 11(1), 55–69.  
<https://doi.org/https://doi.org/10.23971/eds.v11i1>
- Muzaffar, A. (2016). Validitas Tes dan Kualitas Butir. *Lisanuna, Jurnal Bahasa Arab Dan Pembelajarannya*, 5(1), 128–143.  
<https://doi.org/http://dx.doi.org/10.22373/l.v5i1.859>
- Muzakki, N. A., Diana, S., & Priyandoko, D. (2023). Misconception Analysis of Cell Material Using Four-Tier Multiple Choice Diagnostic Test. *Quagga:*

*Jurnal Pendidikan Dan Biologi*, 15(2), 120–130.  
<https://doi.org/10.25134/quagga.v15i2.32>

- Myanda, A. A., Riezky, M. P., & Maridi, M. (2020). Development of Two-Tier Multiple-Choice Test to Assess Students' Conceptual Understanding on Respiratory System Material of 11th Grade of Senior High School. *International Journal of Science and Applied Science: Conference Series*, 4(1), 44. <https://doi.org/10.20961/ijscascs.v4i1.49457>
- Nainggolan, L. (2017). Identifikasi Faktor Penyebab Miskonsepsi pada Topik Sistem Peredaran Darah Manusia di Kelas IX SMP Nurul Fadhillah Medan. *Prosiding Seminar Nasional III Biologi Dan Pembelajarannya, September*, 530–537.
- Nandiyanto, A. B. D., Ragadhita, R., Al Husaeni, D. N., & Nugraha, W. C. (2023). Research trend on the use of mercury in gold mining: Literature review and bibliometric analysis. *Moroccan Journal of Chemistry*, 11(1), 1–19. <https://doi.org/10.48317/IMIST.PRSM/morjchem-v%vi%i.36576>
- Nasyidiah, F. I., Siahaan, P., & Sasmita, D. (2020). Pengembangan Instrumen Four-Tier Diagnostic Test Untuk Mendeteksi Miskonsepsi Siswa Kelas X Pada Materi Impuls. *WaPFI (Wahana Pendidikan Fisika)*, 5(2), 31–40. <https://doi.org/10.17509/wapfi.v5i2.27156>
- Ningrum, K. D., Utomo, E., Marini, A., & Setiawan, B. (2022). Media Komik Elektronik Terintegrasi Augmented Reality dalam Pembelajaran Sistem Peredaran Darah Manusia di Sekolah Dasar. *Jurnal Basicedu*, 6(1), 1297–1310. <https://doi.org/10.31004/basicedu.v6i1.2289>
- Nisa'i, S. H., Syofyan, H., Hotimah, U., & Nurhayati, R. (2022). Penggunaan Metode Ceramah dalam Pembelajaran IPA di Kelas Rendah dan Tinggi. *Prosiding Esa Unggul*, 5(9), 258–261. <https://prosiding.esaunggul.ac.id/index.php/snip/issue/view/12>
- Noprianti, E., & Utami, L. (2017). Penggunaan Two-Tier Multiple Choice Diagnostic Test Disertai Cri Untuk Menganalisis Miskonsepsi Siswa. *JTK (Jurnal Tadris Kimiya)*, 2(2), 124–129. <https://doi.org/10.15575/jtk.v2i2.1876>
- Nurfitriah, A. S. R. (2023). Development of the Human Circulatory System Module to Support Junior High School Students' Independent Learning. *Islamic Journal of Integrated Science Education (IJISE)*, 2(1), 30–45. <https://doi.org/10.30762/ijise.v2i1.962>
- Nurhaeni, A., Aimatun Nisa, N., & Marisa, D. E. (2022). Hubungan Merokok Dengan Kejadian Hipertensi. *Jurnal Kesehatan Mahardika*, 9(2), 46–51. <https://doi.org/https://doi.org/10.54867/jkm.v9i2>
- Nurlita, S. (2022). Pengembangan Four-Tier Diagnostic Test Berbasis Keterampilan Proses Sains untuk Mengidentifikasi Miskonsepsi pada Materi Redoks. *Journal of Natural Science Learning*, 02(02), 90–103. <https://eprints.walisongo.ac.id/id/eprint/18659>
- Nurlitasari, A., & Hamami, T. (2023). Assessment as, for, of learning pembelajaran

