PEMBELAJARAN 6E *LEARNING BY DESIGN* PADA KONSEP ALGAE UNTUK MEMBEKALI KETERAMPILAN RISET MAHASISWA

TESIS

Diajukan sebagai salah satu untuk memperoleh gelar Magister Pendidikan pada Program Studi Pendidikan Biologi

Oleh

Arum Sanjayanti

NIM 1707183

PROGRAM STUDI PENDIDIKAN BIOLOGI

SEKOLAH PASCASARJANA

UNIVERSITAS PENDIDIKAN INDONESIA

2019

LEMBAR HAK CIPTA

PEMBELAJARAN 6E *LEARNING BY DESIGN* PADA KONSEP ALGAE UNTUK MEMBEKALI KETERAMPILAN RISET MAHASISWA

Oleh
Arum Sanjayanti
S.Pd Universitas Nusantara PGRI Kediri, 2016

Sebuah tesis yang diajukan untuk memenuhi salah satu syarat memperoleh gelar
Magister Pendidikan pada Prodi Pendidikan Sekolah Pascasarjana

LEMBAR PENGESAHAN

PEMBELAJARAN 6E *LEARNING BY DESIGN* PADA KONSEP ALGAE UNTUK MEMBEKALI KETERAMPILAN RISET MAHASISWA

Oleh:
Arum Sanjayanti
1707183

Disetujui oleh

Pembimbing I

Prof. Dr. Hj. Nuryani Y Rustaman, M.Pd
NIP. 195012311979032029

Pembimbing II

Dr. Topik Hidayat, M.Si.
NIP. 197004101997021001

Mengetahui,
Ketua Program Studi Pendidikan Biologi

Dr. Bambang Supriatno, M.Si
NIP 196305211988031002

ABSTRAK

PEMBELAJARAN 6E *LEARNING BY DESIGN* PADA KONSEP ALGAE UNTUK MEMBEKALI KETERAMPILAN RISET MAHASISWA

Oleh

Arum Sanjayanti
1707183

Penelitian ini dilatarbelakangi oleh kesulitan mahasiswa dalam menulis karya tulis ilmiah, kurangnya keterampilan menulis, kemampuan membuat kunci dikotomik, dan mengklasifikasi. Penelitian menggunakan metode deskriptif dalam mengembangkan Praktikum Botani Cryptogamae berbasis 6E *learning by design* (*engage*, *explore*, *explain*, *engineer*, *enrich*, *evaluate*) dalam membekali keterampilan riset mahasiswa. Penelitian ini melibatkan 38 mahasiswa selama 3 bulan. Data dikumpulkan melalui beberapa instrumen meliputi: penulisan proposal keterampilan riset, *Test of Logical Thinking* (TOLT), kuisioner kemampuan mengkaji artikel ilmiah, kemampuan mengidentifikasi algae mikroskopis dan makroskopis, keterampilan berkomunikasi mahasiswa, dan respon mahasiswa terhadap pembelajaran. Hasil penelitian menunjukkan bahwa keterlaksanaan implementasi pembelajaran 6E *learning by design* pada praktikum algae dalam membekali keterampilan riset mahasiswa secara keseluruhan terlaksana semua, akan tetapi terdapat tahapan dilakukan diluar jam pembelajaran dan tahapan diganti dengan pembuatan bagan *re-design* sebagai bentuk tahap " *engineer*". Keseluruhan hasil penulisan proposal keterampilan riset mahasiswa, kemampuan mengkaji artikel ilmiah, kemampuan mengidentifikasi algae mikroskopis dan makroskopis, keterampilan berkomunikasi mahasiswa pada level sedang. Sedangkan respon mahasiswa terhadap pembelajaran 6E *learning by design* pada level tinggi. Hasil positif pembekalan keterampilan riset mahasiswa dapat membuat produk dari algae makroskopis berupa susu bubuk, es krim, keripik, masker jerawat, nori, sirup rumput laut, cireng, dan obat antipiretik. Keseluruhan produk tersebut berbahan dasar dari *Gracillaria sp*., *Ulva lactuca*, dan *Sargassum sp*.

Kata kunci: Algae, 6E *learning by design*, Keterampilan riset mahasiswa

ABSTRACT

6E LEARNING BY DESIGN IN THE ALGAE CONCEPT TO EQUIPPING STUDENTS' RESEARCH SKILLS

Oleh

Arum Sanjayanti
1707183

This research is motivated by the difficulties of students in writing scientific papers, writing skills, ability to make dichotomy keys, and classifying. The research used descriptive methods in developing the 6E-based Cryptogamae Botanical Practicum by design (*engage*, *explore*, *explain*, *engineer*, *enrich*, *evaluate*) in equipping students' research skills. This study involved 38 students for 3 months. Data was collected through several instruments including: research skills proposals, Test of Logical Thinking (TOLT), questionnaires on the ability to review scientific articles, identification abilities of microscopic and macroscopic algae, student communication skills, and student responses to learning. The results showed that the implementation of learning 6E learning with the design of the algae practicum in equipping students' research skills as a whole was carried out, but it was displayed outside the learning hours, and the stages were replaced by making a redesign chart as the initial "engineer" stage. Overall, the results of the student's research skills proposal, the ability to review scientific articles, the ability to identify microscopic and macroscopic algae, and the students' communication skills at a moderate level. While the student response to learning 6E learning with design at a high level. The positive results of the provision of student research skills can make products from macroscopic algae in the form of powdered milk, ice cream, chips, acne masks, nori, seaweed syrup, cireng, and antipyretic drugs. All of these products are made from Gracillaria sp., Ulva lactuca, and Sargassum sp.

Keywords: Algae, 6E learning by design, Student research skills

DAFTAR ISI

Halaman

DAFTAR TABEL

Tabel **Halaman**

DAFTAR GAMBAR

Gambar **Halaman**

DAFTAR LAMPIRAN

Lampiran **Halaman**

DAFTAR PUSTAKA

Adedokun, O. A., Bessenbacher, A. B., Parker, L. C., Kirkham, L. L., & Burgess, W. D. (2013). Research skills and STEM undergraduate research students' aspirations for research careers: Mediating effects of research self-efficacy. *Journal of Research in Science teaching*, *50*(8), 940-951.

Ain, C. T., Sabir, F., & Willison, J. (2019). Research skills that men and women developed at university and then used in workplaces. *Studies in Higher Education*, *44*(12), 2346-2358.

