PENGEMBANGAN BAHAN AJAR KIMIA PADA MATERI LAJU REAKSI MENGGUNAKAN METODE 4S TMD (*Four Steps Teaching Material Development*) DENGAN PENDEKATAN SETS (*Science, Environment, Technology, and Society*) UNTUK MEMBANGUN LITERASI SAINS SISWA

TESIS

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar
Magister Pendidikan Kimia

oleh

Oktri Lestari
NIM 1706382

PROGRAM STUDI
PENDIDIKAN KIMIA
SEKOLAH PASCASARJANA
UNIVERSITAS PENDIDIKAN INDONESIA
2019

PENGEMBANGAN BAHAN AJAR KIMIA PADA MATERI LAJU REAKSI MENGGUNAKAN METODE 4S TMD (*Four Steps Teaching Material Development*) DENGAN PENDEKATAN SETS (*Science, Environment, Technology, and Society*) UNTUK MEMBANGUN LITERASI SAINS SISWA

Oleh
Oktri Lestari
S.Pd Universitas Riau, 2016

Sebuah Tesis yang diajukan untuk memenuhi sebagian dari syarat untuk memperoleh gelar Magister Pendidikan (M.Pd) Program Studi Pendidikan Kimia Pada Sekolah Pascasarjana Universitas Pendidikan Indonesia

OKTRI LESTARI

PENGEMBANGAN BAHAN AJAR KIMIA PADA MATERI LAJU REAKSI MENGGUNAKAN METODE 4S TMD (*Four Steps Teaching Material Development*) DENGAN PENDEKATAN SETS (*Science, Environment, Technology, and Society*) UNTUK MEMBANGUN LITERASI SAINS SISWA

Disetujui dan disahkan oleh:

Pembimbing I

Dr. (paed) H. Sjaeful Anwar
NIP. 196208201987031002

Pembimbing II

Galuh Yuliani, M.Si., Ph.D.
NIP. 198007252001122001

Mengetahui,
Ketua Program Studi Magister Pendidikan Kimia
Sekolah Pascasarjana Universitas Pendidikan Indonesia

Dr. Hendrawan, M. Si
NIP. 196309111989011001

ABSTRAK

Penelitian ini bertujuan untuk mengembangkan bahan ajar berbasis SETS (*Science, Environment, Technology and Society*) pada pokok bahasan laju reaksi untuk meningkatkan literasi sains siswa. Metode penelitian yang digunakan adalah *Development Research*, yang meliputi tiga tahap yaitu *design*, *development*, dan *evaluation*. Pada tahap *design* dilakukan analisis permasalahan, identifikasi materi kimia sulit, dan penentuan jenis bahan ajar yang dikembangkan. Selanjutnya, pada tahap *development* dikembangkan bahan ajar melalui metode 4S TMD, yang meliputi proses seleksi, strukturisasi, karakterisasi, dan reduksi didaktik. Terakhir, pada tahap *evaluation* dilakukan analisis kesesuaian *SETS* pada bahan ajar, uji keterpahaman, dan uji kelayakan. Pada tahap *design* didapati bahan ajar yang sulit dipahami oleh siswa, literasi sains siswa yang rendah dan materi laju reaksi yang sulit. Pada tahap *development* dikembangkan KD 3.7, 3.6, dan 4.7, nilai terkait konsep, uraian konsep, peta konsep, struktur makro dan multiple representasi kemudian karakterisasi teks hingga reduksi didaktik. Hasil evaluasi terhadap bahan ajar yang dikembangkan mendapatkan hasil pada persentase kelayakan bahan ajar sebesar 97,42% yang berarti sangat layak, dan hasil evaluasi juga memberikan kesimpulan bahwa bahan ajar yang dikembangkan memiliki karakteristik bersifat *self instructional*, yang ditunjukkan melalui Persentase keterpahaman bahan ajar sebesar 85,66 % .

