

**PENGARUH MODEL PEMBELAJARAN *INQUIRY* TERBIMBING
MENGUNAKAN *VIRTUAL LAB* TERHADAP PERUBAHAN
KONSEPSI SISWA PADA GERAK HARMONIK SEDERHANA**

SKRIPSI

Diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana
Pendidikan Program Studi Pendidikan Fisika



disusun oleh :

Firdausha Adhika Putri (1604223)

DEPARTEMEN PENDIDIKAN FISIKA

**FAKULTAS PENDIDIKAN ILMU MATEMATIKA DAN ILMU
PENGETAHUAN ALAM**

UNIVERSITAS PENDIDIKAN INDONESIA

BANDUNG

2020

**PENGARUH MODEL PEMBELAJARAN *INQUIRY* TERBIMBING
MENGUNAKAN *VIRTUAL LAB* TERHADAP PERUBAHAN
KONSEPSI SISWA PADA GERAK HARMONIK SEDERHANA**

Oleh

Firdausha Adhika Putri

Sebuah skripsi yang diajukan untuk memenuhi sebagian syarat mendapatkan gelar Sarjana Pendidikan pada Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

© Firdausha Adhika Putri

Universitas Pendidikan Indonesia

Agustus, 2020

Hak Cipta dilindungi undang-undang.

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

Firdausha Adhika Putri, 2020

PENGARUH MODEL PEMBELAJARAN *INQUIRY* TERBIMBING MENGGUNAKAN *VIRTUAL LAB* TERHADAP PERUBAHAN KONSEPSI SISWA PADA GERAK HARMONIK SEDERHANA

Universitas Pendidikan Indonesia | repositoery.upi.edu | perpustakaan.upi.edu

FIRDAUSHA ADHIKA PUTRI
PENGARUH MODEL PEMBELAJARAN *INQUIRY* TERBIMBING
MENGGUNAKAN *VIRTUAL LAB* TERHADAP PERUBAHAN
KONSEPSI SISWA PADA GERAK HARMONIK SEDERHANA

Disetujui dan disahkan oleh pembimbing

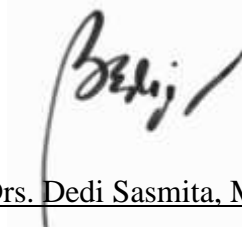
Pembimbing I



Drs. Iyon Suyana, M. Si.

NIP. 196208241991031001

Pembimbing II



Drs. Dedi Sasmita, M. Si.

NIP. 196506151998031001

Mengetahui,

Ketua Departemen Pendidikan Fisika



Dr. Taufik Ramlan Ramalis, M. Si.

NIP. 195904011986011001

Pengaruh Model Pembelajaran *Inquiry* terbimbing menggunakan *Virtual Lab* terhadap Perubahan Konsepsi Siswa pada Materi Gerak Harmonik Sederhana

Firdausha Adhika Putri, Iyon Suyana, Dedi Sasmita

*Departemen Pendidikan Fisika. FPMIPA, Universitas Pendidikan Indonesia,
Jalan Dr. Setiabudhi 229 Bandung 40154, Indonesia*

**Email: firdaushaputri@student.upi.edu*

HP : 089654626063

ABSTRAK

Pembelajaran menggunakan model *Inquiry* terbimbing adalah pembelajaran yang didalamnya siswa menjadi pemeran utama dimana siswa menemukan sendiri konsep dari materi yang dipelajari melalui arahan dan bimbingan dari guru berupa pertanyaan. *Virtual Lab* dapat digunakan menjadi salah satu media dalam pembelajaran dengan model *Inquiry* terbimbing. Tujuan dari penelitian ini adalah mengetahui pengaruh dari model pembelajaran *Inquiry* terbimbing menggunakan *Virtual Lab* terhadap perubahan konsepsi siswa pada materi gerak harmonik sederhana. Penelitian ini merupakan penelitian dengan metode kuantitatif yang dilakukan secara kuasi eksperimen. Pada pelaksanaannya penelitian ini menggunakan desain *One Group Pretest and Posttest*. Sampel dalam penelitian ini adalah 28 peserta didik kelas X IPA di salah satu SMA di Kota Bandung yang akan ditinjau perbedaan konsepsinya sebelum dan setelah mengikuti pembelajaran dengan model *Inquiry* terbimbing menggunakan *Virtual Lab* dengan mengikuti *pre-test* dan *post-test* yang berupa *Three-Tier Test* sebelum dan sesudah pembelajaran. Dari hasil penelitian diketahui bahwa terdapat peningkatan jumlah siswa yang mengalami paham konsep setelah dilakukannya pembelajaran dengan model *Inquiry* terbimbing menggunakan *Virtual Lab* pada materi gerak harmonik sederhana.