- pendidikan agama Islam tingkat menengah atas. *Humanika*, 23(2), 225–234. <https://doi.org/10.21831/hum.v23i2.61406>
- Ole, A. A., & Dipan, E. G. (2023). Hubungan kondisi lingkungan belajar di sekolah dan hasil belajar siswa. *Jurnal Inovasi Pembelajaran Matematika: PowerMathEdu*, 2(1), 71–78. <https://doi.org/10.31980/powermathedu.v2i1.2434>
- Pandey, S. (2023). Lack of Knowledge in the Modern World: A Descriptive Analysis. *SSRN Electronic Journal*, August 2021, 0–2. <https://doi.org/10.2139/ssrn.4590416>
- Pelaez, N. J., Boyd, D. D., Rojas, J. B., & Hoover, M. A. (2005). Prevalence of blood circulation misconceptions among prospective elementary teachers. *American Journal of Physiology - Advances in Physiology Education*, 29(3), 172–181. <https://doi.org/10.1152/advan.00022.2004>
- Perdana, G. P. (2017). Pengetahuan Awal Dan Tingkat Keyakinan Siswa Tentang Konsep Listrik Dinamis. *Jurnal Ilmiah Pendidikan Dan Pembelajaran*, 1(2), 143–152. <https://doi.org/https://doi.org/10.23887/jipp.v1i2>
- Pickett, S. B., Nielson, C., Marshall, H., Tanner, K. D., & Coley, J. D. (2022). Effects of Reading Interventions on Student Understanding of and Misconceptions about Antibiotic Resistance. *Journal of Microbiology & Biology Education*, 23(1). <https://doi.org/10.1128/jmbe.00220-21>
- Prastika, Y. D. (2020). Pengaruh Minat Belajar Siswa Terhadap Hasil Belajar Matematika Siswa Smk Yadika Bandar Lampung. *Jurnal Ilmiah Matematika Realistik*, 1(2), 17–22. <https://doi.org/10.33365/ji-mr.v1i2.519>
- Pratiwi, A. N., Erlina, E., Lestari, I., Masriani, M., & Rasmawan, R. (2023). Identification of Students' Misconceptions Using a Four-Tier Multiple Choice Diagnostic Test on Colligative Properties of Solutions. *Jurnal Penelitian Pendidikan IPA*, 9(11), 10033–10042. <https://doi.org/10.29303/jppipa.v9i11.4018>
- Putica, K. B. (2023). Development and Validation of a Four-Tier Test for the Assessment of Secondary School Students' Conceptual Understanding of Amino Acids, Proteins, and Enzymes. *Research in Science Education*, 53(3), 651–668. <https://doi.org/10.1007/s11165-022-10075-5>
- Putri, R. S., Wigati, I., & Laksono, P. J. (2022). Faktor-Faktor yang Mempengaruhi Miskonsepsi Siswa pada Materi Asam dan Basa. *Prosiding Seminar Nasional Pendidikan Kimia 2022*, 1(1), 280–286. <https://proceedings.radenfatah.ac.id/index.php/snpk/article/view/80>
- Rahmiati Darwis, & Muhammad Rizal Hardiansyah. (2022). Analisis Miskonsepsi Calon Guru IPA Terpadu pada Materi Pemanasan Global Menggunakan Certainty of Response Index. *Jurnal Pendidikan Mipa*, 12(4), 1023–1030. <https://doi.org/10.37630/jpm.v12i4.732>
- Ramatni, A., Anjely, F., Cahyono, D., Rambe, S., & Shobri, M. (2023). Proses Pembelajaran dan Asesmen yang Efektif. *Journal on Education*, 5(4), 15729–

