LITERACY SCIENCE LEARNING FOR STUDENTS OF MI/SD IN THE DIGITAL AGE

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ABSTRACT

The purpose of science learning is to build students' science literacy. Because of the low scientific literacy ratings of Indonesia according to PISA, the development of digital media has become a momentum for improving the science literacy rankings. The development of technology in the digital age offers a paradigm shift in the learning process including in teaching science literacy for students of MI/SD. Learning is not only in the classroom or real laboratory. However, teachers can utilize instructional media in increasing science literacy through computer simulation/virtual laboratory, e-learning, digital book, video, film etc. The digital era provides open access to interactive materials and information through the internet network. The students can learn without space or time constraints.

Keywords: Learning, Science Literacy, Digital Age.

INTRODUCTION

Natural Science (IPA) is the use of facts to build explanations, predictions and knowledge through scientific testing of natural phenomena[20]. IPA consists of four elements: product, process, scientific attitude and application[21]. The purpose of science learning (IPA) is to build students' science literacy, which has the ability to understand facts, concepts, principles of science; also has the ability of process skills and scientific thinking to discover the concepts of science, communicate the findings, solve problems and apply science in everyday life, and have a scientific attitude[22]. Thus, science learning becomes a vehicle for students to learn about themselves and the environment, as well as the prospects for their application in daily life. The learning process emphasizes the provision of hands-on experience to develop competencies to explore and understand the

20 National Academy of Sciences. 2008. *Science, Evolution and Creationism*. NAS Press: Washington, DC.

21 Indrawati. 2010. *Model Pembelajaran IPA Terpadu untuk SMP*. Bandung: PPPPTK IPA.

22 Usaid Prioritas. Buku Sumber Bagi Dosen LPTK. Pembelajaran IPA SMP di LPTK. (Usaid Prioritas) 2014. Hal. 13

natural world scientifically.

Science literacy is important to be taught for students since primary education so that in the future students can understand the environment, health, economics and other problems faced by modern society who rely heavily on technology and the progress and development of science. The ability of science literacy can improve the understanding of science and technology which will benefit the society in which the students live[23]. However, the Indonesian science literacy from year to year is still low. The low ability of students in the field of science, especially science literacy is evident from the results of research Program for International Student Assessment (PISA). Science literacy rankings from year to year is ranked 38th of 40 participating countries in 2002[24], ranked 53rd of 57 countries in 2006 (OECD, 2008) [25], ranked 57th out of 65 countries in 2009[26], ranked 64th out of 65 countries in 2012[27], Rank 62 of 70 countries by 2015[28].

PISA is tested on 15-year-old students, but elementary school level needs to be introduced science literacy. The low literacy of science is caused by the learning process that still have orientation towards the mastery of theory and memorization in all areas of study. It causes student learning ability becomes inhibited. Learning methods tend to be teacher centered and ignore the rights, needs, and growth and development of children thinking.[29] In general, the stage of development of children cognitive is divided into four stages, namely 0-2 years as motor sensory stage, 2-7 years as a pre-operational stage, 7-11 years as a concrete operational stage, and 11 years and above as the formal thinking stage[30]. The age of elementary school (MI/SD) is 7-11 years. According to Piaget, that age is a stage of concrete operational development. Learning at the age of MI/SD needs a lot of practice or examples of concrete events in everyday life. Learning science at the age of MI/SD no longer reads textbooks but interacts with nature by emphasizing the provision of direct learning experiences through the use and development of process skills and scientific attitudes.

Along with the development of the age of technological information revolution called the digital era, the digital era is a term used to describe digital technology. Thus, digital age literacy can be defined as the ability in a particular field that can be used in the age of digital technology[31]. Within the framework of 21st century education, digital-age literacy

23 Laugksch, R. C. 2000. Scientific literacy: A Conceptual Overview. *Science Education,* 84 (1): 71-94.

24 OECD. *FIRST RESULTS FROM PISA 2003 Executive Summary*. (OECD, 2003). Hlm. 36

25 OECD. *Executive Summary PISA 2006: Science Competencies for Tomorrow's World.* (OECD, 2007). Hlm. 20

26 OECD. *PISA 2009 Results: Executive Summary*.(OECD, 2010). Hlm. 8

27 OECD. *PISA 2012 Results in Focus. What 15-year-olds know and what they can dowith what they know.* (OECD, 2014). Hlm. 5

28 OECD. PISA 2015 Results in Focus. (OECD, 2016). Hlm. 8

29 Depdiknas. 2007. *Naskah Akademik Kajian Kebijakan Kurikulum Mata Pelajaran IPA*. Jakarta: Puskur Balitbang Depdiknas.