Kata kunci : Model pembelajaran *Inquiry* terbimbing; *Virtual Lab*; *Konsepsi Siswa*

Firdausha Adhika Putri, 2020

PENGARUH MODEL PEMBELAJARAN INQUIRY TERBIMBING MENGGUNAKAN VIRTUAL LAB TERHADAP PERUBAHAN KONSEPSI SISWA PADA GERAK HARMONIK SEDERHANA

Universitas Pendidikan Indonesia | repositoery.upi.edu | perpustakaan.upi.edu

DAFTAR ISI

HALAMAN JUDUL

HALAMAN PENGESAHAN

HALAMAN PERNYATAAN

KATA PENGANTAR.....ERROR! BOOKMARK NOT DEFINED.

UCAPAN TERIMAKASIH.....ERROR! BOOKMARK NOT DEFINED.

ABSTRAK 4

DAFTAR ISI..... 5

DAFTAR TABELERROR! BOOKMARK NOT DEFINED.

DAFTAR GAMBAR.....ERROR! BOOKMARK NOT DEFINED.

DAFTAR GRAFIKERROR! BOOKMARK NOT DEFINED.

DAFTAR LAMPIRANERROR! BOOKMARK NOT DEFINED.

BAB I PENDAHULUAN.....ERROR! BOOKMARK NOT DEFINED.

1.1. Latar Belakang Penelitian **Error! Bookmark not defined.**

1.2. Rumusan Masalah **Error! Bookmark not defined.**

1.3. Definisi Operasional **Error! Bookmark not defined.**

1.4. Tujuan Penelitian 8

1.5. Manfaat Penelitian 8

1.6. Struktur Penulisan Skripsi..... **Error! Bookmark not defined.**

BAB II KAJIAN PUSTAKAERROR! BOOKMARK NOT DEFINED.

2.1. *Virtual Laboratory* (Laboratorium Virtual).. **Error! Bookmark not defined.**

2.2. Model Pembelajaran *Inquiry* terbimbing (*Guided Inquiry*)**Error! Bookmark not defined.**

2.3. Perubahan Konsep **Error! Bookmark not defined.**

2.3.1. Instrumen *Three-Tier Test* untuk Mengetahui Konsepsi Siswa ...**Error!**

Bookmark not defined.

2.4. Konsep Gerak Harmonik Sederhana dalam Pembelajaran *Inquiry* terbimbing menggunakan *Virtual Lab*..... **Error! Bookmark not defined.**

2.4.1. Gaya Pemulih **Error! Bookmark not defined.**

2.4.2. Hubungan Periode dengan Besaran-Besaran yang Mempengaruhi Gerak Harmonik **Error! Bookmark not defined.**

2.4.3. Kecepatan dan Percepatan Gerak Harmonik Sederhana**Error! Bookmark not defined.**

2.4.4. Energi Mekanik Gerak Harmonik Sederhana.....**Error! Bookmark not defined.**

BAB III METODE PENELITIANERROR! BOOKMARK NOT DEFINED.

3.1. Metode dan Desain Penelitian **Error! Bookmark not defined.**

3.2. Populasi dan Sampel Penelitian **Error! Bookmark not defined.**

3.3. Prosedur Penelitian **Error! Bookmark not defined.**

3.4. Instrumen Penelitian **Error! Bookmark not defined.**

3.4.1. Teknik Analisis Instrumen Penelitian . **Error! Bookmark not defined.**

3.5. Analisis Data Penelitian **Error! Bookmark not defined.**

BAB IV HASIL PENELITIAN DAN PEMBAHASAN.....ERROR! BOOKMARK NOT DEFINED.

