

# Synthesis of Indicators of Scientific Literacy Components for Junior High School Students: Via Online System

Chayada Jomtarak<sup>1</sup>,  
Peerawut Suwanjan<sup>2</sup>,  
Phadungchai Pupat<sup>3</sup>,  
and Lertlak Klinhom<sup>4</sup>

Faculty of Industrial Education and Technology,  
King Mongkut's Institute of Technology Ladkrabang, Thailand

<sup>1</sup>chayada3014@gmail.com

<sup>2</sup>peerawut.su@kmitl.ac.th

<sup>3</sup>pdc\_2500@yahoo.com

<sup>4</sup>kkkertla@kmitl.ac.th

**Abstract** - The objective of this research study aimed to synthesize indicators of scientific literacy components for junior high school students: via online system. The source of data is related documents and research studies associated with indicators of scientific literacy components. The instrument used for collecting data is document record forms. Content analysis technique is employed to analyze data. The research found as follows:

The research results indicated that indicators of scientific literacy included 4 components; perception and application in scientific context and scientific competency, knowledge of science, knowledge about science and scientific attitude.

**Keywords** - Scientific, Literacy, Online System, Guideline

## I. INTRODUCTION

Today it is an era of the 21<sup>st</sup> century where the progress of technology is extremely advanced. The Basic Education Core Curriculum B.E. 2551 [3] stated that "Science plays an important role in our present and future world communities, as it concerns all of us in our daily lives and livelihoods. Science also involves technologies [8], instruments, devices

and various products at our disposal, which facilitate our life and work. All these benefit from our scientific knowledge which is combined with creativity as well as other disciplines. Science enables us to develop our thinking skills in various aspects – logical, creative, analytical and critical. It also enables us to acquire essential investigative skills for seeking knowledge and allows the ability for systematic problem solving, and for verifiable decision-making based on diverse data and evidences. All of us therefore need to be provided with scientific knowledge so as to acquire knowledge and understanding of nature and man-made technologies that can be applied through logical, creative and moral approaches". This is consistent to Vicharn Panich.

Science literacy started in the United States of America based on a policy that people need to have a basic knowledge of scientific principles leading to an important goal concerning scientific study in the United States after educational reform. Since scientific and economic competition increase, it is determined as a target of scientific management on education management in many countries. Science literacy is scientific management on educational management that changes in accordance with social requirement. The Basic Education Core Curriculum B.E. 2551 [3]

mentioned that “science plays an important role in our present and future world communities as it concerns all of us in our daily lives and livelihoods. Science also involves technologies, instruments, devices and various products at our disposal, which facilitate our life and work. All these benefit from our scientific knowledge which is combined with creativity as well as other disciplines. Science enables us to develop our thinking skills in various aspects; logical, creative, analytical and critical. It also enables us to acquire essential investigative skills for seeking knowledge and allows the ability for systematic problem-solving and for verifiable decision-making based on culture of the new world known as knowledge-based society. Therefore, all of us need to be provided with scientific knowledge development so as to acquire knowledge and understanding of nature and man-made technologies that can be applied through logical, creative and moral approaches”. Scientific knowledge empowers technology development and technologies play important role in speeding scientific knowledge exploration. So, knowledge for systematic problem-solving is a culture in the new world which is a knowledge-based society in determining requirement, accessibility, management, assessment, integration, creativity, and information and communication including good characteristics of effective learning and for the workplace. The mentioned literacy can be occurred requires basic of knowledge, skills, and attitude. Persons with positive attitude can express how they see value, benefit and how they pay attention to create and perform their tasks successfully.

Based on the mentioned importance, in order to obtain indicators of components for developing science learners to have knowledge, skills and positive attitude, the researcher is interested in synthesizing indicators of scientific literacy components for junior high school students so as to use as a framework to develop students who study in the field of science accordingly.

## II. OBJECTIVE

To synthesize indicators of scientific literacy components for junior high school students.