30 Suparno, Paul. 2013. *Metodologi Pembelajaran Fisika Konstruktivistik dan menyenangkan*. Yogyakarta: Universitas Sanata Dharma.

31 Asrizal, Festiyed, dan Ramadhan Sumarmin. Analisis Kebutuhan Pengembangan Bahan Ajar IPA Terpadu Bermuatan Literasi Era Digital Untuk Pembelajaran Siswa SMP Kelas VIII. *Jurnal Eksakta Pendidikan,* 1, no. 1 (2017): 3

skills are one of the major domains that need attention in the world of education today. This domain covers 8 aspects, namely: basic, scientific, information, visual, technological, multicultural, and global awareness.[32]

The developments of technology in the digital era of both computers and Internet networks began widely used as an science learning with offline and online simulation models (e-learning). The learning model is to simulate concrete events in everyday life no longer through the laboratory but through a computer (virtual lab). Through this simulation, students can manipulate data, collect data, analyze data and draw conclusions. Thus, the digital era is a challenge for science teachers who can not be considered one eye.

From the background, it is indispensable for learning science to increase science literacy by optimizing digital development. Therefore, there is a need for theoretical study on the growth of science literacy in the digital era.

DISCUSSION

Urgency of Science Literacy at MI/SD

The main purpose of science learning is the achievement of science literacy[33]. The literacy of science (science literacy, LS) comes from a combination of two Latin words (literatus and scientia). Literatus means marked with letters, literacy, or educated. Scientia means having knowledge[34]. Literacy of science is an attitude of understanding of science and its application; the ability to think scientifically; understanding of the nature of science; including its relationship with culture[35] and the ability to use science knowledge in an effort to solve problems[36]. Science literacy can be defined as the ability to use science knowledge, identify problems and draw conclusions based on evidence in order to understand and make decisions about nature and the changes that occur to nature as a result of human activity in everyday life.

The domain for science literacy of PISA 2006 consists of scientific knowledge, context, competence and attitude[37]. The following explanation of science literacy domain PISA 2006:

1. Scientific Knowledge

   The scientific knowledge used by PISA 2006 includes knowledge of science and on science. Knowledge of science includes knowledge of physics, chemistry, biology, IPBA and science-based technology, while knowledge on science includes tools (scientific inquiry), and goals (scientific explanations).

32 NCREL & Metiri Group. (2003). *enGauge 21st century skills: digital literacy for digital age*. Napierville, IL and Los Angeles, CA: NCREL and Metiri.

33 Wenning, CJ. Assessing Inquiry Skills as a Component of Scientific Literacy. *J. Phys. Tchr. Educ. Online.* 4 no. 2 (2007). Hlm. 1

34 Uus Toharudin, Sri Hendrawati dan Andrian Rustaman. Membangun Literasi Sains Peserta Didik. (Bandung: Humaniora, 2011), hlm. 1

35 De Boer, G, E. Scientific Literacy: Another Look at Its Historical and Contemporary Meanings and Its Relationship to Science Education Reform. *Journal of Research in Science Teaching.* 37(2000). 582-601.

36 National Research Council. *National Science Education Standards.* (Washington, DC: National Academi Press, 1996)

37 Uus Toharudin, Sri Hendrawati dan Andrian Rustaman. Membangun Literasi Sains Peserta Didik. (Bandung: Humaniora, 2011), hlm. 11

2. Situation or Scientific Context

   Situation or context is the application area of science concepts. The scientific context used in PISA 2006 consists of health, natural resources, environment, science, and technology whose applications are done personally, socially and globally.

3. Scientific Competency

   The scientific competence in PISA 2006 consists of three things:[38]

   a. To identify scientific issues. It means to recognize issues that can be handled scientifically, to identify keywords to search for scientific information, to recognize the key form of investigation.
   b. To explain the scientific phenomenon. It means to apply science knowledge to the given situation conditions, to describe or interpret scientific phenomena and predict changes and to identify descriptions, explanations and proper descriptions.
   c. To use scientific evidence. It means to interprete scientific evidence, to makeg and to communicate conclusions, to identify assumptions, evidence and reasoning behind conclusions, to respond to the social implications of the development of science and technology.