Almroth, B. C. (2015). The importance of laboratory exercises in biology teaching; case study in an ecotoxicology course. *Pedagogical Development And Interactive Learning*, 1-11.

Alter, S., & Dennis, A. R. (2002). Selecting research topics: Personal experiences and speculations for the future. *Communications of the Association for Information Systems*, *8*(1), 21.

Amadieu, F., Van Gog, T., Paas, F., Tricot, A., & Mariné, C. (2009). Effects of prior knowledge and concept-map structure on disorientation, cognitive load, and learning. *Learning and Instruction*, *19*(5), 376-386.

Amelia, M., & Rahmaida, R. (2017). Produktivitas Ilmiah Peneliti Indonesia pada Penelitian Keanekaragaman Hayati Indonesia Berdasarkan Basis Data Scopus 1990-2015. *Jurnal Biologi Indonesia*, *13*(2).

Anderson, J. R. (1981). Effects of prior knowledge on memory for new information. *Memory & Cognition*, *9*(3), 237-246.

Anderson, G., Bowles, R., Daddey, F., & Ruttan, S. (2015). JIBC Student Research Skills Development Framework. *British Columbia, Canada: Justice Institute of British Columbia*.

Anggraeni, S. (2001). Analisis Pembelajaran Biologi Molekuler di SMU Kodya Bandung. Makalah Penelitian. Bandung: FMIPA UPI.

Atman, C. J., Chimka, J. R., Bursic, K. M., & Nachtmann, H. L. (1999). A comparison of freshman and senior engineering design processes. *Design studies*, *20*(2), 131-152.

Ayustaningwarno, F. (2014). Teknologi pangan: Teori praktis dan aplikasi. *Yogyakarta: Graha Ilmu*, *23*.

Bada, S. O., & Olusegun, S. (2015). Constructivism learning theory: A paradigm for teaching and learning. *Journal of Research & Method in Education*, *5*(6), 66-70.

Balata, D., Piazzi, L., & Rindi, F. (2011). Testing a new classification of morphological functional groups of marine macroalgae for the detection of responses to stress. *Marine biology*, *158*(11), 2459-2469.

Bandaranaike, S. (2018). From research skill development to work skill development. *Journal of University Teaching & Learning Practice*, *15*(4), 7.

Barkia, I., Saari, N., & Manning, S. R. (2019). Microalgae for high-value products towards human health and nutrition. *Marine drugs*, *17*(5), 304

Beck, C. W., & Blumer, L. S. (2012). Inquiry-based ecology laboratory courses improve student confidence and scientific reasoning skills. *Ecosphere*, *3*(12), 1-11.

Berry, B.M., & Berry, G. (2014). " Reading an Object": Developing Effective Scientific Inquiry Using Student Questions. *European Journal of Science and Mathematics Education*, *2*(2), 87-97.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., & Rumble, M. (2010). Draft white paper 1: Defining 21st century skills. Kota Kinabalu, Malaysia.

Birzina, R., Cedere, D., & Petersone, L. (2019). Factors influencing the first year students' adaptation to natural science studies in higher education. *Journal of Baltic Science Education, 18*(3), 349.

Bloom, B. S. (1956). Taxonomy of educational objectives. New York: David McKay Company. *Inc. Bloom Taxonomy of Educational Objectives*

Bone, E. K., & Reid, R. J. (2011). Prior learning in biology at high school does not predict performance in the first year at university. *Higher Education Research & Development, 30*(6), 709-724.

Bordovskaia, N., & Kostromina, S. (2014). Personal features and research potential of students. *The European Journal of Social & Behavioural Sciences, 8*(1), 1284.

Boudreaux, A., Shaffer, P. S., Heron, P. R., & McDermott, L. C. (2008). Student understanding of control of variables: Deciding whether or not a variable influences the behavior of a system. *American Journal of Physics, 76*(2), 163-170.

Bray, R., & Boon, S. (2011). Towards a framework for research career development: An evaluation of the UK's Vitae Researcher Development Framework. *International Journal for Researcher Development, 2*(2),99-116. doi:https://doi.org/10.1108/17597511111212709

Brevini, B., Hintz, A., & McCurdy, P. (Eds.). (2013). *Beyond WikiLeaks: Implications for the future of communications, journalism and society*. Springer.

Broady, P. A., & Merican, F. (2012). Phylum Cyanobacteria: blue-green bacteria, blue-green algae. *Kingdoms Bacteria, Protozoa, Chromista, Plantae, Fungi. New Zealand inventory of biodiversity, 3*, 50-69.

Brown, R. T., Daly, B. P., & Leong, F. T. (2009). Mentoring in research: A developmental approach. *Professional Psychology: Research and Practice, 40*(3), 306.

Bruckermann, T., Ochsen, F., & Mahler, D. (2018). Learning opportunities in biology teacher education contribute to understanding of nature of science. *Education Sciences*, *8*(3), 103.

Burke, B.N. (2014). The ITEEA 6E Learning By Design™ Model, Maximizing Informed Design and Inquiry in The Integrative STEM Classroom. *Technology and Engineering Teacher*, *73*(6), 14–19.

Bybee, R. W., Taylor, J. A., Gardner, A., Van Scotter, P., Powell, J. C., Westbrook, A., & Landes, N. (2006). The BSCS 5E instructional model: Origins and effectiveness. *Colorado Springs, Co: BSCS*, *5*, 88-98.

Cantu, L. L., & Herron, J. D. (1978). Concrete and formal Piagetian stages and science concept attainment. *Journal of Research in Science Teaching*, *15*(2), 135-143.

Cargill, M., & O'Connor, P. (2013). *Writing scientific research articles: Strategy and steps*, ISBN 978-1-4051-8619-3. Blackwell Publishing

Carraz, R., & Harayama, Y. (2018). Japan's innovation systems at the crossroads: Society 5.0. *Digital Asia*, 33-45.

Casadevall, A., Ellis, L.M., Davies, E.W., McFall-Ngai M., & Fang, F.C. 2016. A frameworkfor improving the quality of research in the biological sciences. *mBio*, 7(4), doi:10.1128/mBio.01256-16

Casem, M. L. (2006). Student perspectives on curricular change: lessons from an undergraduate lower-division biology core. *CBE—Life Sciences Education*, *5*(1), 65-75.

Casey, S. C., MacCallum, J., Robertson, L., & Strachan, L. (2018). Researching Skills Development: Students as Partners in This Process. *New Directions in the Teaching of Physical Sciences*, *13*(1)

Chapman, R. L. (2013). Algae: the world's most important "plants"—an introduction. *Mitigation and Adaptation Strategies for Global Change*, *18*(1), 5-12.