4.1. Respon Siswa selama pembelajaran *Inquiry* terbimbing menggunakan *Virtual Lab* **Error! Bookmark not defined.**

4.2. Perubahan Konsepsi Siswa **Error! Bookmark not defined.**

4.2.1. Diamati berdasarkan grafik peningkatan nilai siswa **Error! Bookmark not defined.**

4.2.2. Dianalisis berdasarkan hasil perhitungan nilai *N-Gain* Ternormalisasi **Error! Bookmark not defined.**

4.2.3. Dianalisis berdasarkan jawaban siswa pada *Pre-test* dan *Post-test* **Error! Bookmark not defined.**

4.2.4. Dianalisis berdasarkan perubahan jumlah siswa yang mengalami miskonsepsi pada konsep-konsep GHS..... **Error! Bookmark not defined.**

4.2.5. Dianalisis berdasarkan perubahan jumlah siswa yang mengalami setiap kategori konsepsi pada konsep-konsep GHS. **Error! Bookmark not defined.**

BAB V SIMPULAN, IMPLIKASI, DAN REKOMENDASI **ERROR! BOOKMARK NOT DEFINED.**

5.1. Simpulan **Error! Bookmark not defined.**

5.2. Implikasi **Error! Bookmark not defined.**

5.3. Rekomendasi..... **Error! Bookmark not defined.**

DAFTAR PUSTAKA **8**

DAFTAR PUSTAKA

- Abell, S. K. (2007). "Research on Science Teacher Knowledge." In Handbook of Research on Science Education, edited by S. K. Abell and N. G. Lederman, 1105–1149. New Jersey, NJ: Lawrence Erlbaum
- Acakpovi ,A. Olufemi O. Fatonade, and Ahmed G. (2014). Improving the Teaching/Learning of Power System with the Approach of Virtual Laboratory. *International Journal of e-Education, e-Business, e-Management and e-Learning*, 4(2).
- Alatas, F. & Fachrunnisa Z. (2018). Efektivitas POGIL dengan Laboratorium Virtual dalam Proses Meningkatkan Keterampilan dan Sikap Ilmu Pengetahuan: Konsep Motion Motion Simple Harmonic. *Edusains*, 10(2), 327 – 334.
- Alatas, F. & Sakina, W. H. (2019). Guided Discovery berbantuan Virtual Lab untuk Meningkatkan Keterampilan Proses Sains dan Sikap Ilmiah. *Jurnal Pendidikan IPA Veteran*), 3 (2), 138-148
- Aldrich, C. (2005). Learning by doing: A comprehensive guide to simulations, computer games, and pedagogy in e-Learning and other educational experiences. San Francisco, CA: Wiley, Pfeiffer
- Al-Rubayea, A. M. (1996). An Analysis of Saudi Arabian High School Students' Misconceptions about Physics Concepts. Unpublished doctoral dissertation., Kansas State University, Manhattan, KS.
- Amilasari, A, dan Sutiadi, A. (2008). Peningkatan Kecakapan Akademik Siswa SMA dalam Pembelajaran Fisika Melalui Penerapan Inquiry Terbimbing. *Jurnal Pengajaran MIPA FPMIPA UPI*. 12(2).