15743. <https://doi.org/doi.org/10.31004/joe.v5i4.2687>

- Rasul, A., Subhanudin, Hilal, N., & Sonda, R. (2023). Analisis Materi Sulit Dipahami Dan Miskonsepsi Mahasiswa Program Studi Pendidikan Matematika STKIP Hermon Timika Dalam Mata Kuliah Kalkulus Pada Materi Integral. *Jurnal Pendidikan Dewantara*, *1*(2), 35–42. <https://jurnal.yagasi.or.id/index.php/http://dx.doi.org/10./dewantara.v0i0.35-42>
- Reece, Jane B., Urry, Lisa A., Cain, Michael L., Wasserman, Steven A., Minorsky, Peter V., Jackson, R. B. (2011). *Campbell Biology 9th Edition.pdf* (B. Wilbur (ed.); 9th ed.). Benjamin Cummings/Pearson.
- Ridwan, R. S., Al-Aqsha, I., & Rahmadini, G. (2020). Pemanfaatan Media Pembelajaran Berbasis Video dalam Penyampaian Konten Pembelajaran. *Inovasi Kurikulum*, *18*(1), 38–53. <https://doi.org/10.17509/jik.v18i1.37653>
- Riyani, R., Maizora, S., & Hanifah, H. (2017). Uji Validitas Pengembangan Tes Untuk Mengukur Kemampuan Pemahaman Relasional Pada Materi Persamaan Kuadrat Siswa Kelas Viii Smp. *Jurnal Penelitian Pembelajaran Matematika Sekolah (JP2MS)*, *1*(1), 60–65. <https://doi.org/10.33369/jp2ms.1.1.60-65>
- Rohmadhani, I. A. N., Susilo, H., & Lestari, U. (2021). Identification misconceptions using Movement and Circulatory System Diagnostic Test (MCSD-Test) in XI class SMA/MA in East Java. *Journal of Physics: Conference Series*, *1918*(5). <https://doi.org/10.1088/1742-6596/1918/5/052082>
- Rohmah, M., Priyono, S., & Septika Sari, R. (2023). Analisis Faktor-Faktor Penyebab Miskonsepsi Peserta Didik Sma. *UTILITY: Jurnal Ilmiah Pendidikan Dan Ekonomi*, *7*(01), 39–47. <https://doi.org/10.30599/utility.v7i01.2165>
- Rohmah, S. A. (2024). ANALISIS PROFIL MISKONSEPSI MENGGUNAKAN TEKNIK CERTAINTY OF RESPONSE INDEX ( CRI ) PADA MATERI SISTEM PEREDARAN DARAH KELAS XI SMA Misconception Profile Analysis Using the Certainty of Response Index ( CRI ) Technique in Class XI High School Circulatory S. *BioEdu: Berkala Ilmiah Pendidikan Biologi*, *13*(2), 524–532. <https://doi.org/https://doi.org/10.26740/bioedu.v13n2>
- Rosamsi, S., Miarsyah, M., & Ristanto, R. H. (2019). Interactive Multimedia Effectiveness in Improving Cell Concept Mastery. *Journal of Biology Education*, *8*(1), 56–61. <https://doi.org/10.15294/jbe.v8i1.28154>
- Rusilowati, A. (2015). Pengembangan Tes Diagnostik Sebagai Alat Evaluasi Kesulitan Belajar Fisika. *Prosiding Seminar Nasional Fisika Dan Pendidikan Fisika*, *6*(1), 1–10.
- Safitri, S., Muharrami, L. K., Hadi, W. P., & Wulandari, A. Y. R. (2021). Faktor Penting Dalam Pemahaman Konsep Siswa Smp: Two-Tier Test Analysis. *Natural Science Education Research*, *4*(1), 45–55.