Chase, J. A. D., Topp, R., Smith, C. E., Cohen, M. Z., Fahrenwald, N., Zerwic, J. J., & Conn, V. S. (2013). Time management strategies for research productivity. *Western Journal of Nursing Research*, *35*(2), 155-176.

Cheney, D. (2016). Toxic and harmful seaweeds. In *Seaweed in health and disease prevention*, 407-421. Academic Press.

Christoffersen, M. L. (1995). Cladistic taxonomy, phylogenetic systematics, and evolutionary ranking. *Systematic biology*, *44*(3), 440-454.

Chu, S. K. W., Reynolds, R. B., Tavares, N. J., Notari, M., & Lee, C. W. Y. (2017). Twenty-first century skills education in Switzerland: An example of project-based learning using Wiki in science education. In *21st century skills development through inquiry-based learning* , 61-78. Springer, Singapore

Chung, Y., Yoo, J., Kim, S. W., Lee, H., & Zeidler, D. L. (2016). Enhancing Students'communication Skills In The Science Classroom Through Socioscientific Issues. *International Journal of Science and Mathematics Education*, *14*(1), 1-27

Chung, C. C., Lin, C. L., & Lou, S. J. (2018). Analysis Of The Learning Effectiveness of The STEAM-6E Special Course—A Case Study About The Creative Design Of IoT Assistant Devices For The Elderly. *Sustainability*, *10*(9), 3040.

Cimer, A. (2012). What makes biology learning difficult and effective: Students' views. *Educational Research and Reviews*, *7*(3), 61

Coiro, J. (2011). Predicting reading comprehension on the Internet: Contributions of offline reading skills, online reading skills, and prior knowledge. *Journal of literacy research*, *43*(4), 352-392.

Corcoran, J. (2016). Logic teaching in the 21st century. (1):1-34

Creswell, J.W. (2009). *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches* (Edisi Ketiga). Thousand Oaks: Sage

Cumming, G. (2014). The new statistics: Why and how. *Psychological science*, *25*(1), 7-29.

Demirel, M. (2009). Lifelong learning and schools in the twenty-first century. *Procedia-Social and Behavioral Sciences*, *1*(1), 1709-1716

Derntl, M. (2014). Basics of research paper writing and publishing. *International Journal of Technology Enhanced Learning*, *6*(2), 105-123.

Diaz, K. (2017). Prior Knowledge: Its Role in Learning. *University of the Philippines Los Baños. doi*, *10*.

Dominguez, H., & Loret, E. P. (2019). Ulva lactuca, a source of troubles and potential riches. *Marine drugs*, *17*(6), 357.

Duch, B. J., Groh, S. E., & Allen, D. E. (2001). *The power of problem-based learning: a practical" how to" for teaching undergraduate courses in any discipline*. Stylus Publishing, LLC.

Duke, N. K., & Pearson, P. D. (2009). Effective practices for developing reading comprehension. *Journal of education*, *189*(1-2), 107-122.

Duran, L. B., & Duran, E. (2004). The 5E Instructional Model: A Learning Cycle Approach for Inquiry-Based Science Teaching. *Science Education Review*, *3*(2), 49-58.

Edelmann, H. G., Martius, T., Hahn, A., Schlüter, K., & Nessler, S. H. (2016). Learning About The Nature of Science Using Algae. *School Science Review*, *98*(362), 85-90

Etemadzadeh, A., Seifi, S., & Far, H. R. (2013). The role of questioning technique in developing thinking skills: The ongoing effect on writing skill. *Procedia-Social and Behavioral Sciences*, *70*, 1024-1031.

Etzler, F. M., & Madden, M. (2014). The test of logical thinking as a predictor of first-year pharmacy students' performance in required first-year courses. *American journal of pharmaceutical education*, *78*(6).

Ferreira, C. M., & Serpa, S. (2018a). Society 5.0 and Social Development: Contributions to a Discussion, 5(4), doi: 10.5430/mos.v5n4p26.

Ferreira, C. M., & Serpa, S. (2018b). Society 5.0 and social development. *Management and Organizational Studies,(5)*, 26-31.

Fosnot, C. T. (Ed.). (1996). *Constructivism, perspectives and practice*. New York

Fosnot, C. T. (2013). *Constructivism: Theory, perspectives, and practice*. Teachers College Press.

Gabbay, D. M., & Rivlin, L. (2017). HEAL2100: Human Effective Argumentation and Logic for the 21st Century. The Next Step in the Evolution of Logic. *IfCoLog Journal of Logics and Their Applications*. *4*(6).

Galeano, N., Morales-Menendez, R., & Cantú, F. J. (2012). Developing research skills in undergraduate students through an internship program in research and innovation. *International Journal of Engineering Education*, *28*(1), 48.

Garlapati, D., Chandrasekaran, M., Devanesan, A., Mathimani, T., & Pugazhendhi, A. (2019). Role of cyanobacteria in agricultural and industrial sectors: an outlook on economically important byproducts. *Applied microbiology and biotechnology*, *103*(12), 4709-4721

Garnett, P. J., Tobin, K., & Swingler, D. G. (1985). Reasoning abilities of secondary school students aged 13-16 and implications for the teaching of science. *European Journal of Science Education*, *7*(4), 387-397.

Gilmore, J., & Feldon, D. (2010). Measuring Graduate Students' Teaching and Research Skills through Self-Report: Descriptive Findings and Validity Evidence. *Online Submission*.

Glasser, W. (1986). *Control theory in the classroom*. Perennial Library/Harper & Row Publishers.

Goedhart, C. M., & McLaughlin, J. S. (2016). Student Scientists: Transforming the Undergraduate Biology Lab into a Research Experience. *The American Biology Teacher*, *78*(6), 502-508.

Goff, W., & Veresov, N. (2015). Examining teacher-researcher collaboration through the cultural interface. *Cultural Studies of Science Education*, *10*(3), 621-627.

Goodstein, M., & Howe, A. C. (1978). The Use of Concrete Methods in Secondary Chemistry Instruction. *Journal of Research in Science Teaching*, *15*(5), 361-66.

Griffin, P., & Care, E. (Eds.). (2014). *Assessment and teaching of 21st century skills: Methods and approach*. Springer.