- Amnirullah, L. (2015). Analisis kesulitan penguasaan konsep mahasiswa pada topik rotasi benda tegar dan momentum sudut. *Jurnal Fisika Indonesia*, 19(55): 34-37.
- Anderson, L. W., & Krathwohl, D. R. (2010). *A Taxonomy for Learning, Teaching and Assesing: a Revision of Bloom's Taxonomy*. New York: Longman Publishing.
- Andrini, V. (2016). The Effectiveness of Inquiry Learning Method to Enhance Student' Learning Outcome: A Theoretical and Empirical Review. *Journal od education and Practice*, 7(3), 38-42.
- Arifin, Zainal. (2014). *Penelitian Pendidikan: Metode dan Paradigma Baru*. Bandung: PT Remaja Rosdakarya.
- Arikunto, S. (2012). *Prosedur Penelitian Suatu Pendekatan Praktis*. Edisi Revisi VI. Jakarta: PT. Rineka Cipta.
- Arikunto, S. (2013). *Prosedur Penelitian Suatu Pendekatan Praktik*. Jakarta: Rineka Cipta.
- Aulia, E. V., Poedjiastoeti, S., Agustin, R . (2018). The Effectiveness of Guided Inquiry-based Learning Material on Students' Science Literacy Skills. *Journal of Physics*, 947, 1-7
- Aydoğan, S., B. Güneş, and Ç. Gülçiçek. (2003). The Misconceptions about Heat and Temperature. *Gazi University Journal of Gazi Educational Faculty*, 23 (2), 111–124.
- Azwar, S. (2013). *Metode Penelitian* . Yogyakarta: Pustaka Pelajar.
- Bajpai, M. & Kumar, A. (2015). Effect of Virtual Laboratory on Students' Conceptual Achievement in Physics. *International Journal of Current Research*, 7(02), 12808 – 12813.
- Bajpai, M. (2013). Developing concepts in physics through virtual lab experiment: an effectiveness study. *International Journal of Educational Technology*, 3(1), 43-50.
- Banchi, H., & Bell, R. (2008). The Many Levels of Inquiry. *Science and Children*, 46 (2): 26-29.

- Barke, H. D., A. Hazari, and S. Yitbarek. (2009). *Misconceptions in Chemistry: Addressing Perceptions in Chemical Education*. Heidelberg: Springer.
- Basher, H., & Isa, S.A. (2006). On-Campus and Online Virtual Laboratory Experiments with LabVIEW, Conference Paper SoutheastCon.
- Caleon, I., and R. Subramaniam. (2010a). Development and Application of a Three-Tier Diagnostic Test to Assess Secondary Students' Understanding of Waves. *International Journal of Science Education*, 32 (7), 939–96.
- Chao, J. et. al. (2015). Sensor-augmented Virtual Labs: Using Physical Interactions with Science Simulations to Promote Understanding of Gas Behavior. *J Sci Educ Technol*.
- Dahar, R.W. (2011). *Teori-Teori Belajar dan Pembelajaran*. Jakarta: Erlangga.
- Darrah, M., Humbert, R., Finstein, J., Simon, M. & Hopkins, J. (2014). Are virtual labs as effective as hands-on labs for undergraduate physics? a comparative study at two major universities. *Journal of Science Education Technology*, 23 (6), 803-814
- Duffin, J.M. & Simpson, A.P. (2000). A search for understanding. *The journal of mathematical behavior*, 18 (4), 415-427
- Eryilmaz, A., and E. Sürmeli. (2002). Identifying Students' Misconception on Heat and Temperature through Three-Tier Questions. *Paper presented at the 5th National Conference on Science and Mathematics Education*.
- Faour, M.A. & Ayoubi, Z. (2018). The effect of using virtual laboratory on grade 10 students' conceptual understanding and their attitudes towards physics. *Journal of Education in Science, Environment and Health (JESEH)*, 4(1), 54-68.
- Gönen, S., and A. Akgün. (2005). The Investigation of Applicability of Worksheet Was Developed about Relationship between Heat and Temperature Concepts. *Electronic Journal of Social Sciences*, 3 (11), 92–106.
- González-Gómez et al., (2013). Automatic Web-Based Grading System: Application in an Advanced Instrumental Analysis Chemistry Laboratory. *Journal of chemical education*, 90(3), 308- 314.