4. Scientific Attitude

   The attitude described in PISA identifies students' interest in science, loves scientific inquiry, motivation to be responsible, for example of natural resources and the environment.[39]

38 *Ibid.,* Hlm. 11

39 *Ibid*,. Hlm. 12

The ability of science literacy can be known by measuring students' inquiry skills. Students who are literate in science literacy are students who have scientific knowledge, inquiry skills, and the ability to make wise decisions about socio-scientific issues[40]. Inquiry refers to student activities in which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study nature[41]. The inquiry can increase the students' competence of having a strong curiosity and identify the problem to be investigated, to train the students to think inductively. Thus, students are able to construct hypotheses, practice deductive thinking, formulate what possibilities will occur based on prepared hypotheses, design experiments and make observations to test hypotheses, collect data, organize data, and analyze data accurately and draw conclusions and communicate results.[42]

In the inquiry activities for primary education, teachers need to start observations from the concrete then slowly toward the abstract. Students of MI/SD need to be familiarized with observing and contacting events or problems in real terms according to the child's situation. They should use more of their senses such as seeing, observing, smelling, hearing, measuring, etc. By observing and experimenting on their own, the child will understand the concept more and find it difficult

40 Laugksch, R. C. Scientific literacy: A Conceptual Overview. *Science Education,* 84 no.1 (2000): 71-94.

41 National Research Council. *National Science Education Standards.* (Washington, DC: National Akademi Press, 1996). Hlm. 23

42 Izzatin Kamala. Pengembangan Modul IPA Terpadu Berbasis *Inquiry Lesson* Tema Pencemaran Lingkungan Untuk Meningkatkan Literasi Sains. Thesis tidak ditebitkan, 2014. Hlm. 52

to forget his own experience in the experiment. The use of mathematics in science learning at MI/SD level is done after students see the real event and after the concept is obtained. In addition, the use of language needs to be adjusted to the cognitive level of students. At a low level, then the use of language should be easy and simple.

Challenges of Science Learning at MI/SD in the Digital Age

Students who are studying in elementary school are the children of Generation Z (born 1995-2009) and Alpha Generation (born in 2010-estimated to 2024). While teachers who teach in elementary school include Generation X (born 1946-1962) and there may still be a Baby Boomer (born 1946-1962).[43] The rapid development of information and communication technology has resulted in a significant difference in technological mastery among teachers and students. Ease of obtaining information through various electronic media makes students have various alternative learning sources and very accustomed to using computers and devices (gadgets).

In the world of science education, this progress can not be ignored. But instead it should be used to advance science education. In science learning in the digital age, a teacher is not only as a source of learning, but also as facilitator, mentor and evaluator. In the context of being a facilitator, teachers have a role in providing services to students to be able to facilitate students receive the material. For that, science learning in the digital era not only use textbooks and lab work in the laboratory, can take advantage of technological progress.

Along with the development of technology, many science learning have been developed by using information technology. Such as computer simulation (virtual laboratory), e- learning, digital book, video, film etc.

Computer Simulation/Virtual Laboratory

Modern learning model that widely used in science learning is computer simulation. Simplifically, computer simulation is a learning model that uses a computer program to simulate a science experiment known as a virtual laboratory. Virtual laboratory as a series of computer programs that can visualize abstract phenomena conducted in the laboratory, so as to increase learning activities in an effort to develop the skills needed in problem solving.[44]

Learning through a virtual laboratory of science (IPA) enhances the student's learning experience to conduct experimental activities like in a laboratory. Virtual laboratory of IPA can stimulate students about real laboratory activities through computers with visual depictions and functions of practicum tools, as well as work procedures. Through Virtual laboratory learning is more effective and efficient to overcome the limitations of time in learning. In addition, this learning is beneficial for students because students can do repeatedly without having to be accompanied by teachers. The presence of

43 McCrindle. (2015), Generation Alpha, Mark McCrindle Q & A with the New York Times, *http://*mccrindle.*com.au/the-mccrindle-blog/generation-alpha- mark%20mccrindle-q-a-with-the-new-york-times* , diunduh 10 April 2017

44 Ahmad Swandi. Pengembangan Media Pembelajaran Laboratorium Virtual untuk Mengatasi Miskonsepsi pada Materi Fisika Inti di SMAN 1 Binamu, Jeneponto. *Jurnal Fisika Indonesia*. XVIII. No 52 (2014) Hlm.22

virtual laboratory can improve students' inquiry skills. This opinion is corroborated by Brinson's research which states that Student learning outcome achievement is equal or higher in Non Traditional Laboratory versus Traditional Laboratory across all learning outcomes categories (knowledge and understanding, inquiry skills, practical skills, perception, analytical skills, and social and scientific communication)[45]. In addition, Tuysuz's research stated that practicum implementation using virtual laboratory is more effective, interesting and more useful and able to enable learners to repeat the experiment.[46] Through a virtual laboratory, students' literacy skills can also be improved.