Gurgel, C.F.D., & Bautista,J.L (2007). Red algae, doi:10.1002/9780470015902.a0000335

Gustavii, B. (2010). How to write and illustrate scientific. Cambridge University Press.

Hadi, S. (2004). Metodologi research (jilid 1-4). *Yogyakarta*

Hailikari, T., Katajavuori, N., & Lindblom-Ylanne, S. (2008). The relevance of prior knowledge in learning and instructional design. *American journal of pharmaceutical education*, *72*(5).

Harcombe, E. S. (2001). *Science teaching/science learning: Constructivist learning in urban classrooms* (Vol. 14). Teachers College Press.

Hatfield, R.S. 2014. Assessing Oral Communication, 34-44, Winona State University.

Hidayat, T & Pancoro, A. 2008. Ulasan Kajian Filogenetika Molekuler dan Peranannya dalam Menyediakan Informasi Dasar untuk Meningkatkan Kualitas Sumber Genetik Anggrek, *4*(1), 35-40, doi: http://dx.doi.org/10.21082/jbio.v4n1.

Horikawa, K., Stern, D., KenalEy, S., Fleming, T. (2015). Teaching and Learning Ecology Using a Classroom Algal Photobioreactor. Boyce Thompson Institute for Plant Research.

Husman, J., & Lens, W. (1999). The role of the future in student motivation. *Educational psychologist*, *34*(2), 113-125.

Inhelder, B., & Piaget, J. (1958). *The growth of logical thinking from childhood to adolescence: An essay on the construction of formal operational structures*, (22). Psychology Press.

Inhelder & Piaget, J, B. (2008). *The psychology of the child*. Basic books.

Ismail, N., Alias, S., & Albakri, I. (2006). Inquiry Based Learning: A New Approach to Classroom Learning. *English Language Journal*, *2*(1), 13-24.

Jacquemart, A. L., Lhoir, P., Binard, F., & Descamps, C. (2016). An interactive multimedia dichotomous key for teaching plant identification. *Journal of Biological Education*, *50*(4), 442-451.

Jorge, J. M. (2005). Developing teachers' knowledge and skills as researchers: A conceptual framework. *Asia-Pacific Journal of Teacher Education*, *33*(3), 303-319.

Kaniawati, D. S., & Suryadi, S. (2016). Integration of STEM Education In Learning Cycle 6E To Improve Problem Solving Skills on Direct Current Electricity. *Proceeding of ICMSE*, *3*(1).

Kanli, U., & Yagbasan, R. (2008). The effects of a laboratory approaches on the development of university students' science process skills and conceptual achievement. *Essays in Education*, *24*(1), 11.

Katehi, L., Pearson, G., & Feder, M. (2009). *Engineering in K-12 education: Understanding the status and improving the propects*. Washington, DC: The National Academies Press.

Kaur, C. D. (2013). Research publications: Need for Academicians. *Asian J. Res. Pharm. Sci*, *3*(4), 220-228.

Kementerian Pendidikan dan Kebudayaan Republik Indonesia. (2010). Peraturan kementerian pendidikan dan kebudayaan Republik Indonesia no. 17 tahun 2010 tentang pencegahan dan penanggulangan plagiat di perguruan tinggi. Jakarta: Kementerian Pendidikan dan Kebudayaan Republik Indonesia

Kepel, R. C., Mantiri, D. M., & Rumengan, A. (2018). The biodiversity of macroalgae in the coastal waters of Blongko Village, Sub-District of Sinonsayang, District of South Minahasa. *Jurnal Ilmiah PLATAX*, *6*(1), 174-187.

Keshav, S. (2007). How to read a paper. *Acm Sigcomm Computer Communication Review*, *37*(3), 83-84.

Kiley, M., & Wisker, G. (2009). Threshold concepts in research education and evidence of threshold crossing. *Higher Education Research & Development*, *28*(4), 431-441.

Klimova, B. F. (2014). Approaches to the teaching of writing skills. *Procedia-Social and Behavioral Sciences*, *112*, 147-151.

Ko, J., & Sammons, P. (2013). *Effective Teaching: A Review of Research and Evidence*. CfBT Education Trust. 60 Queens Road, Reading, RG1 4BS, England.

Krathwohl, D. R. (2002). A revision of Bloom's taxonomy: An overview. *Theory into practice*, *41*(4), 212-218.

Kuo, Y. H. (2009). The Role of a Mentor in Undergraduates' Research Writing Process. *Online Submission*

Lamanauskas, V., & Augienė, D. (2015). Development of scientific research activity in university: A position of the experts. *Procedia-Social and Behavioral Sciences*, *167*, 131-140.

Lander, J., Seeho, S., & Foster, K. (2019). Learning Practical Research Skills Using An Academic Paper Framework–An Innovative, Integrated Approach. *Health Professions Education*, *5*(2), 136-145.

Lang, H. R., & Evans, D. N. (2006). *Models, strategies, and methods for effective teaching*. Allyn & Bacon.

Lang, H. R., & Evans, D. N. (2006). *Models, strategies, and methods for effective teaching*. Allyn & Bacon.

Lapena, J. F. F., & Peh, W. C. (2019). Various Types of Scientific Articles. *A Guide to the Scientific Career: Virtues, Communication, Research and Academic Writing*, 351-355.

Larsen, P., & Ins, V. M. (2010). The rate of growth in scientific publication and the decline in coverage provided by Science Citation Index. *Scientometrics*, *84*(3), 575-603.

Lawson, A. E., & Renner, J. W. (1975). Relationships of science subject matter and developmental levels of learners. *Journal of Research in Science Teaching*, *12*(4), 347-358.

Lawson, A. E. (1979). Combining Variables, Controlling Variables, and Proportions: Is There a Psychological Link?. *Science Education*, *63*(1), 67-72.

Lawson, A. E. (1982). Formal Reasoning, Achievement, and Intelligence: An Issue of Importance. *Science Education*, *66*(1), 77-83.

Lawson, A. E. (1985). A review of research on formal reasoning and science teaching. *Journal of research in science teaching*, *22*(7), 569-617.

Lee, E.R. (2008). Phycology Fourth edition. Cambridge University Press.

Lin, K. Y., Hsiao, H. S., Williams, P. J., & Chen, Y. H. (2019). Effects of 6E-oriented STEM practical activities in cultivating middle school students' attitudes toward technology and technological inquiry ability. *Research in Science & Technological Education*, *38*(1), 1-18.