- Gumilar, R. P., dkk. (2020). The Implementation of Guided Inquiry Learning Models on The Concept Mastery, Science Attitude, and Science Process Skill. *Journal of Primary Education*. 9(2). 148 – 154.
- Gunawan, G. and Liliyasi, L. (2012). Model virtual laboratory fisika modern untuk meningkatkan disposisi berpikir kritis calon guru J. *Cakrawala Pendidik*. 31 (185).
- Gunawan, G., Harjono, A, Hermansyah, H., Herayanti, L. (2019) Guided Inquiry model Through Virtual Laboratory to Enhance Students' Science Process Skills on Heat Concept. *Jurnal Ilmiah Pendidikan*. 38 (2), 259 - 268
- Gunawan, G., Nisrina, N., Suranti, N. M. Y., Herayanti, L., Rahmatiah, R..(2018). Virtual Laboratory to Improve Students' Conceptual Understanding in Physics Learning. *Journal of Physics: Conf. Series*, 1108.
- Gunawan., Harjono, A., Sahidu, H., & Herayanti, L. (2017). Virtual laboratory to improve students' problem-solving skills on electricity concept. *Jurnal Pendidikan IPA Indonesia*. 6(2), 257- 264.
- Gurcay, D. & Gulbas E. (2015). Development of Three-Tier Heat, Temperature, and Internal Energy Diagnostic Test. *Research in Science & Technological Education*.
- Hake, R. R. (1998). Analyzing Change/Gain. Score. Dept. of Physics, Indian University
- Helm. (1980). Misconceptions in Physics amongst South African Students. *Physics Education*, 15, 92–105.
- Hermansyah, H., Gunawan, G. Harjono, A., Adawiyah, R. (2019). Guided Inquiry Model with Virtual Labs to Improve Students' Underderstanding of Heat Concept. *Journal of Physics*. 1-5.
- Hestenes, D., & Halloun, I. (1995). Interpreting the force concept inventory. *Physics Teacher*, 33, 502–506.
- Holden, J. T. & Gamor, K. I. (2010). An Instructional Media Selection Guide for Distance Learning (2nd ed.) (United States of America: United States Distance Learning Association)

- Istiyani, R., Muchyidin, A., Rahardjo, H. (2018). Analisis Miskonsepsi Siswa pada Konsep Geometri Menggunakan Three-Tier Diagnostic Test. *Cakrawala Pendidikan*. (2). 223 – 236
- Jannati, E. D., dkk. (2018). Virtual Laboratory Learning Media Development to Improve Science Literacy Skills of Mechanical Engineering Students on Basic Physics Concept of Material Measurement. *Journal of Physics: Conf. Series*. 1013. 1-5
- Jauhari, T., Hikmawati, & Wahyudi. (2016). Pengaruh model pembelajaran berbasis masalah berbantuan media phet terhadap hasil belajar fisika siswa kelas X SMAN 1 Gunungsari Tahun Pelajaran 2015/2016. *Jurnal Pendidikan Fisika dan Teknologi*, 2(1), 7-12.
- Jimoyiannis, A. & Komis, V. (2001). Computer simulations in physics teaching and learning: a case study on students' understanding of trajectory motion. *Journal Computer Education*, 36, 183.
- Junaidi, J., Gani, A., & Mursal, M. (2016). Metode Virtual Laboratory Berbasis Inkuiri untuk Meningkatkan Keterampilan Generik Sains Siswa MA. *Jurnal Pendidikan Sains Indonesia*, 4, 130.
- Juškaite, L. (2019). The Impact of The Virtual Laboratory on The Physics Learning Process. *Proceedings of The International Scientific Conference*, 5, 159 – 168.
- Juwariyah, S., Koes, H., Latifah, E. (2017). Guided Inquiry Method Employing Virtual Laboratory to Improve Scientific Working Skills. *Jurnal Pendidikan Sains*. 5(1). 17-25.
- Kaltacki-Gurel, Eryilmaz, A., McDermott, L. C. (2017). Development and Application of a Four-Tier Test to Asses Pre-Service Physics Teachers' Misconceptions about Geometrical Optics. *Research in Science & Technological Education*.
- Kaltakci, D., and A. Eryilmaz. (2010). Sources of Optics Misconceptions. In *Contemporary Science Education Research: Learning and Assessment*, edited by G. Çakmakçı and M. F. Taşar, 13–16. Ankara: Pegem Akademi