ABSTRACT

This study aims to develop SETS (Science, Environment, Technology and Society) -based teaching materials on the subject of reaction rates to improve students' scientific literacy. The research method used is Development Research, which includes three stages, namely design, development, and evaluation. In the design phase, problem analysis is carried out, identification of difficult chemical material, and determination of the type of teaching material developed. Furthermore, in the development phase learning materials are developed through the 4S TMD method, which includes the process of selection, structuring, characterization, and didactic reduction. Finally, in the evaluation phase SETS conformity analysis is carried out on teaching materials, understanding tests, and feasibility tests. At the design stage found teaching materials that are difficult to understand by students, student science literacy is low and material reaction rates are difficult. In the development stage, KD 3.7, 3.6, and 4.7 are developed, values related to concepts, conceptual descriptions, concept maps, macro structures and multiple representations, then characterization of texts to didactic reduction. The results of the evaluation of the instructional materials developed get results on the percentage of the feasibility of teaching materials of 97.42% which means very feasible, and the evaluation results also provide conclusions that the instructional materials developed have self-instructional characteristics, which are indicated by the comprehension percentage of 85 , 66%.

DAFTAR ISI

Hal

DAFTAR TABEL

Hal

DAFTAR GAMBAR

Hal

DAFTAR LAMPIRAN

Hal

DAFTAR PUSTAKA

Abualrob, M. M. A., & Daniel, E. G. S. (2013). The Delphi Technique in Identifying Learning Objectives for the Development of Science, Technology and Society Modules for Palestinian Ninth Grade Science Curriculum. *International Journal of Science Education*, *35*(15), 2538–2558. https://doi.org/10.1080/09500693.2011.610381

Akker, J. (1999). *Principles and Methods of Development Research.*

Ali, M. (2011). *Aplikasi KTSP dan bahan Ajar dalam Pendidikan Islam*. Jakarta: Raja Wali Pers.

Ángel, S. A. (2015). Real and virtual bioreactor laboratory sessions by STSE-CLIL WebQuest. *Education for Chemical Engineers*, *13*, 1–8. https://doi.org/10.1016/j.ece.2015.06.004

Anwar, S. (2015). *Pengolahan Bahan Ajar (4 Steps Teaching Material Development)[Handout Perkuliahan]*. Bandung.

Anwar, Sjaeful, Noviyanti, N., & Hendrawan, H. (2017). Analisis Kelayakan Buku Teks Kimia Sma/Ma Kelas X Materi Reaksi Redoks Berdasarkan Kriteria Tahap Seleksi 4S Tmd. *Jurnal Penelitian Pendidikan Kimia : Kajian Hasil Penelitian Pendidikan Kimia*, *4*(2), 97--104.

Arifin. (2015). *Pengembangan Bahan Ajar IPA Terpadu Pada Tema Udara Berbasis Nilai Religius Menggunakan 4 Steps Teaching Material Development*. Bandung: Universitas Pendidikan Indonesia.

Arifin, M., & Kusrianto, A. (2009). *Sukses Menulis Buku Ajar dan Referensi*. Jakarta: Grasindo.

Arons, A. B. (1983). *Achieving wider scientific literacy*. Daedalus.

Basar, M., & Gurbuz, M. (2017). *Effect of the SQ4R Technique on the Reading Comprehension of Elementary School 4th Grade Elementary School Students*. *10*(2), 131–144.

Bauer, J. R., & Booth, A. E. (2019). Exploring potential cognitive foundations of scientific literacy in preschoolers: Causal reasoning and executive function. *Early Childhood Research Quarterly*, *46*, 275–284. https:/p/doi.org/10.1016/j.ecresq.2018.09.007

Becker, N., Stanford, C., Towns, M., & Cole, R. (2015). Translating across macroscopic, submicroscopic, and symbolic levels: The role of instructor facilitation in an inquiry-oriented physical chemistry class. *Chemistry Education Research and Practice*, *16*(4), 769–785. https://doi.org/10.1039/c5rp00064e

Binadja, A. (2002). *Hakekat dan Tujuan Pendidikan SETS dalam Konteks Kehidupan dan Pendidikan Yang Ada*. Makalah Seminar dan Lokakarya Nasional.