## III. RESEARCH METHODOLOGY

### *A. Data Sources, Related Documents, and Research Studies Associated with Framework*

National Science Education Standards or [2] defines scientific literacy as the knowledge and understanding of scientific concepts and processes required for personal decision-making, participation in civic and cultural affairs, and economic productivity. It also includes specific types of abilities.

The [8] defines scientific literacy as having knowledge in 3 aspects: 1) essential scientific concepts, 2) scientific process, and 3) application of scientific knowledge in everyday life.

The [8] gives a definition of science literacy as capacity to use scientific knowledge, to identify questions and to draw evidence-based conclusions in order to understand and help make decisions about the natural world and the changes made to it through human activity.

The [9] science literacy in PISA 2009 is defined as “scientific knowledge and use of that knowledge to identify questions, to acquire new knowledge, to explain scientific phenomena, and to draw evidence based conclusions about science related issues, understanding of the characteristics of features of science as a form of human knowledge and inquiry, awareness of how science and technology shape material, intellectual, and cultural environments, and willingness to engage in science-related issues, and with the ideas of sciences as constructive, concerned, and reflective citizens”. [4] defines scientific and technological literacy as the capacity to use scientific and technological knowledge to apply in everyday life such as solving problems in real situations or to use as information for making decisions. Besides, the information about components of scientific

literacy from other students are made conclusion which comprise of having knowledge and understanding of science and technology contents, having scientific attitude, having science and technology process skills, and capacity of applying scientific knowledge and science process skills in everyday life [5] stated that scientific literacy refers to capacity to use scientific knowledge, student's scientific knowledge and student's attitude to respond to scientific issues by using scientific knowledge assessed from scientific competency and using scientific evidence. Scientific competency can help students understand and help make decisions about everyday situations associated with science and technology.

Bauer [1] mentioned that scientific literacy included 3 components: 1) Having knowledge and understanding of scientific principles, 2) Having understanding in activities related to science, having science process skills, and 3) Knowing scientific role in society and culture.

### ***B. Variables in the Study are Indicators of Scientific Literacy Components***

#### **• Research Instrument**

Document record forms that verified appropriateness from experts using to record details obtained from studying a framework / indicators of scientific literacy components from related documents and research studies.

#### **• Data Collection**

The researcher studied related documents and research studies associated with framework / indicators of scientific literacy components and recorded the data in document record forms.

#### **• Data Analysis**

Content analysis technique is used to analyze data in this research.

## **IV. RESEARCH RESULTS**

Based on the study of a framework of indicators of scientific literacy components from related documents and research studies, the synthesis of definition and indicators of scientific literacy components can be detailed as follow:

**TABLE I  
SYNTHESIS OF INDICATORS OF SCIENTIFIC LITERACY COMPONENTS**

Synthesis of indicators of scientific literacy components	Indicators	Bauer	NSES (1990)	IPST (2004)	PISA (2006)	ISA (2009)	Pacharee (2006)	Wannam (2010)	Frequency
1. Perception and application of scientific context and scientific competency	√	√		√	√	√	√	√	6
2. Knowledge of science	√	√	√	√	√	√	√	√	7
3. Knowledge about science	√		√	√		√	√	√	5
4. Scientific attitude	√	√	√		√	√	√	√	6

Based on the Table I, indicators of scientific literacy components mentioned by educationists and organizations are consistent. The researcher used frequency equal to 3 for consideration of content analysis. The research results indicated that indicators of scientific literacy components included the following:

1) Perception and application in science context and science literacy. The context of science assessment covers perception of real-life situations associated with science and technology in a certain matter. Scientific literacy refers to using scientific knowledge to identify scientific issues, to explain phenomena scientifically, and to use scientific evidence.

2) Knowledge of science refers to knowledge that covers concept and body of knowledge about the natural world such as knowledge in biology.

3) Knowledge about science refers to knowledge in methods or process in seeking scientific knowledge and science process skills that lead to the goal of obtaining knowledge.

