

**PENGGUNAAN DIFERENSIASI MEDIA AUDIOVISUAL TERHADAP
KEMAMPUAN REPRESENTASI SISWA SMA PADA MATERI
PERUBAHAN LINGKUNGAN**

SKRIPSI

*Diajukan untuk memenuhi salah satu syarat dalam memperoleh gelar Sarjana
Pendidikan Program Studi Pendidikan Biologi*



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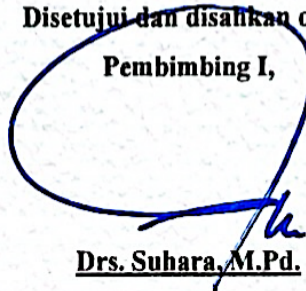
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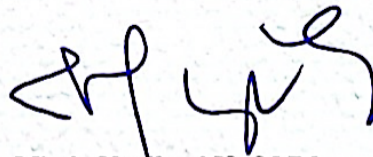
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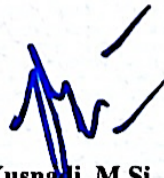


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ABSTRAK

Diferensiasi media audiovisual merupakan suatu bentuk modifikasi konten pembelajaran yang bertujuan untuk memfasilitasi semua siswa dengan gaya belajar yang berbeda agar mendapatkan hasil belajar yang maksimal. Penelitian ini bertujuan untuk menganalisis dampak penggunaan diferensiasi media audiovisual berdasarkan gaya belajar terhadap kemampuan representasi siswa SMA pada materi perubahan lingkungan. Metode dalam penelitian ini adalah *pre-experiment* dengan desain penelitian *one group pretest-posttest design*. Subjek penelitian berjumlah 31 siswa dan hanya terdiri atas satu kelompok eksperimen. Pembelajaran materi perubahan lingkungan dilaksanakan sebanyak tiga kali pertemuan selama tiga minggu dengan masing-masing pertemuan diberikan media audiovisual yang berbeda. Data kemampuan representasi didapatkan dengan menggunakan instrumen tes berupa esai, sedangkan data respons siswa terhadap penggunaan diferensiasi media audiovisual didapatkan dengan menggunakan instrumen nontes berupa kuesioner, serta wawancara sebagai instrumen tambahan. Data kemampuan representasi diuji menggunakan *Paired Sample T-Test*. Hasil penelitian menunjukkan bahwa penggunaan diferensiasi media audiovisual berpengaruh signifikan terhadap naiknya skor kemampuan representasi siswa. Siswa dengan gaya belajar visual menunjukkan peningkatan kemampuan representasi yang lebih tinggi dibandingkan dengan siswa dengan gaya belajar auditorial dan kinestetik. Diferensiasi media audiovisual lebih efektif dalam memfasilitasi siswa dengan gaya belajar visual, terutama dalam memperbaiki kemampuan representasi dalam bentuk grafik dan/atau gambar.

Kata Kunci: Diferensiasi Media Audiovisual, Kemampuan Representasi, Gaya Belajar, Pembelajaran Perubahan Lingkungan

ABSTRACT

Audiovisual media differentiation is a form of learning content modification that aims to facilitate the maximum learning outcomes for all students with different learning styles. This study aims to analyze the impact of using audiovisual media differentiation based on learning styles on the representational abilities of high school students on environmental change material. The method in this study was a pre-experiment with a one-group pretest-posttest design. The research subjects were 31 students and consisted of only one experimental group. Learning the environmental change material was carried out in three meetings for three weeks with each meeting given different audiovisual media. Data on representational abilities were obtained using a test instrument in the form of an essay. In contrast, data on student responses to audiovisual media differentiation were obtained using a non-test instrument in the form of a questionnaire, and interviews as additional instruments. Representational ability data were tested using a Paired Sample T-Test. The results showed that the use of audiovisual media differentiation had a significant effect on increasing students' representational ability scores. Students with a visual learning style showed a higher increase in representational abilities compared to students with auditory and kinesthetic learning styles. Audiovisual media differentiation is more effective in facilitating students with a visual learning style, especially in improving representational abilities in the form of graphs and/or images.