- Kanli, U. (2014). A Study on Identifying the Misconceptions of Pre-Service and N-Service Teachers about Basic Astronomy Concepts. *Eurasia Journal of Mathematics, Science & Technology Education*, 10 (5), 471–479.
- Kareth, Dahlan, K., Akbar, M., Togibasa, O. (2018). Harmonic Oscillation Characteristic using Visual Basic Application. *JPhCS*, 1028 (1).
- Kikas, E. (2004). Teachers' Conceptions and Misconceptions concerning Three Natural Phenomena. *Journal of Research in Science Teaching*, 41 (5), 432–448.
- Kızılcık, H. Ş., and B. Güneş. 2011. Developing Three-Tire Misconception Test Bout Regular Circular Motion. *Hacettepe University Journal of Education*, 41, 278–292.
- Koestoro & Basrowi. (2006). Strategi Penelitian Sosial dan Pendidikan. Yayasan Kampusina: Surabaya.
- Korur, F. (2015). Exploring Seventh-Grade Students and Pre-Service Science Teachers' Misconceptions in Astronomical Concepts. *Eurasia Journal of Mathematics, Science & Technology Education*, 11 (5), 1041–1060.
- Kuhlthau, C, Leslie, M., Ann, C. (2012). Guided Inquiry Design: A framework for inquiry in your school. Diakses melalui: [http://comminfo.rutgers.edu/~kuhlthau/docs/WebsiteGuided InquiryDesign.pdf](http://comminfo.rutgers.edu/~kuhlthau/docs/WebsiteGuided%20InquiryDesign.pdf)
- Lederman, N. G., Lederman, J. S., and Antink, A. (2013). *International Journal of Education, Mathematics, Science, and Technology*, 1-138.
- Lkhagva, O., Ulambayar, T., & Enkhtsetseg, P. (2012). Virtual laboratory for physics teaching. *Proceedings of the International Conference on Management and Education Innovation IPEDR*, 37, 319-323.
- Llewellyn, D. (2005). Teaching High School Science Through Inquiry. Amerika: Corwin Press.
- Ma, J., & Nickerson, J. V. (2006). Hands-on, simulated, and remote laboratories: a comparative literature review. *ACM Computing Surveys*, 38(3), 1-24.
- Malikha, Z. & Amir, M. F. (2018). Analisis Miskonsepsi Siswa Kelas V-B Min Buduran Sidoarjo Pada Materi Pecahan Ditinjau Dari Kemampuan Matematika. *Jurnal Mathemtics Education Jurnal*, 1 (2), 75-81

- Maulidah, S. S. & Prima, E. C. (2018). Using Physics Education Technology a Virtual Laboratory in Learning Waves and Sounds. *Journal of Science Learning*, 1(3), 116 -121.
- McDermott, L. C., P. R. L. Heron, P. S. Shaffer, and M. R. Stetzer. (2006). Improving the Preparation of K-12 Teachers through Physics Education Research. *American Journal of Physics*, 74 (9), 763–767.
- Megalina, Y., Sandi E. (2019). Pengaruh Model Pembelajaran *Inquiry Training* Terhadap Hasil Belajar Siswa Pada Materi Elastisitas Zat Padat Dan Hukum Hooke. *Jurnal Pendidikan Fisika*, 8(1), 74-78.
- Mestre, L. (2006). Accommodating Diverse Learning Styles in an Online Environment. *Reference & User Services Quarterly*, 46(2), 27-32.
- National Research Council. (2001). Adding It Up: Helping Children Learn Mathematics. Washington, DC: National Academy Press.
- Nisrina. N., Gunawan. G., Harjono, A. (2016). Pembelajaran kooperatif dengan media virtual untuk peningkatan penguasaan konsep fluida statis siswa. *Jurnal Pendidikan Fisika dan Teknologi*, 2 (66).
- Novitasari, D. (2010). Pengaruh Penggunaan Multimedia Interaktif terhadap Kemampuan Pemahaman Konsep Matematis Siswa. *Jurnal Pendidikan Matematika & Matematika*, 2 (2), 8-18.
- Obafemi, D., dan Onwioduokit, F. (2013) Identification of Difficult Concepts in Senior Secondary School Two (SS2) Physics Curriculum in Rivers State, Nigeria. *Asian Journal of Education and e-Learning*, 1, 317–322.
- Pesman, H. & Eryilmaz, A. (2010) Development of a Three-Tier Test to Assess Misconceptions About Simple Electric Circuits. *The Journal of Educational Research*, 208 – 222.
- Rafiza, A. R., & Maryam, A. R. (2013). Pembinaan media pengajaran berasaskan multimedia di kalangan guru ICTL. *Jurnal Kurikulum & Pengajaran Asia Pasifik*, 1(2), 20-31.