Binadja, Achmad. (2006). *Pedoman Pengembangan Silabus Bervisi dan Berpendekatan SETS (Science, Environment, Technology, and Society).* Semarang: Laboratorium SETS: Program Pascasarjana, UNNES.

Binadja, Ahmad. (2005). *Pembelajaran sains berdasarkan kurikulum 2004 bervisi dan berpendekatan SETS, implikasinya pada pengembangan silabus subjek sains*. Semarang: MIPA, Unnes.

Brady, J. (1994). *Kimia Universitas: Asas dan Struktur Jilid Dua*. Tangerang: Binarupa Aksara.

Bybee, R., & Mccrae, B. (2011). *Scientific Literacy and Student Attitudes : Perspectives from PISA 2006 science*. *33*(1), 7–26. https://doi.org/10.1080/09500693.2011.518644

Bybee, R., McCrae, B., & Laurie, R. (2009). PISA 2006: An assessment of scientific literacy. *Journal of Research in Science Teaching*, *46*(8), 865–883. https://doi.org/10.1002/tea.20333

Chang, R. (2005). *Kimia Dasar Konsep-Konsep Inti Jilid 1 dan 2, Edisi Ketiga*. Jakarta: Erlangga.

Chawla, J., & Singh, G. (2015). Effect Of Concept Mapping Strategy On Achievement In Chemistry Among IX Grader Girls. *International Journal of Informative and Futuristic Research*, *3*(3), 1036–1044.

Corradi, D. M. J., Elen, J., Schraepen, B., & Clarebout, G. (2014). Understanding Possibilities and Limitations of Abstract Chemical Representations for Achieving Conceptual Understanding. *International Journal of Science Education*, *36*(5), 715–734. https://doi.org/10.1080/09500693.2013.824630

Crowell, A., & Schunn, C. (2015). Unpacking the Relationship Between Science Education and Applied Scientific Literacy. *Research in Science Education*, *46*(1), 129–140. https://doi.org/10.1007/s11165-015-9462-1

DeBoer, G. E. (2000). Scientific literacy: Another look at its historical and contemporary meanings and its relationship to science education reform. *Journal of Research in Science Teaching*, *37*(6), 582–601. https://doi.org/10.1002/1098-2736(200008)37:6<582::AID-TEA5>3.0.CO;2-L

Direktorat Pembinaan Sekolah Menengah. (2008). *Panduan Pengembangan Bahan Ajar*. Jakarta: Departemen Pendidikan Nasional.

Eymur, G., Çetin, P., & Geban, Ö. (2013). Analysis of the alternative conceptions of preservice teachers and high school students concerning atomic size. *Journal of Chemical Education*, *90*(8), 976–980. https://doi.org/10.1021/ed300027f

Fatokun, K., & Eniayeju, P. (2014). The Effect of Concept Mapping-Guided Discovery Integrated Teaching Approach on Chemistry Students' Achievement and Retention. *Educational Research and Reviews*, *9*(22), 1218–1223. https://doi.org/10.5897/ERR2014.1848

Gilbert, J. K. (2010). The role of visual representations in the learning and teaching of science: An introduction. *Asia-Pacific Forum on Science Learning and Teaching*, *11*(1), 1–19.

Gravemeijer, K. (1994). Educational Development and Developmental Research in Mathematics Education. *Journal for Research in Mathematics Education*, *25*(5), 443. https://doi.org/10.2307/749485

Handayani. (2015). *Pengembangan Bahan Ajar IPA Terpadu dengan Four Step Teaching Material Development Pada Tema Bunyi dan Aplikasinya untuk Meningkatkan Literasi Sains Siswa SMP*. Bandung: Universitas Pendidikan Indonesia.