Linn, M. C., Palmer, E., Baranger, A., Gerard, E., & Stone, E. (2015). Undergraduate research experiences: Impacts and opportunities. *Science*, *347*(6222).

Lo, M. C., Thurasamy, R., & Liew, W. T. (2014). Relationship between bases of power and job stresses: role of mentoring. *Springerplus*, *3*(1), 1-15.

Loveys, B. R., Kaiser, B. N., McDonald, G., Kravchuk, O., Gilliham, M., Tyerman, S., & Able, A. J. (2014). The development of student research skills in second year plant biology. *International Journal of Innovation in Science and Mathematics Education*, *22*(3).

Lunenberg, M., Korthagen, F., & Swennen, A. (2007). The teacher educator as a role model. *Teaching and teacher education*, *23*(5), 586-601.

Mack, C. A. (2018). How to write a good scientific paper. ISBN 9781510619135. Society of Photo-Optical Instrumentation Engineers (SPIE).

Malmfors, T., Di Marco, P., & Savolainen, K. (2004). Good Evaluation Practice: a proposal of guidelines. *Toxicology letters*, *151*(1), 19-23.

Manapa, E.S. & Rustaman, N. (2011). "A concept model toward coral reefs literacy: Case study on primary school students". *Paper presented in The 2nd Coral Reef Management Symposium on the Coral Triangle Area*. Kendari, South Sulawesi.

Manoylov, K. M. (2014). Taxonomic identification of algae (morphological and molecular): species concepts, methodologies, and their implications for ecological bioassessment. *Journal of phycology*, *50*(3), 409-424.

Masic, I. (2014). Plagiarism in scientific research and publications and how to prevent it. *Materia socio-médica*, *26*(2), 141.

Maskour, L., Alami, A., Zaki, M., & Agorram, B. (2019). Plant classification knowledge and misconceptions among university students in morocco. *Education sciences*, *9*(1), 48.

Mason, K., Losos, J., & Singer, S. (2017). Biology; Eleventh Edition. McGraw-Hill Education, New York.

McCurdy, S. M., Zegwaard, K. E., & Dalgety, J. (2013). Evaluating the Development of Science Research Skills in Work-Integrated Learning through the Use of Workplace Science Tools. *Asia-Pacific Journal of Cooperative Education*, *14*(4), 233-249.

McKinnon, J. W., & Renner, J. W. (1971). Are colleges concerned with intellectual development?. *American Journal of Physics*, *39*(9), 1047-1052.

McSweeney, P., & Rayner, J. (2011). Developments in Australian agricultural and related education. *Journal of Higher Education Policy and Management*, *33*(4), 415-425.

Mendez, M. (2018). Ten simple rules for developing good reading habits during graduate school and beyond. PLoS Comput Biol 14(10). doi:10.1371/journal.pcbi.1006467

Millar, R. (2004). The role of practical work in the teaching and learning of science. *Commissioned paper-Committee on High School Science Laboratories: Role and Vision. Washington DC: National Academy of Sciences*, *308*.

Milledge, J. J., Nielsen, B. V., & Bailey, D. (2016). High-value products from macroalgae: the potential uses of the invasive brown seaweed, Sargassum muticum. *Reviews in Environmental Science and Bio/Technology*, *15*(1), 67-88.

Morreale, S. P., Osborn, M. M., & Pearson, J. C. (2000). Why communication is important: A rationale for the centrality of the study of communication. *Jaca-Annandale-*, *1*, 1-25.

National Research Council. (1996). *National science education standards*. National Academies Press.

National Research Council (US) Committee on a New Biology for the 21st Century: Ensuring the United States Leads the Coming Biology Revolution. (2009). A new biology for the 21st century: ensuring the United States leads the coming biology revolution.

National Research Council. (2012). *A Framework For K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. National Academies Press.

Nielsen, K. H. (2013). Scientific communication and the nature of science. *Science & Education*, *22*(9), 2067-2086.

Novak, J. D. (1981). *Applying Learning Psychology and Philosophy of Science to Biology Teaching*. *43*(1), 12–21.

Nurdiani, N. (2018). Kerangka Kerja TPACK (Technological Pedagogical and Content Knowledge) dalam Meningkatkan Kemampuan Penalaran dan Penguasaan Konsep Embriologi Mahasiswa Calon Guru Biologi. (Disertasi), Universitas Pendidikan Indonesia, Bandung. Tidak diterbitkan.

Oktaviani, F., & Hidayat, T. (2010). Profil keterampilan berkomunikasi siswa sma menggunakan metode fenetik dalam pembelajaran klasifikasi arthropoda. *Jurnal Pengajaran MIPA*, *15*(1), 13-24.

Oryza, D., Mahanal, S., & Sari, M. S. (2017). Identifikasi Rhodophyta sebagai Bahan Ajar Di Perguruan Tinggi. *Jurnal Pendidikan: Teori, Penelitian, dan Pengembangan*, *2*(3), 309-314.

Osborne, D. V. (1963). Some aspects of the theory of dichotomous keys. *New Phytologist*, *62*(2), 144-160

Ozuru, Y., Dempsey, K., & McNamara, D. S. (2009). Prior knowledge, reading skill, and text cohesion in the comprehension of science texts. *Learning and instruction*, *19*(3), 228-242.

Pansing, J., Gerung, G., Sondak, C., Wagey, B., Ompi, M., & Kondoy, K. (2017). Morfologi Sargassum SP Di Kepulauan Raja Ampat, Papua Barat. *Jurnal Pesisir dan Laut Tropis*, *5*(1), 13-17.

Panula, Y.E., Jeronen, E., Lemmetty, P., & Pauna, A. (2018). Teaching methods in biology promoting biodiversity education. *Sustainability*, *10*(10), 3812.

Pardeshi, R., & Deshmukh, P. D. (2019). Classification of Microscopic Algae: An Observational Study with AlexNet. In *International Conference on Soft Computing and Signal Processing*, 309-316, Springer, Singapore.

Partnership for 21stCentury Skills P21. (2011). *Framework for 21st Century Learning.* Washington DC, Partnership for 21st Century Skills.

Partnership for 21stCentury Skills P21. (2014). *Reimagining Citizenship for the 21st Century: A Call to Action for Policymakers and Educators.* Washington DC, Partnership for 21st Century Skills. Retrieved from http://www.p21.org/our-work/citizenship.

Pasztor, A., & Csapo, B. (2014). Improving combinatorial reasoning through inquiry-based science learning. In *Science and Mathematics Education Conference*, 24-25.