- Reese, M. C. (2013). Comparison of student achievement among two science laboratory types: Traditional and virtual (Doctoral dissertation). Diakses melalui: ProQuest Dissertations and Theses database. (UMI No 3590234)
- Rian, V., & Kamisah, O. (2013). Keberkesanan penggunaan pelbagai media pengajaran dalam meningkatkan kemahiran proses sains dalam kalangan pelajar. *Jurnal Pendidikan Malaysia*, 37(1), 1-11.
- Rizal, M. (2015). The Effect of Guided Inquiry Learning with Multi Representation of the Science Process Skills and Concepts Mastery of Natural Science of Junior High School Students. *Jurnal Pendidikan Sains (JPS)*, 2(3), 159–165.
- Sahyar, Hastini, N. (2017). The Effect of Scientific Inquiry Learning Model Based on Conceptual Change on Physics Cognitive Competence and Science Process Skill (SPS) of Students at Senior High School. *Journal of Education and Practice*, 8(5), 120-126.
- Samsudin, A., Suhandi, A., Rusdiana, D., Kaniawati, I., & Coştu, B. (2017). Promoting Conceptual Understanding on Magnetic Field Concept Through Interactive Conceptual Instruction (ICI) with PDEODE* E Tasks. *Advanced Science Letters*, 23(2), 1205-1209.
- Sari, P.I., Gunawan. & Harjono, A. (2016). Penggunaan discovery learning berbantuan laboratorium virtual pada penguasaan konsep fisika siswa. *Jurnal Pendidikan Fisika dan Teknologi*. 2(4), 176-182.
- Schmidt, H. J. (1997). Students' Misconceptions? Looking for a Pattern. *Science Education*, 81(2), 123–135.
- Sholikhan. (2017). Understanding Concepts Through Inquiry Learning Strategy. *Journal of Research & Method in Education*, 7(1), 97-102.
- Silaban, B. (2014). Hubungan antara penguasaan konsep fisika dan kreativitas dengan kemampuan memecahkan masalah pada materi pokok listrik statis. *Jurnal Penelitian Bidang Pendidikan*, 20, 65.
- Simbolon, D. & Sahyar. (2015). Pengaruh Model Pembelajaran Inkuiri Terbimbing Berbasis Eksperimen Riil dan Laboratorium Virtual terhadap Hasil Belajar Fisika Siswa. *Jurnal Pendidikan dan Kebudayaan*, 21(3), 299-315.