Keywords: Audiovisual Media Differentiation, Representation Ability, Learning Style, Environmental Change Learning

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DAFTAR PUSTAKA

- Ainsworth, S. (2006). DeFT: A conceptual framework for considering learning with multiple representations. *Learning and Instruction, 16*(3), 183–198. <https://doi.org/10.1016/j.learninstruc.2006.03.001>
- Alhafiz, N. (2022). Analisis Profil Gaya Belajar Siswa untuk Pembelajaran Berdiferensiasi di SMP Negeri 23 Pekanbaru. *Jurnal Pengabdian Kepada Masyarakat, 1*(8).
- Arif, S., & Muthoharoh, A. N. (2021). Penggunaan Media Audio Visual Berbasis Powtoon Untuk Meningkatkan Kemampuan Representasi IPA di Tengah Pandemi COVID-19. *Jurnal Dimensi Pendidikan Dan Pembelajaran, 9*(2), 80–91.
- Arnheim, R. (1974). *Art and Visual Perception: The Psychology of the Creative Eye*. Berkeley: University of California Press.
- Binali, T., Chang, C. H., Chang, Y. J., & Chang, H. Y. (2024). High School and College Students' Graph-Interpretation Competence in Scientific and Daily Contexts of Data Visualization. *Science and Education, 33*(3), 763–785. <https://doi.org/10.1007/s11191-022-00406-3>
- Bobek, E., & Tversky, B. (2016). Creating visual explanations improves learning. *Cognitive Research: Principles and Implications, 1*(1). <https://doi.org/10.1186/s41235-016-0031-6>
- Breaux, E., & Magee, M. B. (2013). How the best teachers differentiate instruction. *How the Best Teachers Differentiate Instruction, 1*–166. <https://doi.org/10.4324/9781315855257>
- Brilliant Albar, B., & Sari, I. M. (2021). *Learning Technology Development through Podcasts for Auditory Learning Styles*. <https://anchor.fm/berribet>
- Campbell, N. A., Urry, L. A., Cain, M. L., Minorsky, P. V, Wasserman, S. A., & Orr, R. B. (2020). *Campbell Biology* (12th edition). Pearson.
- Clark, J. M., & Paivio, A. (1991). Dual Coding Theory and Education. *Educational Psychology Review, 3*(3), 149–210.

- Clark, R. Colvin., & Mayer, R. E. . (2011). *E-learning and the science of instruction : proven guidelines for consumers and designers of multimedia learning*. Pfeiffer.
- Clark, R. Colvin., & Mayer, R. E. . (2024). *E-learning and the science of instruction: proven guidelines for consumers and designers of multimedia learning*. Wiley.
- Cohen, A. D., & Weaver, S. J. (2005). *Styles and Strategies-Based Instruction: A Teachers' Guide*.
- Cohen, L., Manion, L., & Morrision, K. (2007). *Research Methods in Education* (Sixth Edition). Routledge.
- Costley, J., Fanguy, M., Lange, C., & Baldwin, M. (2021). The effects of video lecture viewing strategies on cognitive load. *Journal of Computing in Higher Education*, 33(1), 19–38. <https://doi.org/10.1007/s12528-020-09254-y>
- Cox, J. T. (2012). *Differentiating Mathematics Instruction So EVERYONE Learns*.
- Cox, N. J. (2007). The Grammar of Graphics. *Journal of Statistical Software*, 17.
- Dewey, J. (1938). *Experience and Education*.
- Evagorou, M., Erduran, S., & Mäntylä, T. (2015). The role of visual representations in scientific practices: from conceptual understanding and knowledge generation to ‘seeing’ how science works. *International Journal of STEM Education*, 2(1). <https://doi.org/10.1186/s40594-015-0024-x>
- Everitt, B. S. (2002). *The Cambridge Dictionary of Statistics* (Second Edition).
- Few, S. (2004). *Show Me the Numbers Designing Tables & Graphs to Enlighten Data Visualization for Enlightening Communication*.
- Fleming, N. D., & Mills, C. (1992). Not Another Inventory, Rather a Catalyst for Reflection. *To Improve the Academy: A Journal of Educational Development*, 11, 137–155. <https://digitalcommons.unl.edu/podimproveacad>
- Frank, E. (2024). *EasyChair Preprint Kinesthetic Learning Style*.
- Friedlingstein, P., Jones, M. W., O’Sullivan, M., Andrew, R. M., Bakker, D. C. E., Hauck, J., Le Quéré, C., Peters, G. P., Peters, W., Pongratz, J., Sitch, S., Canadell, J. G., Ciais, P., Jackson, R. B., Alin, S. R., Anthoni, P., Bates, N. R., Becker, M., Bellouin, N., ... Zeng, J. (2022). Global Carbon Budget 2021.