Pedaste, M., Mäeots, M., Siiman, L. A., De Jong, T., A.N.S., Van Riesen, S. A., Kamp, E. T, Manoli, C.C., Zacharia, C.Z., & Tsourlidaki, E. (2015). Phases of inquiry-based learning: Definitions and the inquiry cycle. *Educational research review*, *14*, 47-61.

Pedditzi, M. L., & Spigno, M. (2012). Motivation to learn: a research on university students. *Procedia-Social and Behavioral Sciences*, *69*, 1198-1207.

Peng, Y., Xie, E., Zheng, K., Fredimoses, M., Yang., Zhou., & Liu, Y. (2013). Nutritional and chemical composition and antiviral activity of cultivated seaweed Sargassum naozhouense Tseng et Lu. *Marine drugs*, *11*(1), 20-32.

Phillips, S.T. C. (2008). Defining biological communication. *Journal of evolutionary biology*, *21*(2), 387-395.

Piaget, J., & Cook, M. (1952). *The origins of intelligence in children 8*(5), 18-1952. New York: International Universities Press.

Piaget, J. (1972). The psychology of the child, New York: Basic books.

Piaget, J., & Buey, F. J. F. (1983). *Psicología y pedagogía*. Barcelona, España: Ariel.

Piazzi, L., Balata, D., Cecchi, E., Cinelli, F., & Sartoni, G. (2009). Species composition and patterns of diversity of macroalgal coralligenous assemblages in the north-western Mediterranean Sea. *Journal of natural history*, *44*(1-2), 1-22.

Pratiwi, R., Sumarti, S. S., & Susilaningsih, E. (2018). Identification of Students Basic Science Process Skills Assisted of Practical Worksheet Based on Multiple Representations. *Journal of Innovative Science Education*, *7*(1), 107-113.

Purwanto. 2013. *Evaluasi Hasil Belajar*. Yogyakarta: Pustaka Pelajar.

Qazi, W., Rawat, K. J., & Thomas, M. (2012). The role of practicum in enhancing student teachers' teaching skills. *American Journal of Scientific Research*, *44*(12), 44-57.

Randler, C. (2008). Teaching species identification–A prerequisite for learning biodiversity and understanding ecology. *Eurasia Journal of Mathematics, Science and Technology Education*, *4*(3), 223-231.

Rasyid, A. (2017). Evaluation of nutritional composition of the dried seaweed Ulva lactuca from Pameungpeuk waters, Indonesia. *Tropical life sciences research*, *28*(2), 119.

Rasyid, A., Ardiansyah, A., & Pangestuti, R. (2019). Nutrient composition of dried seaweed Gracilaria gracilis. *Indones J Mar Sci*, *24*, 1-6.

Rezaeian, M. (2014). The necessity and importance of writing and publishing non-research papers. *From the Editor*, *7*(10), 9.

Riesen, S. A., Gijlers, H., Anjewierden, A., & Jong, D.T. (2018). The influence of prior knowledge on experiment design guidance in a science inquiry context. *International Journal of Science Education*, *40*(11), 1327-1344.

Robnett, R. D., Nelson, P. A., Zurbriggen, E. L., Crosby, F. J., & Chemers, M. M. (2018). Research mentoring and scientist identity: insights from undergraduates and their mentors. *International journal of STEM education*, *5*(1), 1-14.

Rohman, A., Aryati, R. W., & Rejeki, S. (2018). Penentuan kesesuaian wilayah pesisir muara gembong, kabupaten bekasi untuk lokasi pengembangan budidaya rumput laut dengan pemanfaatan Sistem Informasi Geografis (SIG). *Sains Akuakultur Tropis: Indonesian Journal of Tropical Aquaculture*, *2*(1).

Ruscic, M., Vidovic, A., Kovacevic, G., & Sirovina, D. (2018). The use of microscope in school biology teaching. *Resolution and Discovery*, *3*(1), 13-16.

Rustaman, N. Y. (2003). Strategi Belajar Mengajar Biologi. Bandung: Jurusan Pendidikan Biologi FPMIPA UPI.

Rustaman, N. Y. (2005). Perkembangan penelitian pembelajaran berbasis inkuiri dalam pendidikan sains. In *Makalah dipresentasikan dalam Seminar Nasional II Himpunan Ikatan Sarjada dan Pemerhati Pendidikan IPA Idonesia Bekerjasama dengan FPMIPA*, 22-23. Universitas Pendidikan Indonesia, Bandung

Rustaman, N.Y. (2019b). "Pemberdayaan Klasifikasi-Generalisasi dan Tree Thinking untuk Membangun Disposisi Berpikir Generasi Muda dalam Mengelola *BioResources* di Indonesia". Makalah Seminar nasional Biologi. Universitas Lampung, Bandar Lampung.

Rustaman, N.Y. (2019c). Menyiapkan Generasi yang Adaptif-Reflektif-Inovatif Melalui Pendidikan Berorientasi Biologi. Makalah Seminar Biologi. FKIP Universitas Siliwangi,

Rykiel, E. J., Berkson, J., Brown, V. A., Krewitt, W., Peters, I., Schwartz, M., & Latesteijn, V. H. (2002). Science and decisionmaking. In *Understanding and Solving Environmental Problems in the 21st Century*, 153-166. Elsevier Science

Sanders, M. (2009). Integrative STEM education: primer. *The Technology Teacher*, *68*(4), 20-26.

Sanjayanti, A., Rustaman, N.Y., & Hidayat, T. (2019a). Equipping Students' Research Skills and Logical Thinking Through Practical Work On Algae Topic. *Journal of Physics: Conference Series*, *1521*(4),

doi: 10.1088/1742-6596/1521/4/042035.

Sanjayanti, A., Rustaman, N.Y., & Hidayat, T. (2019b). 6E learning by design in facilitating logical thinking and identifying algae. *AIP Conference Proceedings 2194* (1), doi:10.1063/1.5139841.

Santhi, V. S., Bhagat, A. K., Saranya, S., Govindarajan, G., & Jebakumar, S. R. D. (2014). Seaweed (Eucheuma cottonii) associated microorganisms, a versatile enzyme source for the lignocellulosic biomass processing. *International Biodeterioration & Biodegradation*, *96*, 144-151.

Santora, K. A., Mason, E. J., & Sheahan, T. C. (2013). A model for progressive mentoring in science and engineering education and research. *Innovative Higher Education*, *38*(5), 427-440.