<https://doi.org/10.21107/nser.v4i1.8150>

- Sanaky, M. M. (2021). Analisis Faktor-Faktor Keterlambatan Pada Proyek Pembangunan Gedung Asrama Man 1 Tulehu Maluku Tengah. *Jurnal Simetrik*, 11(1), 432–439. <https://doi.org/10.31959/js.v11i1.615>
- Sari, I. P., Mustikasari, V. R., & Pratiwi, N. (2019). Pengintegrasian penilaian formatif dalam pembelajaran IPA berbasis saintifik terhadap pemahaman konsep peserta didik. *JIPVA (Jurnal Pendidikan IPA Veteran)*, 3(1), 52. <https://doi.org/10.31331/jipva.v3i1.778>
- Sasmita, I., Waluyati, I., & Syaifullah. (2022). Pengaruh Penggunaan Media Pembelajaran Terhadap Tingkat Pemahaman Peserta Didik Pada Pembelajaran IPS Di SMPN 6 Woja. *Jurnal Pendidikan Sosiologi*, 5(2), 1–10. <https://doi.org/https://doi.org/10.33627/es.v5i2>
- Setiawan et al. (2021). Diagnosis Dan Tatalaksana Stroke Hemoragik. *Jurnal Medika Hutama*, 02(01), 402–406. <https://www.jurnalmedikahutama.com/index.php/JMH/article/view/336%0A>
- Setiyawan, A. (2014). Faktor- faktor yang Mempengaruhi Reliabilitas Tes. *Jurnal An Nûr*, VI(2), 341–354.
- Slamet, R., & Wahyuningsih, S. (2022). Validitas Dan Reliabilitas Terhadap Instrumen Kepuasan Ker. *Aliansi : Jurnal Manajemen Dan Bisnis*, 17(2), 51–58. <https://doi.org/10.46975/aliansi.v17i2.428>
- Soeharto, Csapó, B., Sarimanah, E., Dewi, F. I., & Sabri, T. (2019). A review of students' common misconceptions in science and their diagnostic assessment tools. *Jurnal Pendidikan IPA Indonesia*, 8(2), 247–266. <https://doi.org/10.15294/jpii.v8i2.18649>
- Songsirisak, P., & Jitpranee, J. (2019). Impact of Homework Assignment on Students' Learning. *Journal of Education Naresuan University*, 21(2), 1–19. [https://so06.tci-thaijo.org/index.php/edujournal\\_nu/article/view/117542](https://so06.tci-thaijo.org/index.php/edujournal_nu/article/view/117542)
- Suendarti, M. (2020). Pemahaman Konsep Ilmu Pengetahuan Alam Ditinjau dari Motivasi Belajar Siswa. *Prosiding Seminar Nasional Sains*, 1(1), 273–277. <https://proceeding.unindra.ac.id/index.php/sinasis/issue/view/22>
- Susetyadi, A. D., Permanasari, A., & Riandi, R. (2019). *Analyzing Concept For Developing STEM-Based Integrated Science Teaching Materials Themed "Blood"*. 303, 11–14. <https://doi.org/10.2991/icpeopleunnes-18.2019.3>
- Susi Susilawati. (2022). PEMAHAMAN KONSEP IPA DITINJAU DARI KONSEP DIRI DAN KEMANDIRIAN BELAJAR SISWA. *Jurnal Pendidikan Indonesia (Japendi)*, 3(1), 64–85. <https://doi.org/https://doi.org/10.59141/japendi.v3i01>
- Sutrisno, N. A., & Suprijono, A. (2022). Penggunaan Metode CRI (Certainty of Response Index) untuk Mengidentifikasi Pemahaman Siswa Terhadap Materi Kerajaan Hindu-Budha dan Islam di Indonesia Kelas XI IPS 2 SMA Negeri 21 Surabaya. *Journal Pendidikan Sejarah*, 12(3), 110.

<https://ejournal.unesa.ac.id/index.php/avatara/article/view/48127>

- Syafri;Ratnawulan;Putra, A. A. (2019). PENGARUH BUKU TEKS IPA TERPADU DALAM PENDEKATAN SAINTIFIK TERHADAP HASIL BELAJAR SISWA KELAS VIII SMPN 13 PADANG Mahasiswa Pendidikan Fisika , FMIPA Universitas Negeri Padang Staf Pengajar Jurusan Fisika , FMIPA Universitas Negeri Padang. *Pillar of Physics Education*, 12(2), 201–208.
- Syarafina, Mustofa, Zainul, D., & Prayitno, T. A. (2020). Penerapan Soal Four Tier untuk Mengidentifikasi Miskonsepsi Siswa pada Materi Aktivitas Jantung dan Pembuluh Darah. *Jurnal Biologi Dan Pendidikan Biologi*, 5(1), 6–13.
- Syarafina, S., & Zainul Mustofa. (2020). Application of a Four-Tier Diagnosis Test for Evaluating Student’s Misconception about Blood Classification. *Bioeduscience*, 4(2), 195–202. <https://doi.org/10.22236/j.bes/424931>
- Tarihoran, N. M., & Cendana, W. (2020). Upaya Guru dalam Adaptasi Manajemen Kelas untuk Efektivitas Pembelajaran Daring. *Jurnal Perseda*, III(3), 134–140. <https://doi.org/http://dx.doi.org/10.37150/perseda.v3i3>
- Telaumbanua, A. C., & Rahayu, Y. (2021). Penyuluhan Dan Edukasi Tentang Penyakit Hipertensi. *Jurnal Abdimas Saintika*, 3(1), 119. <https://doi.org/10.30633/jas.v3i1.1069>
- Tüysüz, C. (2009). Development of Two-Tier Diagnostic Instrument and Assess Students’ Understanding in Chemistry. *Scientific Research and Essays*, 4(6), 626–631.
- Ulfa, S., Sulistyorini, & Dewi, N. R. (2023). Peningkatan Pemahaman Konsep Ipa Melalui Model Pembelajaran Problem Based Learning Berbantuan Media Diorama Kelas Vii Smp Negeri 19 Semarang. *Seminar Nasional IPA XIII*, 312–327. <https://proceeding.unnes.ac.id/index.php/snipa/article/view/2313>.
- Umami, R. (2022). Difficulties In Understanding The Science Learning Material as Related to Educational Psychology. *Psikologia : Jurnal Psikologi*, 6(1), 13–22. <https://doi.org/10.21070/psikologia.v6i1.1119>
- Utama, O. pandu adi. (2020). Pembuatan Alat Peraga 3 Dimensi Media Pembelajaran Biologi Dalam Materi Sistem Peredaran Darah. *Journal of Education*, 1(May), 8.
- Vemuri, S., Krishna Veni, D. V., Neha, C., & Reddy, S. (2020). A questionnaire study on knowledge and awareness of metabolic syndrome and it’s components in undergraduate medical students at entry level. *International Journal of Research in Pharmaceutical Sciences*, 11(3), 3645–3656. <https://doi.org/10.26452/ijrps.v11i3.2525>
- Vitharana, P. R. K. A. (2021). Secondary School Learners Conceptions of the Structure and Function of the Human Circulatory System. *International Journal of Humanities, Social Sciences and Education*, 8(4), 283–292. <https://doi.org/10.20431/2349-0381.0804024>