- Earth System Science Data*, 14(4), 1917–2005. <https://doi.org/10.5194/essd-14-1917-2022>
- Gagne, R. M., Briggs, L. J., & Wager, W. W. (1974). *Principles of Instructional Design* (Fourth Edition). Ted Buchholz.
- Giannakos, M. N., Chorianopoulos, K., Ronchetti, M., Szegedi, P., & Teasley, S. D. (2014). Video-Based learning and open online courses. *International Journal of Emerging Technologies in Learning*, 9(1), 4–7. <https://doi.org/10.3991/ijet.v9i1.3354>
- Gilbert, J. K. (2008). *Visualization: An Emergent Field of Practice and Enquiry in Science Education*.
- Goldin, G. A. (2000). Affective Pathways and Representation in Mathematical Problem Solving. *Mathematical Thinking and Learning*, 2(3), 209–219. https://doi.org/10.1207/s15327833mtl0203_3
- Guo, D., McTigue, E. M., Matthews, S. D., & Zimmer, W. (2020). The Impact of Visual Displays on Learning Across the Disciplines: A Systematic Review. In *Educational Psychology Review* (Vol. 32, Issue 3, pp. 627–656). Springer. <https://doi.org/10.1007/s10648-020-09523-3>
- Haslam, C. Y., & Hamilton, R. J. (2010). Investigating the use of integrated instructions to reduce the cognitive load associated with doing practical work in secondary school science. *International Journal of Science Education*, 32(13), 1715–1737. <https://doi.org/10.1080/09500690903183741>
- Hawkins, T. R., Singh, B., Majeau-Bettez, G., & Strømman, A. H. (2013). Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles. *Journal of Industrial Ecology*, 17(1), 53–64. <https://doi.org/10.1111/j.1530-9290.2012.00532.x>
- Heacox, Diane. (2012). *Differentiating instruction in the regular classroom : how to reach and teach all learners*. Free Spirit Publishing.
- Herpiandi, W., Hidayat, O., & Sumarno, U. (2003). Analisis Kemampuan Siswa SMU dalam Mentranslasikan Data ke dalam Bentuk Grafik Pada Konsep Ekologi. *Jurnal Pengajaran MIPA*, 4, 1412–0917.
- Hoegh-Guldberg, O., Mumby, P. J., Hooten, A. J., Steneck, R. S., Greenfield, P., Gomez, E., Harvell, C. D., Sale, P. F., Edwards, A. J., Caldeira, K., Knowlton,

