

# Reading -To-Learn Science: the Perspective of Thai Science Student Teachers

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## ABSTRACT

This exploratory classroom research aims to study Thai science student teachers' perspective on learning science through reading and identify factors and difficulties of comprehensive science reading. The participants were 18 student teachers majoring in science teaching and taking a course Reading in Contemporary Science Education Issue (159372) in the 2006 Academic year at Faculty of Education, Kasetsart University, Bangkok, Thailand. The students were assigned to write a one-page essay to express their opinion on whether science teachers need to be a reading teacher. Key ideas of their writing were identified and discussed with the cohort. It was found that the students thought that reading was both learning and teaching tools in science. Reading could help students become scientific literate- the principal goal of science education and foster higher order thinking. However, reading science was not easy. From focus group interview, the students raise a number of difficulties of reading science including the use of scientific terminology, symbol, presentation and language issue. Regarding these difficulties, students urged science teachers to promote this basic communication skill for effective science learning.

**Key words:** reading in science, scientific literacy, science student teachers

## INTRODUCTION

National Science Curriculum Standards of Thailand (IPST, 2002) stated that scientific literacy is the principal goal of science education at all levels. Accordingly, all educational institution nationwide must provide students knowledge and understanding of scientific concepts and processes required for personal decision making, participation in civic and cultural affairs, and economic productivity related to science and technology (AAAS, 1989; Glynn & Muth, 1994). To become scientific literate, reading is a vital tool (Wright, 1982; Holliday *et al.*, 1994). Students can learn science concepts and develop thinking through reading. Scientific texts can encourage

students to evaluate and interpret the information they have acquired. By reading, students can construct meaning with higher mental processing, requiring students to organize ideas relative to each other and integrate with their prior knowledge (Wright, 1982; Holliday *et al.*, 1994).

However, previous studies repeatedly indicated that to many students, reading science was difficult to comprehend by a number of reasons (Thelen, 1984; Graesser *et al.*, 2002). First, science text is loaded with technical terms, mathematical language with symbols and formulas which is virtually not used in daily life or used but having totally different meanings. Secondly, students need to have background knowledge to understand science concepts (West &

Fensham, 1976; Novak *et al.*, 1983). They must seek to integrate what they are reading with what they have already known. It is common that what they bring mismatch with what they are going to read. Student's non-scientific explanatory model interferes with the scientific concept and principle presented in the text. These difficulties can hinder comprehension of overall text. If the text does not make sense, students likely become bored. Bored students gradually withdraw from the learning situation and do not pay attention to science lessons. They refuse to do classroom assignment and potentially become discipline problems in class or even missing the class (Thelen, 1984). This present study aims to explore Thai students' perspective on learning science through reading and identified the difficulties of reading scientific texts. The findings from this study would give educational personnel issues to be considered and guidelines in promoting reading habit and efficacy, a bridge to scientific literacy. The research questions to be explored are: 1) How do Thai science student teachers view learning science through reading? and 2) What are the difficulties of reading scientific contexts?

## METHODOLOGY

### Context of study

This research is an exploratory classroom research. The data was gathered from 18 second and third year students pursuing five year B.Ed. program in science teaching at Kasetsart University, Bangkok, Thailand. The students enrolled in a fifteen-week course, Reading in Contemporary Science Education Issue (159372), taught by the researcher during the first semester of 2006 academic year. The session of each week lasted for two hours. This course aimed to equip the students with knowledge and skills for effective science reading for comprehension and appreciation and discuss the issues in science and technology during 2000 to 2006 from information sources such as newspaper, magazine, and internet --which would be useful for teaching career. The

data used in this study was taken from the sessions of the first two weeks which centered on the goals of reading science and the language of science.