Hernández, G. E., Criswell, B. A., Kirk, N. J., Sauder, D. G., & Rushton, G. T. (2014). Pushing for particulate level models of adiabatic and isothermal processes in upper-level chemistry courses: A qualitative study. *Chemistry Education Research and Practice*, *15*(3), 354–365. https://doi.org/10.1039/c4rp00008k

Holbrook, J. (2005). Making chemistry teaching relevant. *Chemical Education International*, *6*(1), 3–8.

Hu, X., Gong, Y., Lai, C., & Leung, F. K. S. (2018). The relationship between ICT and student literacy in mathematics, reading, and science across 44 countries: A multilevel analysis. *Computers and Education*, *125*(September 2017), 1–13.

https://doi.org/10.1016/j.compedu.2018.05.021

Humairoh, F. (2015). Pengembangan E-Book Interaktif Berbasis Salingtemas (Sains, Lingkungan, Teknologi, Masyarakat) pada Materi Fluida Dinamis untuk Meningkatkan Pemahaman Konsep Siswa dan Penerapannya. *Inovasi Pendidikan Fisika*, *4*(2), 69–75.

Husna, L. (2015). *Analisis Materi Laju Reaksi pada buku Teks Pelajaran SMA/MA Kelas XI dari Perspektif 4S TMD pada Tahap Seleksi*. Universitas Pendidikan Indonesia.

Johnstone, A. H. (1982). *Macro and micro chemistry School Science Review*.

Johnstone, Alex H. (2000). TEACHING OF CHEMISTRY-LOGICAL OR PSYCHOLOGICAL? *Chemistry Education: Research and Practice in Europe*, *1*(1), 9–15. Retrieved from http://www.chem.uoi.gr/cerp/2000_January/pdf/056johnstonef.pdf

Keenan. (1986). *Kimia Untuk Universitas Edisi 6 Jilid I*. Jakarta: Erlangga.

Khusniyah, N. L., & Lustyantie, N. (2017). Improving English Reading Comprehension Ability through Survey, Questions, Read, Record, Recite, Review Strategy (SQ4R). *English Language Teaching*, *10*(12), 202. https://doi.org/10.5539/elt.v10n12p202

Kirker, M. J., & Stonebraker, I. (2019). Architects, Renovators, Builders, and Fragmenters: A Model for First Year Students' Self-perceptions and Perceptions of Information Literacy. *Journal of Academic Librarianship*, *45*(1), 1–8. https://doi.org/10.1016/j.acalib.2018.10.009

Kolomuç, A., & Tekin, S. (2011). Chemistry Teachers' Misconceptions Concerning Concept of Chemical Reaction Rate. *Eurasian J. Phys. Chem. Educ*, *3*(2), 84–101. Retrieved from http://www.eurasianjournals.com/index.php/ejpce

Komarudin, O. (2010). *Ringkasan Lengkap Kimia SMA*. Jakarta: Cmedia.

Lawless, K. A., Brown, S. W., Rhoads, C., Lynn, L., Newton, S. D., Brodowiksa, K., … Wang, M. (2018). Promoting students' science literacy skills through a simulation of international negotiations: The GlobalEd 2 Project. *Computers in Human Behavior*. https://doi.org/10.1016/j.chb.2017.08.027

Lin, Y. I., Son, J. Y., & Rudd, J. A. (2016). Asymmetric translation between multiple representations in chemistry. *International Journal of Science Education*, *38*(4), 644–

662. https://doi.org/10.1080/09500693.2016.1144945

Mæland, K., & Espeland, M. (2017). Teachers ' Conceptions of Improvisation in Teaching : Inherent Human Quality or a Professional Teaching Skill ? *Education Inquiry*, *00*(00), 1–17. https://doi.org/10.1080/20004508.2017.1293314

Mesch. (1994). Didactic Reduction by Theory, with Special Attention to Measurement education. *Journal Elsevier:Science*.