- N., Eakin, C. M., Iglesias-Prieto, R., Muthiga, N., Bradbury, R. H., Dubi, A., & Hatziolos, M. E. (2007). Coral Reefs Under Rapid Climate Change and Ocean Acidification. *Science*, *318*(5857), 1737–1742. <http://science.sciencemag.org/>
- Houghton, J. T. (2009). *Global Warming: The Complete Briefing* (Fourth Edition).
- Indah, R. A., & Fadilah, M. (2024). Literature Review : Pengaruh Media Pembelajaran Literasi Visual Terhadap Hasil Belajar Biologi Siswa SMA. *BIODIK*, *10*(2), 188–198. <https://doi.org/10.22437/biodik.v10i2.33803>
- Jacobson, M. Z., Delucchi, M. A., Bazouin, G., Bauer, Z. A. F., Heavey, C. C., Fisher, E., Morris, S. B., Piekutowski, D. J. Y., Vencill, T. A., & Yeskoo, T. W. (2015). 100% clean and renewable wind, water, and sunlight (WWS) all-sector energy roadmaps for the 50 United States. *Energy and Environmental Science*, *8*(7), 2093–2117. <https://doi.org/10.1039/c5ee01283j>
- Joseph, S., Thomas, M., Simonette, G., & Ramsook, L. (2013). The Impact of Differentiated Instruction in a Teacher Education Setting: Successes and Challenges. *International Journal of Higher Education*, *2*(3), 28–40. <https://doi.org/10.5430/ijhe.v2n3p28>
- Joughin, G. (2009). Assessment, learning and judgement in higher education. In *Assessment, Learning and Judgement in Higher Education*. Springer Netherlands. <https://doi.org/10.1007/978-1-4020-8905-3>
- Kali, H. D. (2005). First-Year University Biology Students' Difficulties with Graphing Skills [Thesis]. In *University of the Witwatersrand, Johannesburg*. University of the Witwatersrand, Johannesburg.
- Kemendikbudristek. (2024). *Kajian Akademik Kurikulum Merdeka*.
- Kemendikbudristek. (2024). *Keputusan Kepala Badan Standar, Kurikulum, Dan Asesmen Pendidikan Kementerian Pendidikan, Kebudayaan, Riset, Dan Teknologi Nomor 032/H/KR/2024*.
- Komang Wahyu Wiguna, I., Adi Nugraha Tristaningrat, M., & Tinggi Agama Hindu Negeri Mpu Kuturan Singaraja, S. (2022). *Edukasi: Jurnal Pendidikan Dasar Langkah Mempercepat Perkembangan Kurikulum Merdeka Belajar*. *3*(1), 17–26. <http://jurnal.stahnmpukuturan.ac.id/index.php/edukasi>

- Kozma, R. (2003). The material features of multiple representations and their cognitive and social affordances for science understanding. In *Learning and Instruction* (Vol. 13, Issue 2, pp. 205–226). Elsevier BV. [https://doi.org/10.1016/s0959-4752\(02\)00021-x](https://doi.org/10.1016/s0959-4752(02)00021-x)
- Ladisa, S., Rahmat, A., & Supriatno, B. (2020). Analisis Kemampuan Representasi Visual dan Representasi Verbal Mahasiswa Pada Materi Morfologi Tumbuhan Serta Hubungannya dengan Kemampuan Visual dan Kemampuan Verbal Umum. *Jurnal Psikologi Jambi*, 05(01), 43–49.
- Lee, H., Calvin, K., Dasgupta, D., Krinner, G., Mukherji, A., Thorne, P. W., Trisos, C., Romero, J., Aldunce, P., Barrett, K., Blanco, G., Cheung, W. W. L., Connors, S., Denton, F., Diongue-Niang, A., Dodman, D., Garschagen, M., Geden, O., Hayward, B., ... Ha, M. (2023). *IPCC, 2023: Climate Change 2023: Synthesis Report*. (P. Arias, M. Bustamante, I. Elgizouli, G. Flato, M. Howden, C. Méndez-Vallejo, J. J. Pereira, R. Pichs-Madruga, S. K. Rose, Y. Saheb, R. Sánchez Rodríguez, D. Ürge-Vorsatz, C. Xiao, N. Yassaa, J. Romero, J. Kim, E. F. Haites, Y. Jung, R. Stavins, ... C. Péan, Eds.). <https://doi.org/10.59327/IPCC/AR6-9789291691647>
- Lemke, P. J., Ren, J., Alley, R. B., Allison, I., Carrasco, J., Flato, G., Fujii, Y., Kaser Austria, G., Mote, P., Thomas, R. H., Barry, R., Koike, T., Ren, J., Alley, R., Allison, I., Carrasco, J., Flato, G., Fujii, Y., Kaser, G., ... Tignor, M. (2007). Observations: Changes in Snow, Ice and Frozen Ground. In: *Climate Change 2007: The Physical Science Basis*.
- Lorenzo, A. R., & Lorenzo, B. U. (2013). Learning Styles of Teacher Education Students: Basis in Improving the Teaching - Learning Process. *Procedia - Social and Behavioral Sciences*, 103, 595–605. <https://doi.org/10.1016/j.sbspro.2013.10.377>
- Madigan, D. J., & Curran, T. (2021). Does Burnout Affect Academic Achievement? A Meta-Analysis of over 100,000 Students. *Educational Psychology Review*, 33(2), 387–405. <https://doi.org/10.1007/s10648-020-09533-1>
- Mafirah, W. N., Rufiana, I. S., & Wahyudi. (2020). Analisis Kemampuan Representasi Visual Siswa Pada Materi Pengolahan Data Ditinjau dari Gaya