4) Scientific attitude; the attitude to be measured comprises response to science with interest, support scientific knowledge seeking, and being responsible for various matters such as natural resource and environmental issues, etc.

All 4 components in assessing scientific literacy are related to one another. It can be said that under a scientific context, it forces a person to have competency to confront or react and how well that person can react is an effect from individual's knowledge and attitude.

## V. RESULT DISCUSSION

The synthesis of indicators of scientific literacy components for junior high school students revealed that educationists or organizations had determination of indicators of scientific literacy components, similarly and differently as importance and emphasis on taking indicators to practices were placed differently.

The indicators of scientific literacy components are directly valuable for students. They enable student to exceedingly have knowledge, opportunity to express their opinion and specific talent to different aspects. Besides, students can practice their responsibility and spend their leisure time usefully and develop their process skills as well as positive attitude towards science. They can promote students to use obtained knowledge and skills in their everyday life which consistent with the elevation of scientific knowledge and in harmony with the context of scientific literacy recommended by PISA 2015 that determines three vital aspects of critical literacy as reading literacy, mathematical literacy, and scientific literacy.

The PISA framework for assessing the scientific literacy includes four interrelated aspects: context, competency, knowledge, and attitude and PISA test comes with the diverse array of situations that students can encounter. National Science Education Standards or known as NSES (1990) defines scientific literacy is the capacity to use scientific knowledge to identify questions and to draw evidence-based conclusion in order to understand and help make decisions about the natural world. Pacharee Tewsikhares defines scientific literacy as capacity to apply scientific and technology knowledge in everyday life.

## VI. RECOMMENDATIONS

The results of synthesis of indicators of scientific literacy component for junior high school students are the information that can be used as a guideline to develop student's scientific knowledge for learning and working competency as well as to be a framework in designing a measure of scientific literacy accordingly.

## REFERENCES

**(Arranged in the order of citation in the same fashion as the case of Footnotes.)**

- [1] Bauer, H. (1994). "Scientific literacy and myth of the science method". Urbana, IL: University of Illinois press.
- [2] NSES. (1990). "Science / Technology / Society: Anew effort for providing appropriate science for all". <[www.nsta.org/positionstatement&psid=34](http://www.nsta.org/positionstatement&psid=34)>.
- [3] Ministry of education. (2008). "Indicators and Learning Area of Science, the Basic Education Core Curriculum". Bangkok: Chulalongkorn University Press.
- [4] Tewsikhares, P. (2006). "Research and development of a manual for managing learning activities in a science resource for scientific and technological literacy development of Mathayom Suksa 3 students". (Master's thesis), Chulalongkorn University.
- [5] Marakong, W. (2010). "Enhancing of grade 6 students' scientific literacy at

- Ban Nonmoung School, Khon Kaen province in learning about world phenomenon and space technology through science technology and society approach (STS Approach)". (Master's thesis), Khon Kaen University, Khon Kaen province.
- [6] Panich, V. (2012). "Learning path for students". Bangkok: Government House Printing Office.
- [7] Ministry. (2008). "The Basic Education Core Curriculum B.E. 2551 (A.D. 2008)". Bangkok: The Agricultural Cooperative Federation of Thailand Printing Press.
- [8] Sawatmul, S. (2001). "A study of scientific literacy characteristics". (Master's thesis), Khon Kaen University, Khon Kaen province.
- [9] Institute for the Promotion of Teaching Science and Technology. (2008). "Scientific knowledge and scientific competencies for tomorrow's world, PISA 2006 Results". Institute for the Promotion of Teaching Science and Technology.
- [10] Institute for the Promotion of Teaching Science and Technology. (2011). "PISA 2009 Results: Reading literacy, Mathematical literacy and Scientific literacy". Bangkok: Aroon Printing Limited Partnership.
- [11] Ongard, N. (2008). "Research Design: Quantitative, Qualitative, Mixed Methods". Bangkok: Chulalongkorn University Press.