- Wahyuni, S., Hambali, H., & Fadhilah, N. (2020). Identifikasi Miskonsepsi Siswa Pada Konsep Sistem Peredaran Darah Dengan Menggunakan Three-Tier Test di Kelas XI Mia 1 SMAN 8 Bulukumba. *KROMATIN: Jurnal Biologi Dan Pendidikan Biologi*, 1(2), 2020.
- Wahyuni, S. I. (2022). Identification of Misconceptions In Second Class (XI) MA PPKP Darul Ma'la Winong Pati Senior High School Students In Circulation System Materials Using Three Tier Diagnostic Instruments. *Jurnal Pembelajaran Dan Biologi Nukleus*, 8(3), 711–720. <https://doi.org/10.36987/jpbn.v8i3.2919>
- Wahyuningsih, E. (2016). Identifikasi Miskonsepsi Ipa Siswa Kelas V Di Sd Kanisius Beji. *Jurnal Pendidikan Guru Sekolah Dasar*, 22, 115–123.
- Wang, X., & Cheng, Z. (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest*, 158(1), S65–S71. <https://doi.org/10.1016/j.chest.2020.03.012>
- Wasilyastuti, W., Dhamarjati, A., & Siswanto. (2019). Imunosenesens dan Kerentanan Populasi Usia Lanjut Terhadap Coronavirus Disease 2019 (Covid-19). *Respirologi Indonesia*, 40(3), 182–191.
- Wawan Eka Setiawan, & Neri Egi Rusmana. (2020). Penerapan Model Pembelajaran Problem Based Learning Dalam Meningkatkan Pemahaman Konsep Dan Memperbaiki Miskonsepsi Siswa Tentang Materi Ipa Kelas V Sd. *Jurnal Tunas Bangsa*, 7(1), 116–126. <https://doi.org/10.46244/tunasbangsa.v7i1.981>
- Wulandari, D. S., Prayitno, B. A., & Maridi, M. (2022). Developing the guided inquiry-based module on the circulatory system to improve student's critical thinking skills. *JPBI (Jurnal Pendidikan Biologi Indonesia)*, 8(1), 77–85. <https://doi.org/10.22219/jpbi.v8i1.16512>
- Yip, D. Y. (1998). Teachers' misconceptions of the circulatory system. *Journal of Biological Education*, 32(3), 207–215. <https://doi.org/10.1080/00219266.1998.9655622>
- Yuliati, Y. (2017). Literature Review. *Jurnal Bio Education*, 2, 50–58.
- Yuwono, G. R., Sunarno, W., & Aminah, N. S. (2020). Pengaruh Kemampuan Berpikir Analitis Pada Pembelajaran Berbasis Masalah (Pbl) Terhadap Hasil Belajar Ranah Pengetahuan. *Edusains*, 12(1), 106–112. <https://doi.org/10.15408/es.v12i1.11659>
- Zellatifanny, C. M., & Mudjiyanto, B. (2018). Tipe Penelitian Deskripsi dalam Metode Penelitian. *Diakom: Jurnal Media Dan Komunikasi*, 1(2), 83–90.
- Zubaidah, S., Mahanal, S., Yuliati, L., Dasna, I. W., Pangestuti, A. A., Puspitasari, D. R., T, H., Robitah, A., Kurniaawati, Z. L., Rosyida, F., & Mar'atus, S. (2017). *Ilmu Pengetahuan Alam Buku Guru*.