- Belajar VAK. *J-PiMat: Jurnal Pendidikan Matematika*, 2(2), 175–186.
<https://doi.org/10.31932/j-pimat.v2i2.875>
- Maicas, S. (2020). The role of yeasts in fermentation processes. In *Microorganisms* (Vol. 8, Issue 8, pp. 1–8). MDPI AG.
<https://doi.org/10.3390/microorganisms8081142>
- Maya, J., Luesia, J. F., & Pérez-Padilla, J. (2021). The relationship between learning styles and academic performance: consistency among multiple assessment methods in psychology and education students. *Sustainability (Switzerland)*, 13(6). <https://doi.org/10.3390/su13063341>
- Mayer, R. E. . (2010). *Multimedia learning*. Cambridge University Press.
- Mayer, R. E., & Moreno, R. (2002). Animation as an Aid to Multimedia Learning. In *Educational Psychology Review* (Vol. 14, Issue 1).
- McCarthy, J., Porada, K., & Treat, R. (2023). Educational Podcast Impact on Student Study Habits and Exam Performance. *Family Medicine*, 55(1), 34–37.
<https://doi.org/10.22454/FamMed.55.183124>
- Meier, W., Stroeve, J., Fetterer, F., & Knowles, K. (2005). Reductions in Arctic sea ice cover no longer limited to summer. *Eos, Transactions American Geophysical Union*, 86(36), 326–326. <https://doi.org/10.1029/2005eo360003>
- Montgomery, S. M. (1995). Addressing Diverse Learning Styles Through the Use of Multimedia. *Proceedings Frontiers in Education*, 1.
- Murphy, D. H., Hoover, K. M., Agadzhanian, K., Kuehn, J. C., & Castel, A. D. (2022). Learning in double time: The effect of lecture video speed on immediate and delayed comprehension. *Applied Cognitive Psychology*, 36(1), 69–82. <https://doi.org/10.1002/acp.3899>
- Mutanaffisah, R., Ningrum, R., & Widodo, A. (2021). Ketepatan pemilihan pendekatan, metode, dan media terhadap karakteristik materi IPA. *Jurnal Inovasi Pendidikan IPA*, 7(1), 12–21. <https://doi.org/10.21831/jipi.v7i1.32622>
- Nan, J., & Lan Nai Ciang. (2024). An Action Research on the Impact of Podcasts in Grammar Learning of Elementary Students. *International Journal of Language and Literary Studies*, 6(2), 360–384.
<https://doi.org/10.36892/ijlls.v6i2.1671>