E-Learning

The development of information Technology, especially on computer technology and the Internet, creates a new culture for all areas around the world, including education. In the field of education, the development is utilized for the purposes of learning, namely as a medium of learning. Media that utilizes computer technology and internet network is known as e-learning media. E-learning is an internet-based application program that contains all the information about education that is clear, dynamic, and accurate and up to date makes it easy for learners to do the learning online.[47]

Science (IPA) learning should have evolved using e-learning. Through e-learning, students can learn anywhere by using internet network. Teaching materials are provided by teachers through e-learning and students can access them. Through e-learning not only the students themselves can access it, but other students can also access it. This means that the learning materials provided by teachers have a broad impact in the dissemination of knowledge.

In learning using e-learning, teachers act as facilitators, directors, and correctors if there is a mistake in the process and the conclusion of student learning outcomes. Conventional learning is still needed, while e-learning serves as a complement to support the improvement of learning quality. The use of e-learning is expected not only to build students' science literacy but also to technological literacy, so that students are not just mastering science but also technology.

Digital Book

Digital books are also known as electronic books that have various types of formats including PDF, ePUB, Proprietary format, Interactive, Digital textbooks, Apps, Audiobooks[48]. Digital books can be used as a medium of science learning. Through digital books, students will learn with fun. Polanka explains that digital books can provide a variety of interesting learning environments

45 Brinson, James R. Learning Outcome Achievement In Non-Traditional (Virtual and Remote) Versus Traditional (Hands-On) Laboratories: A Review of The Empirical Research. *Journal Computers & Education*. 87. (2015) Hlm. 218–237.

46 Tuysuz, Cengiz (2010). The Effect of the Virtual Laboratory on Students' Achievement and Attitude in Chemistry. *International Online Journal of Educational Sciences.* 2 (1). Hlm. 47

47 Munir. *Kurikulum Berbasis Teknologi Informasi dan Komunikasi.* (Bandung: Alfabeta, 2012). Hlm. 170

48 Finita Dewi. Proyek Buku Digital: Upaya Peningkatan Keterampilan Abad 21 Calon Guru Sekolah Dasar Melalui Model Pembelajaran Berbasis Proyek. *Metodik Didaktik* 9 No. 2 (2015). Hml. 6

such as:[49]

- To provide demonstration and interact with animation
- To work Puzzles
- To repeat the question
- To try different types of response
- To get fast feedback
- To Provide a choice of learning environment

To make digital books more interactive, in the making, it needs additional applications required to add various features, such as interactive quizzes, interactive cartoons for virtual laboratory, audio and video. Based on these explanations, digital books contain not only textbooks alone. However, it can also contain a variety of interactive media for learning, especially in science lessons. The digital books of IPA can be in the activity of inquiry, video, or Virtual laboratory.

Video and Film

It has been a long time for learning science to use video or film that is used to present the themes on science learning. In science teaching using video or film, students learn the concept of IPA by viewing and observing images or events through impressions on video and film. Video and movies for science learning are currently available on the internet, especially on the You Tube app. Video and film learning has the advantage of carrying dead or living images and even any natural phenomena can be brought into the student's study.

The weakness of this video and movies is that students can not manipulate data to obtain various variations of results. Students just observe, see and discuss it. Then, the teacher provides assistance with questions for student discussion materials. Then, the students together with the teacher to conclude. Then, the teacher gives the note as necessary. Video and the film is only used as a supporting medium followed by inquiry activities and discussions.

CONCLUSION

Development of science literacy through the utilization of digital media is very important to be delivered to students of MI/SD to face the challenge of globalization. The urgency is supported by the fact of the need to increase the science literacy of Indonesian students in PISA rankings. Through technological development, the digital age offers a change in the role of teachers in the process of teaching science literacy. Teachers can take advantage of digital learning media in increasing science literacy through computer simulation/virtual laboratory, e-learning, digital book, video and film. The digital era provides open access to interactive material and information through the Internet. Thus, the use of digital media in building science literacy will facilitate students to learn without space and time constraints.