Santos, S. A., Vilela, C., Freire, C. S., Abreu, M. H., Rocha, S. M., & Silvestre, A. J. (2015). Chlorophyta and Rhodophyta macroalgae: A source of health promoting phytochemicals. *Food chemistry*, *183*, 122-128.

Saptono, S., Rustaman, N. Y., & Widodo, A. (2013). Model integrasi atribut asesmen formatif (IAAF) dalam pembelajaran biologi sel untuk mengembangkan kemampuan penalaran dan berpikir analitik mahasiswa calon guru. *Jurnal Pendidikan IPA Indonesia*, *2*(1).

Sari, D.P. 2018. Membangun Keterampilan Riset Aba Ke-21 Siswa Melalui Learning Management System Berbasis Edmodo Pada Pembelajaran Proyek Biologi. (Tesis). Universitas Pendidikan Indonesia, Bandung. Tidak diterbitkan.

Schaeffer, N. C., & Presser, S. (2003). The science of asking questions. *Annual review of sociology*, *29*.

Schwab, K. (2016). The Fourth Industrial Revolution. Switzerland. World Economic Press.

Schwortz, A. C., Burrows, A. C., & Guffey, S. K. (2017). Mentoring partnerships in science education. *Educational Action Research*, *25*(4), 630-649.

Scully, G., & Kerr, R. (2014). Student workload and assessment: Strategies to manage expectations and inform curriculum development. *Accounting Education*, *23*(5), 443-466.

Serediak, N & Huynh, L.M. (2011). Algae Identification Field Guide. Agriculture and Agri-Food Canada.

Setiono, S., Rustaman, N. Y., Rahmat, A., & Anggraeni, S. (2018). Kemampuan Mahasiswa Calon Guru Biologi dalam Menyusun Scientific Papers. *Jurnal Bioedukatika*, *5*(2), 54-58.

Setiono, S., Rustaman, N. Y., Rahmat, A., & Anggraeni, S. (2019). Student's inquiry skills and learning achievement in plant anatomy practical work using open-guided inquiry. In *Journal of Physics: Conference Series*, 1157 (2). IOP Publishing.

Shadiqi, M. A. (2019). Memahami dan Mencegah Perilaku Plagiarisme dalam Menulis Karya Ilmiah. *Buletin Psikologi*, *27*(1), 30-42.

Showman, A., Cat, L. A., Cook, J., Holloway, N., & Wittman, T. (2013). Five essential skills for every undergraduate researcher. *Council on Undergraduate Research Quarterly*, *33*(3), 16-21.

Sidik, S. M. (2004). How to Write a Research Proposal. *The Family Physician 2005;13(3)*, 30-32.

Smith, J. P., Disessa, A. A., & Roschelle, J. (1994). Misconceptions reconceived: A constructivist analysis of knowledge in transition. *The journal of the learning sciences*, *3*(2), 115-163.

Snieder, R., & Larner, K. (2009). *The art of being a scientist: A guide for graduate students and their mentors*. Cambridge University Press.

Solihat, R. (2016). Perkembangan Kemampuan Meneliti Peserta Program Pendidikan Profesi Guru (PPG) Biologi. (Disertasi). Sekolah Pascasarjana, Universitas Pendidikan Indonesia, Bandung).

Stern, R.K., Bidlack, E.J. & Jansky, H.S. (2008). Introductory plant biology Eleventh Edition. The McGraw-Hill Companies.

Stofflett, R. T., & Baker, D. R. (1992). The Effects of Training in Combinatorial Reasoning and Propositional Logic on Formal Reasoning Ability in Junior High School Students. *Research in Middle Level Education*, *16*(1), 159-177.

Strimel, G. (2012). Engineering by Design™: Preparing Students For the 21 st Century. *Conference Technology Education in the 21st Century*, *(*073), 434-443. Linkoping University Electronic Press.

Suatma. (2013). Pengembangan Program Perkuliahan Metodologi Penelitian Berbasis Experiental Learning Untuk Meningkatkan Keterampilan Riset Kependidikan Sains Mahasiswa Calon Guru Biologi. (Disertasi). Universitas Pendidikan Indonesia, Bandung. Tidak diterbitkan.

Sugiyono. 2001. Metode Penelitian Administrasi. Bandung: Alfabeta.

Sugiono, 2016. Metode Penelitian Pendidikan. Bandung: Alfabeta

Sukaesih, S. (2018). Permasalahan Plagiarisme Dalam Penelitian Kualitatif Di Indonesia. *Jurnal Politikom Indonesiana*, *3*(1), 210-210.

Sulistiowati, D., Surtikanti, H. K., & Suwarma, I. R. (2019). Investigating Scientific Literacy Of Students On The Topic Of Water Pollution Through STEM Based 6E Learning By Design. *Journal of Physics: Conference Series*, *1157* (2), doi: 10.1088/1742-6596/1157/2/022038.

Supriatno, B. (2013). Pengembangan Program Perkuliahan Pengembangan Praktikum Biologi Sekolah Berbasis ANCORB untuk Mengembangkan Kemampuan Merancang dan Mengembangkan Desain Kegiatan Laboratorium. (Disertasi). Sekolah Pasca Sarjana Universitas Pendidikan Indonesia, Bandung.

Sutia, C. (2018). Membangun Keterampilan Riset Abad Ke-21 Siswa melalui Learning Management System Berbasis Google Classroom Pada Pembelajaran Proyek Biologi. (Tesis). Universitas Pendidikan Indonesia, Bandung. Tidak diterbitkan.

Suyitno.(2013). Respons of student of Biology Study Program on Task of Plant Physiolog Articles Analysis Teaching Grant Proyek DUE-Like. Yogyakarta: Universitas Negeri Yogyakarta.

Tairab, H. H. (2016). Assessing Students' Understanding of Control of Variables across Three Grade Levels and Gender. *International Education Studies*, *9*(1), 44-54. Teachers College Press.

Tejeda, M, Rafael., Jimenez, R., & G.A. (2019). Influence of climatic factors on Sargassum arrivals to the coasts of the Dominican Republic. *Journal of Oceanography and Marine Science*, *10*(2), 22-32.

Timmerman, B. E. C., Strickland, D. C., Johnson, R. L., & Payne, J. R. (2011). Development of a 'universal'rubric for assessing undergraduates' scientific reasoning skills using scientific writing. *Assessment & Evaluation in Higher Education*, *36*(5), 509-547.