Munawwarah, M., Anwar, S., & Sunarya, Y. (2017). How to Develop Electrochemistry SETS-Based Interactive E-Book? *Journal of Physics: Conference Series*, *895*(1), 0–7. https://doi.org/10.1088/1742-6596/895/1/012112

Nahum, T. L., Ben-Chaim, D., Azaiza, I., Herskovitz, O., & Zoller, U. (2014). Does stes-oriented science education promote 10th-grade students' decision-making capability? *International Journal of Science Education*, *32*(10), 1315–1336. https://doi.org/10.1080/09500690903042533

Nakhleh, M. B. (1992). Why Some Students Don't Learn Chemistry. *Journal of Chemical Education*.

Norris, S. P., & Phillips, L. M. (2003). How Literacy in Its Fundamental Sense Is Central to Scientific Literacy. *Science Education*, *87*(2), 224–240. https://doi.org/10.1002/sce.10066

Novak, & Gowin. (1985). *Learning How to learn*. Cambridge: Cambridge University Press.

Novak, J. ., & Canas, A. (2008). *The Theory Underlying Concept Maps and How to Construct and Use Them*.

Noviyanti, N., Anwar, S., & Hendrawan. (2017). *Analisis Kelayakan Buku Teks Kimia SMA/MA Kelas X Materi Reaksi Redoks Berdasarkan Kriteria Tahap Seleksi 4S TMD* . Universitas Pendidikan Indonesia.

Nugraha, D. A., Binadja, A., & Supartomo. (2013). Pengembangan Bahan Ajar Reaksi Redoks Bervisi SETS, Berorientasi Konstruktivistik. *Journal of Innovative Science Education (JISE)*, *2*(1), 27–34. Retrieved from http://journal.unnes.ac.id/sju/index.php/jise

Nwagbo, C., & Okonkwo, I. (2014). Effect of Concept Mapping Teaching Strategy on

Students' Achievement in Environmental Concepts in Chemistry. *International Journal of Scientific Research*, *3*(4), 61–63. https://doi.org/10.15373/22778179/apr2014/23

OECD. (2000). *PISA 2006: Science Competencies for Tomorrow'sWorld*.

OECD. (2006). *Assessing scientific, reading and mathematical literacy: A framework for PISA 2006*. Paris: OECD.

Olayinka, A.-R. B. (2016). Effects of Instructional Materials on Secondary Schools Students' Academic Achievement in Social Studies in Ekiti State, Nigeria. *World Journal of Education*, *6*(1), 32–39. https://doi.org/10.5430/wje.v6n1p32

Oxtoby, D. . (2001). *Kimia Modern*. Jakarta: Erlangga.

Pedretti, E. (2003). Teaching Science , Technology , Society and Environment (Stse) Education. *Education*, 219–239.

Pimm, D., Tuan, H. L., & Yore, L. D. (2007). The literacy component of mathematical and scientific literacy. *International Journal of Science and Mathematics Education*, *5*(4), 559–589.

PISA. (2013). *PISA 2015 Draft Science Framework*.

PISA. (2010). *Assesment Framework Key Competencies In Reading, mathematics and science*. OECD.

Poedjiadi, A. (2005). *Sains Teknologi Masyarakat*. Bandung: PT. Remaja.

Rau, M. A., Bowman, H. E., & Moore, J. W. (2017). An adaptive collaboration script for learning with multiple visual representations in chemistry. *Computers and Education*, *109*, 38–55. https://doi.org/10.1016/j.compedu.2017.02.006

Ren, L., Hu, B. Y., & Wu, Z. (2019). Profiles of literacy skills among Chinese preschoolers: Antecedents and consequences of profile membership. *Learning and Individual Differences*, *69*(November 2018), 22–32. https://doi.org/10.1016/j.lindif.2018.11.008

Rita C., R., & James D., K. (2005). Developmental Research Methods: Creating Knowledge From Instructional Design And Development Practice. *Journal of Computing in Higher Education*, *16*(2), 23–38. https://doi.org/10.1007/BF02961473

Setiawan, A., Fatayati, I., & Aliah, H. (2016). *Influence of Concentration of Rind*