- Nandang Mustafa, A. (2023). Reflection On The Latest Pisa Results Of Indonesia. *International Journal of Advanced Research*, 11(05), 1223–1228. <https://doi.org/10.21474/IJAR01/16988>
- National Research Council. (2010). Advancing the Science of Climate Change. In *Advancing the Science of Climate Change*. National Academies Press. <https://doi.org/10.17226/12782>
- Nicholls, R. J., & Cazenave, A. (2010). Sea-level rise and its impact on coastal zones. In *Science* (Vol. 328, Issue 5985, pp. 1517–1520). <https://doi.org/10.1126/science.1185782>
- OECD. (2019). *PISA 2018 Results (Volume I) What Students Know and Can Do*. <https://doi.org/10.1787/5f07c754-en>
- OECD. (2023). *PISA 2022 Results Factsheets Indonesia PUBE*. <https://oecdch.art/a40de1dbaf/C108>.
- Owa, H., & Gardner, R. D. (1993). *Frames of Mind: The Theory of Multiple Intelligences*. (tenth edition). Basic Books.
- Pashler, H., Mcdaniel, M., Rohrer, D., & Bjork, R. (2009). *Learning Styles Concepts and Evidence*. www.learningstyles.net
- Philander, S. G. H. (1985). El Niño, La Niña. *Journal of The Atmospheric Sciences*, 42(43), 2652–2662.
- Pörtner, H.-O., Roberts, D. C., Alegría, A., Nicolai, M., Okem, A., Petzold, J., Rama, B., & Weyer, N. M. (2019). *The Ocean and Cryosphere in a Changing Climate A Special Report of the Intergovernmental Panel on Climate Change Edited by*.
- Pozzer, L. L., & Roth, W. M. (2003). Prevalence, function, and structure of photographs in high school biology textbooks. *Journal of Research in Science Teaching*, 40(10), 1089–1114. <https://doi.org/10.1002/tea.10122>
- Purba, M., Purnamasari, N., Soetantyo, S., Suwarma, I. R., & Susanti, E. I. (2021). *Prinsip Pengembangan Pembelajaran Berdiferensiasi (Differentiated Instruction)*.
- Purwanto. (2009). *Evaluasi Hasil Belajar*. Pustaka Pelajar.

- Putra, D. H. A. (2023, August 22). *Salju Abadi Puncak Jaya Menuju Kepunahan Akibat Perubahan Iklim*. Badan Meteorologi, Klimatologi, Dan Geofisika (BMKG).
- Rahmadana, A., Gani, H. A., & Ismail. (2021). *Modul Belajar Mandiri Calon Guru*.
- Rahmat, A., Soesilowaty, S. A., Nuraeni, E., Yogi, Y., Nugroho, I., & Gemilawati, M. (2017). Representasi Mental Siswa Sma Dalam Membaca Gambar Biologi. *Jurnal Pengajaran Matematika Dan Ilmu Pengetahuan Alam*, 22(1), 68–76. <https://doi.org/10.18269/jpmipa.v22i1.8384>
- Reiser, R. A., Carr-Chellman, A. A., & Dempset, J. V. (2024). *Trends and Issues In Instructional desIgn and Technology: Vol. 5th Edition*.
- Sadoski, Mark., & Paivio, Allan. (2001). *Imagery and text : a dual coding theory of reading and writing*. L. Erlbaum Associates.
- Schmidt, R. A., Lee, T. D., Winstein, C. J., Wulf, G., & Zelaznik, H. N. (2018). *Motor Control and Learning: A Behavioral Emphasis. Human Kinetics*. (Sixth Edition). Human Kinetics.
- Setiyo, A. (2022). Penerapan Pembelajaran Diferensiasi Kolaboratif dengan Melibatkan Orang Tua dan Masyarakat untuk Mewujudkan Student's Well-Being di Masa Pandemi. *BIOMA: Jurnal Ilmiah Biologi*, 11(1), 61–78.
- Silverman, L. K. (2005). *Upside-Down Brilliance: The Visual-Spatial Learner The Institute for the Study of Advanced Development*. www.gifteddevelopment.com;
- Sinaga, G. F. M., Hartoyo, A., & Hamdani. (2016). Kemampuan Representasi Matematis Siswa Ditinjau dari Gaya Belajar Pada Materi Fungsi Kuadrat di SMA. *Jurnal Pendidikan Dan Pembelajaran Khatulistiwa*, 5(6), 9–10.
- Smith, P., Bustamante, M., Ahammad, H., Clark, H., Dong, H., & Elsiddig, E. A. (2014). *Agriculture, Forestry and Other Land Use (AFOLU)* (Chapter 11).
- Sorden, S. D. (2005). A Cognitive Approach to Instructional Design for Multimedia Learning. In *Informing Science Journal* (Vol. 8, pp. 263–279). Informing Science Institute. <https://doi.org/10.28945/498>
- Spence, I., & Lewandowsky, S. (1991). Displaying proportions and percentages. *Applied Cognitive Psychology*, 5(1), 61–77. <https://doi.org/10.1002/acp.2350050106>