Timmerman, B. C., Feldon, D., Maher, M., Strickland, D., & Gilmore, J. (2013). Performance-based assessment of graduate student research skills: Timing, trajectory, and potential thresholds. *Studies in Higher Education*, *38*(5), 693-710.

Tjitrosoepomo, G., 2011. Taksonomi Tumbuhan : Schizophyta, Thallophyta, Bryophyta, Pterydophyta. Gadjah Mada University Press, Yogyakarta.

Tobin, K. G., & Capie, W. (1980). Teaching Process Skills in the Middle School. *School Science and Mathematics*, *80*(7), 590-600.

Tobin, K. G., & Capie, W. (1981). The development and validation of a group test of logical thinking. *Educational and Psychological measurement*, *41*(2), 413-423.

Tonissen, K. F., Lee, S. E., Woods, K. J., & Osborne, S. A. (2014). Development of Scientific Writing Skills Through Activities Embedded Into Biochemistry and Molecular Biology Laboratory Courses. *International Journal of Innovation in Science and Mathematics Education*, *22*(4).

Torres, L. (2018). Research Skills in the First-Year Biology Practical-Are They There?. *Journal of University Teaching and Learning Practice*, *15*(4), 3.

Trifone, J. D. (1987). The Test of Logical Thinking: Applications for teaching and placing science students. *The American Biology Teacher*, 411-416.

Trilling, B., & Fadel, C. (2009). *21st Century Skills, Enhanced Edition: Learning for Life in Our Times*. John Wiley & Sons.

Tsabari, B. A., Sethi, R. J., Bry, L., & Yarden, A. (2006). Using questions sent to an Ask-A-Scientist site to identify children's interests in science. *Science Education, 90*(6), 1050-1072.

Tuckman, B.W. (1978). (Conducting Educational Research) Second Ed. San Diego: Harcourt Brace Jovanovich Publishers, 12-17.

Tunnicliffe, S. D. (2006). The importance of research to biological education. *Journal of Biological Education, 40*(3), 99-100.

Ulla, M. B. (2018). Benefits and challenges of doing research: Experiences from Philippine public school teachers. *Issues in Educational Research, 28*(3), 797-810.

Urry. A. L., Cain.L. M., Minorsky.V.P., Wasserman. A.S., & Reece. B.J. (2016). Campbell biology Eleventh edition. Hoboken : Pearson Higher Education.

Valanides, N. C. (1996). Formal reasoning and science teaching. *School Science and Mathematics, 96*(2), 99-107.

Valanides, N. (1997). Cognitive abilities among twelfth-grade students: implications for science teaching. *Educational Research and Evaluation, 3*(2), 160-186.

Vale, R. D. (2013). The value of asking questions. *Molecular biology of the cell, 24*(6), 680-682.

Vitae (2010a). Researcher Development Framework: Summary of the Analysis of Consultation Responses, available at: www.vitae.ac.uk/CMS/files/upload/Vitae-RDF-consultation-analysis-may-2010.pdf (diakses 30 Juni 2019)

Vitae (2010b). Researcher Development Framework, available at:www.vitae.ac.uk/CMS/files/upload/Vitae-Researcher-Development-Framework.pdf (diakses 30 Juni 2019).

Vygotsky, L. (1978). *Mind and society: The development of higher psychological proces ses*. Cambridge, MA: Harvard University Press.

Vygotsky, L. S. (1986). *Thought and language*. The Massachusetts InstiLute of TechnoJogy (MIT) press.

Walkington, H. (2015). Students as researchers: Supporting undergraduate research in the disciplines in higher education. *York: The Higher Education Academy*.

Watson, S., & Miller, T. (2009). Classification and the Dichotomous Key. *The Science Teacher*, *76*(3), 50.

Weegar, M. A., & Pacis, D. (2012). A Comparison of two theories of learning-behaviorism and constructivism as applied to face-to-face and online learning. *Proceedings e-leader conference, Manila*.

Wenzel, T. J. (1997). What is undergraduate research. *Council on Undergraduate Research Quarterly*, *17*(4), 163.

Wiik, D., Dunn, K., Heydet-Kirsch, P., Holman, M., Meeroff, D., & Peluso, J. (2014). Scaffolding the development of students' research skills for capstone experiences: a multi-disciplinary approach. *Council on Undergraduate Research Quarterly*, *34*(4), 18-26.

Willison, J., & O'Regan, K. (2007). Commonly known, commonly not known, totally unknown: a framework for students becoming researchers. *Higher Education Research & Development*, *26*(4), 393-409.

Willison, J., Peirce, E. & Ricci, M. (2009) Towards student autonomy in literature and field research, in *The Student Experience, Proceedings of the 32nd HERDSA Annual Conference, Darwin,483-491*.

Willison, J. (2009). Development of all students' research skill becomes a knowledge society. *All Ireland Journal of Higher Education*, *2*(1).

Willison, J., & Buisman-Pijlman, F. (2016). PhD prepared: research skill development across the undergraduate years. *International Journal for Researcher Development*.

Willison, J. W. (2018). Research skill development spanning higher education: critiques, curricula and connections. *Journal of University Teaching & Learning Practice*, *15*(4), 1.

Wilmore, M., & Willison, J. (2016). Graduates' attitudes to research skill development in undergraduate media education. *Asia Pacific Media Educator*, *26*(1), 113-128.

Woodin, T., Carter, V. C., & Fletcher, L. (2010). Vision and change in biology undergraduate education, a call for action—initial responses. *CBE—Life Sciences Education*, *9*(2), 71-73.

Wulan, A. R. (2018). Menggunakan Asesmen Kinerja: Untuk Pembelajaran Sains Dan Penelitian (3). UPI Press.

Yenilmez, A., Sungur, S., & Tekkaya, C. (2005). Investigating students' logical thinking abilities: the effects of gender and grade level. *Hacettepe Üniversitesi Eğitim Fakültesi Dergisi*, *28*(28), 219-225.

Yokoyama, H., & Ishihi, Y. (2010). Bioindicator and biofilter function of Ulva spp.(Chlorophyta) for dissolved inorganic nitrogen discharged from a coastal fish farm potential role in integrated multi-trophic aquaculture. *Aquaculture*, *310*(1-2), 74-83.

Yudianto, S A. (1992). Pengantar Cryptogamae. (Sistematika Tumbuhan Rendah). Bandung; PT Tarsito.

Zion, M. I., & Sadeh, I. (2007). Curiosity and open inquiry learning. *Journal of Biological Education*, *41*(4), 162-169.