Extract of Red Dragon Fruit (Hylocereus Costaricensis) Against the Dssc Effeciency Pengaruh Konsentrasi Ekstrak Kulit Buah Naga Merah (Hylocereus Costaricensis) Terhadap Efisiensi Dssc. *12*(1), 77–82. https://doi.org/10.15294/jpfi

Setiyono, F. P. (2011). Pengembangan Perangkat Pembelajaran Kimia Kelarutan Dan Hasil Kali Kelarutan (Ksp) Dengan Pendekatan Sets Untuk Meningkatkan Kreativitas Dan Hasil Belajar Peserta Didik. *Journal of Educational Research and Evaluation, 1*(1), 149–158.

Sihite, D. Y. (2017). *Pengembangan Bahan Ajar Berbasis Chemo-Enterpreneurship Dengan Metode 4S-TMD Pada Pokok Bahasan Asam-Basa Di Kelas XI SMA*. Bandung: Universitas Pendidikan Indonesia.

Slavin, R. (1992). *Cooperative Learning Theory*. USA: Allymand & Bacon.

Smith, K. V., Loughran, J., Berry, A., & Dimitrakopoulos, C. (2012). Developing Scientific Literacy in a Primary School. *International Journal of Science Education*, *34*(1), 127–152. https://doi.org/10.1080/09500693.2011.565088

Soobard, R., & Rannikmäe, M. (2011). Assessing Student's Level of Scientific Literacy Using Interdisciplinary Scenarios. *Science Education International*, *22*(2), 133–144. Retrieved from http://www.ut.ee/BG/miia_rannikmae/Publications/Assessing_Students_Level_of_Scientific_Literacy.pdf

Swe, K. (2014). Critical analysis of science textbooks: Evaluating instructional effectiveness [Kritična analiza naravoslovnih učbenikov : ocenjevanje učinkovitosti poučevanja]. Dordrecht [etc .]: Springer . *Center for Educational Policy Studies Journal*, *4*(1), 137–141.

Syamsuri, B. S., Anwar, S., & Sumarna, O. (2017). Development of Teaching Material Oxidation-Reduction Reactions through Four Steps Teaching Material Development (4S TMD). *Journal of Physics: Conference Series*, *895*(1). https://doi.org/10.1088/1742-6596/895/1/012111

Thummathong, R., & Thathong, K. (2018). Chemical literacy levels of engineering students in Northeastern Thailand. *Kasetsart Journal of Social Sciences*, *39*(3), 478–487. https://doi.org/10.1016/j.kjss.2018.06.009

Toharudin, Uus., Sri Hendrawati., dan A. R. (2011). *Membangun Literasi Sains*

Peserta Didik. Bandung: Humainora.

Wang, J., Jou, M., Lv, Y., & Huang, C. C. (2018). An investigation on teaching performances of model-based flipping classroom for physics supported by modern teaching technologies. *Computers in Human Behavior*, *84*, 36–48. https://doi.org/10.1016/j.chb.2018.02.018

Wardayani, E., St, S., & Kes, M. (2018). *Effectiveness of Using SQ4R Learning Method on Improving Student Learning Outcomes on Studies of Basic Maternity Needs in Sentral Academy of Midwifery Padangsidimpuan in 2016*. (2), 319–322.

Wu, H. K., Krajcik, J. S., & Soloway, E. (2001). Promoting understanding of chemical representations. *Students' Use of a Visualization Tool in the Classroom*, *38*(7), 821–842. https://doi.org/10.1002/tea.1033

Yörük, N., Morgil, I., & Seçken, N. (2010). The effects of science, technology, society, environment (STSE) interactions on teaching chemistry. *Natural Science*, *02*(12), 1417–1424. https://doi.org/10.4236/ns.2010.212173

Yung, B. H. W., Zhu, Y., Wong, S. L., Cheng, M. W., & Lo, F. Y. (2013). Teachers' and Students' Conceptions of Good Science Teaching. *International Journal of Science Education*, *35*(14), 2435–2461. https://doi.org/10.1080/09500693.2011.629375