- Steffen, W., Richardson, K., Rockström, J., Cornell, S. E., Fetzer, I., Bennett, E. M., Biggs, R., Carpenter, S. R., De Vries, W., De Wit, C. A., Folke, C., Gerten, D., Heinke, J., Mace, G. M., Persson, L. M., Ramanathan, V., Reyers, B., & Sörlin, S. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science*, *347*(6223). <https://doi.org/10.1126/science.1259855>
- Subali, B., Rusdiana, D., Firman, H., & Abstrak, I. K. (2015). Analisis Kemampuan Interpretasi Grafik Kinematika pada Mahasiswa Calon Guru Fisika. *Prosiding Simposium Nasional Inovasi Dan Pembelajaran Sains*, 269–272.
- Sugiyono. (2007). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.
- Sugiyono. (2017). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.
- Sugiyono. (2019). *Metode Penelitian Kuantitatif Kualitatif dan R&D*. Alfabeta.
- Sunyono. (2015). *Model Pembelajaran Multipel Representasi*.
- Swezzler, J. (1994). Cognitive Load Theory, Learning Difficulty, and Instructional Design. *Laming and Instruction*, *4*, 295–312.
- Tomlinson, C. A. (2001a). *How to differentiate instruction in mixed-ability classrooms*. Association for Supervision and Curriculum Development.
- Tomlinson, C. A. (2017a). How to Differentiate Instruction in Academically Diverse Classrooms. In *ASCD*.
- Tomlinson, C. A. (2017b). The Rationale for Differentiating Instruction in Academically Diverse Classrooms. *DIFFERENTIATE INSTRUCTION: In Academically Diverse Classrooms*, 12–18. <http://www.ascd.org/ASCD/pdf/siteASCD/publications/books/HowtoDifferentiateInstructioninAcademicallyDiverseClassrooms-3rdEd.pdf>
- Tomlinson, C. A. . (2001b). *How to differentiate instruction in mixed-ability classrooms*. Association for Supervision and Curriculum Development.
- Tomlinson, C. A. . (2005). *The differentiated classroom : responding to the needs of all learners*. Pearson Education.
- Tomlinson, C. A., & Moon, T. R. (2013). Assessment and student success in a differentiated classroom. *Association for Supervision and Curriculum Development*, 1–159.
- Trenberth, K. E. (1997). The Definition of El Nino. *Bulletin of the American Meteorological Society*, *78*(12), 2771–2778.

- Tversky, B. (2011). Visualizing thought. *Topics in Cognitive Science*, 3(3), 499–535. <https://doi.org/10.1111/j.1756-8765.2010.01113.x>
- Vekiri, I. (2002). What is the value of graphical displays in learning? In *Educational Psychology Review* (Vol. 14, Issue 3, pp. 261–312). <https://doi.org/10.1023/A:1016064429161>
- Vose, R. S., & Schmidt, G. A. (2021). *Annual Global Analysis for 2021 NOAA/NASA*.
- Wahyuni, A. S. (2022). Literature Review: Pendekatan Berdiferensiasi Dalam Pembelajaran IPA. *Jurnal Pendidikan MIPA*, 12(2), 118–126. <https://doi.org/10.37630/jpm.v12i2.562>
- Yıldız, D., Fidan, U., Yıldız, M., Er, B., Ocak, G., Güngör, F., Ocak, İ., & Akyıldız, Z. (2024). Development and Evaluation of an Image Processing-Based Kinesthetic Learning System. *Applied Sciences (Switzerland)*, 14(5). <https://doi.org/10.3390/app14052186>
- Yunita, E., Rachmawati, F., & Hilaliyah, T. (2023). Meta Analisis Penerapan Pembelajaran Berdiferensiasi untuk Meningkatkan Hasil Belajar Siswa. *Jurnal Ilmiah Ilmu Pendidikan*, 6(10), 7499–7505. <http://Jiip.stkipyapisdompnu.ac.id>
- Zarate, G. (2012). Cultural Representation. In *The Encyclopedia of Applied Linguistics*. <https://doi.org/10.1002/9781405198431.wbeal0300>