BIBLIOGRAPHY

Ahmad Swandi. Pengembangan Media Pembelajaran Laboratorium Virtual untuk Mengatasi Miskonsepsi pada Materi Fisika Inti di SMAN 1 Binamu, Jeneponto. Jurnal Fisika Indonesia. No 52. Vol XVIII. Hlm. 22. 2014.

Asrizal, Festiyed, dan Ramadhan Sumarmin. Analisis Kebutuhan Pengembangan Bahan Ajar IPA Terpadu Bermuatan

49 Ibid,. Hml. 6

Literasi Era Digital Untuk Pembelajaran Siswa SMP Kelas VIII. Jurnal Eksakta Pendidikan, 1, no. 1. 2017.

Brinson, James R. Learning Outcome Achievement In Non-Traditional (Virtual and Remote) Versus Traditional (Hands-On) Laboratories: A Review of The Empirical Research. Journal Computers & Education. (87). Hlm. 218–237. 2015.

De Boer, G, E. Scientific Literacy: Another Look at Its Historical and Contemporary Meanings and Its Relationship to Science Education Reform. Journal of Research in Science Teaching. (37). Hlm. 582-601. 2000.

Depdiknas. Naskah Akademik Kajian Kebijakan Kurikulum Mata Pelajaran IPA. Jakarta: Puskur Balitbang Depdiknas. 2007.

Finita Dewi. Proyek Buku Digital: Upaya Peningkatan Keterampilan Abad 21 Calon Guru Sekolah Dasar Melalui Model Pembelajaran Berbasis Proyek. Metodik Didaktik 9 No. 2. Hml. 6. 2015.

Indrawati. Model Pembelajaran IPA Terpadu untuk SMP. Bandung: PPPPTK IPA. 2010.

Izzatin Kamala. Pengembangan Modul IPA Terpadu Berbasis Inquiry Lesson Tema Pencemaran Lingkungan Untuk Meningkatkan Literasi Sains. Thesis tidak ditebitkan, 2014.

Laugksch, R. C. Scientific literacy: A Conceptual Overview. Science Education, 84 (1): 71-94. 2000.

McCrindle. Generation Alpha, Mark McCrindle Q & A with the New York Times. 2015. http://mccrindle.com.au/the-mccrindle-blog/generation-alpha- mark%20 mccrindle-q-a-with-the-new-york-times , diunduh 10 April 2017

Munir. Kurikulum Berbasis Teknologi Informasi dan Komunikasi. Bandung: Alfabeta. 2012.

National Academy of Sciences. Science, Evolution and Creationism. NAS Press: Washington, DC. 2008.

National Research Council. National Science Education Standards. Washington, DC: National Akademi Press. 1996.

NCREL & Metiri Group. enGauge 21st century skills: digital literacy for digital age. Napierville, IL and Los Angeles, CA: NCREL and Metiri. 2003.

OECD. Executive Summary PISA 2006: Science Competencies for Tomorrow's World. 2007.

OECD. First Results From Pisa 2003 Executive Summary. 2003.

OECD. PISA 2009 Results: Executive Summary. 2010.

OECD. PISA 2012 Results in Focus. What 15-year-olds know and what they can dowith what they know. 2014.

OECD. PISA 2015 Results in Focus. 2016.

Suparno, Paul. Metodologi Pembelajaran Fisika Konstruktivistik dan menyenangkan. Yogyakarta: Universitas Sanata Dharma. 2013.

Tuysuz, Cengiz The Effect of the Virtual Laboratory on Students' Achievement and Attitude in Chemistry. International Online Journal of Educational Sciences. 2 (1). Hlm. 37-53. 2010.

Usaid Prioritas. Buku Sumber Bagi Dosen LPTK. Pembelajaran IPA SMP di

LPTK. (2014).

Uus Toharudin, Sri Hendrawati dan Andrian Rustaman. Membangun Literasi Sains Peserta Didik. Bandung: Humaniora. 2011.

Wenning, CJ. Assessing Inquiry Skills as a Component of Scientific Literacy. J. Phys. Tchr. Educ. Online. 4 no. 2. 2007.