- Smith, J. P., diSessa, A., A., and Roschelle, J. (1993). Misconceptions Reconceived: A Constructivist Analysis of Knowledge in Transition. *The Journal of the Learning Sciences*, 3 (2), 115–163.
- Sudaryanti. (2015). Komparasi keefektifan pendekatan inkuiri terbimbing dan pendekatan inkuiri terstruktur terhadap keterampilan berpikir kritis, penguasaan konsep dan keterampilan proses sains siswa. Thesis. Yogyakarta: Program Pascasarjana Universitas Negeri Yogyakarta.
- Sugiarto. (2001). Teknik Sampling. Jakarta : PT. Gramedia Pustaka Utama.
- Sugiyono. (2014). *Metode Penelitian Pendidikan (Pendekatan Kuantitatif, Kualitatif dan R&D)*. Bandung: Alfabeta.
- Sukma, dkk. (2016). Pengaruh Model Pembelajaran Inkuiri Terbimbing (Guided Inquiry) dan Motivasi Terhadap Hasil Belajar Fisika Siswa. *Saintifika*, 18(1), 59-63.
- Sularso, Sunarno, W., Sarwanto. (2017). Understanding Students' Concepts through Inquiry Learning and Free Modified Inquiry on Static Fluid Material. *International Journal of Science and Applied Science: Conference Series*, 2(1), 363 – 367.
- Sumintono, B., & Widhiarso, W. (2015). Aplikasi Pemodelan Rasch pada Assesment Pendidikan. *Trim Komunikata: Cimahi*
- Sutarno, dkk. (2017). Keterampilan Pemecahan Masalah Mahasiswa dalam Pembelajaran Bandul Fisis Menggunakan Model Problem Solving Virtual Laboratory. *Jurnal Pendidikan Fisika dan Teknologi*, 3(2).
- Sutarno, S., Setiawan, A., Suhandi, A. & Kaniawati, I. (2017a). Pre-service physics teachers' problem-solving skills in projectile motion concept. *Journal of Physics: Conference Series*, 889.
- Syaifulloh, R. B., & Jatmiko, B. (2014). Penerapan pembelajaran dengan model guided discovery dengan lab virtual PhET untuk meningkatkan hasil belajar siswa kelas XI di SMAN 1 Tuban pada pokok bahasan teori kinetik gas. *Jurnal Inovasi Pendidikan Fisika (JIPF)*, 03(02), 174–179.

- Taslidere, E. (2015). A study investigating the effect of treatment developed by integrating the 5E and simulation on preservice science teacher's achievement in photoelectric effect. *Eurasia Journal of Mathematics, Science and Technology Education*, 11(4), 777-792.
- Taslidere, E. (2016) Development and Use of a Three-Tier Diagnostic Test to Assess High School Students' Misconceptions about The Photoelectric Effect. *Research in Science & Technological Education*.
- Tatli, Z., & Ayas, A. (2013). Effect of a Virtual Chemistry Laboratory on Students' Achievement. *Educational Technology & Society*, 16, 159-170.
- Utari, G. P. & Liliawati, W. (2019). Identifikasi Miskonsepsi Siswa pada Materi Suhu dan Kalor Menggunakan *Four-Tier Diagnostic Test* di SMA. *Prosiding Seminar Nasional Fisika 5.0*, 86-98
- Wandersee, J. H., J. J. Mintzes, and J. D. Novak. (1994). Research on Alternative Conceptions in Science. In *Handbook of Research on Science Teaching and Learning*, edited by D. L. Gabel, 177–210. New York: Macmillan.
- Wenning, C.J. (2011). The Levels of Inquiry Model Of Science Teaching. *Journal Of Physics Education Online*, 6(2), 9–16.
- Wibowo, F.C., Suhandi, A., Rusdiana, D., Darman, D.R., Ruhiat, Y., Denny, Y., Suherman., & Fatah, A. (2016). Microscopic virtual media (MVM) in physics learning: case study on students understanding of heat transfer. *Journal of Physics: Conference Series*, 739.
- Wieman, C., & Perkins, K. (2005). Transforming physics education. *Physics Today*, 58(11), 36-41.
- Woodfield, B. (2005). Virtual chemlab getting started. *Pearson Education website*. 25.
- Ye L, Wong, N S, and Ho, J. W. Y. (2016). Design development and evaluation of biochemistry virtual laboratory for blended learning GSTF. *International Journal of Education*, 3, 40.
- Yunus, S. R., Sanjaya, I. G. M. & Jatmiko, B. (2013). Implementasi pembelajaran fisika berbasis guided inquiry untuk meningkatkan hasil belajar siswa auditorik. *Jurnal Pendidikan IPA Indonesia*, 2(1), 48-52.

- Zacharia, Z. & Anderson, O. R. (2003) The effects of an interactive computer-based simulation prior to performing a laboratory inquiry-based experiment on students' conceptual understanding of physics. *American Journal of Physics*. 71, 618.
- Zulfikar, A., Girsang, D. Y., Saepuzaman, D., & Samsudin, A. (2017). Analyzing educational university students' conceptions through smartphone-based PDEODE* E tasks on magnetic field in several mediums. *AIP Conference Proceedings*, 1848(1).