### Data collection and analysis

To investigate students' views of learning science through reading, the students, (a week before the first session), were assigned to write a one page essay on "Does a Science Teacher Need to Be a Reading Teacher?" In the first session, each student was asked to read his/her essay to the group. Facilitated by the researcher, the students collaboratively analyzed and synthesized for the arguments of their writings. As for reading difficulties, the students were asked to bring a university level science textbooks corresponding to their science majors; Biology, Chemistry, Physics, and General Science. The students were given 15 minutes to get through scientific texts to find out the difficulties within the texts. Doing so is a technique to prompt student thinking. Focus group technique was subsequently conducted with the students. The focus group was conducted in a classroom setting in a permissive non-threatening environment. The interview data was audiotaped and transcribed verbatim. The transcript was then analyzed by looking for trends and patterns that appear and reappear within the focus group. The respondent's comments were particularly considered. Pseudonyms instead of real names were applied in this report to identify the participants for ethical reason.

## RESULTS AND DISCUSSION

In this section, the arguments on learning science through reading and difficulties of learning science emerging from the analysis of students' essay and focus group interview were reported

### 1. Learning science through reading

**Reading is a tool to assess the information of science and technology (5 students from 18 students).**

Reading is a key to enter the world of science and technology. The students thought they all were in the information technology era where there was so much information in science and technology available through various forms of media for example, newspaper, television, movies, radio and internet. They could assess the information easily than ever. Everyone must employ reading to gain the information from these sources. They, especially the young, need to be advised how to effectively assess and wisely consume the mountain of information. “It is us (science teachers) to do the job; training them to evaluate the information sources; what is accurate and factual verses biased and not so accurate”, Manus said.

**Reading Science is difficult and boring to a large number of students. (15 students from 18 students)**

When asked the sources of reading science, most of the students mentioned textbook because they had to depend on it throughout their study; assignment and examination. Many of them felt bored with it. A few students referred to other information sources such as magazine, journals, fiction, internet or newspaper. To the majority of students, reading science sounds very educational, rather than enjoyable and appreciable. They reasoned that it was too difficult and stressful to make sense of the scientific texts. They preferred to do other things more relaxing in their leisure time. The students thought motivation was the most important part of getting to read. Jakarin strengthened this point, “To me, motivation must come first. I love reading science magazine but I would read only the topics that I am most interested in such as GMOs plant, Human Genome Project, Nanotechnology etc.” Lanna added, “It also worked with me that way. Nowadays, the use of forensic science to unlock the crime is common and reported in the newspaper recurrently like Hangthong’s, Jenjira’s cases. In the news, there were a number of unknown words like DNA fingerprinting, patterns of DNA bands, DNA sequencing. The news prompts me to

figure out what they are about so I can constructively participate in the conversation. With this understanding, I could spend hours and hours reading such texts”. From these reasons, science teachers should help students overcome such difficulties. The students thought that the teachers should know the strategy to motivate students to read science even the topics would not be interesting to the young readers and suggest some practical guidelines and tips to handle reading difficulties in the text.

**Reading is a tool to learn science (12 students from 18 students)**

To learn science, students are involved with reading in number of ways formally and informally. In classroom, many science teachers uses textbook to teach science. At home, the students read textbook to review concepts before the examination. At the library, the students go through piles of printed materials to do a project or report. In laboratory, they follow the lab direction or look for particular information from internet or relevant textbooks available. Lot of students go to science museum or science fair, they might have a chance to have a look at the information on the exhibition. In short, the students always read to learn science. Effective reading, accordingly, results in better science learning.

**Goals of learning science can be accomplished by reading (12 students from 18 students)**

The students can gain understanding of concepts in science and develop scientific habits of mind through reading. Darin illustrated this point, “I am a big fan of National Geographic magazine. I love to read about wild life and ecosystems. It is not just entertaining but I learn a lot about science not just concepts but how hard scientists work in the field, the time they spent on their work and contribute what he or she had learnt to scientific community and our society. They must have had passion for their study which is adorable”. Darin said she had developed positive attitudes towards science after reading and reading, in addition, inspired her to be an amateur naturalist in her leisure

time besides teaching job.

#### **Reading can enhance students' higher level of cognition (15 students from 18 students)**

Reading science can foster higher order thinking to students. Science in media is not only informative but quite often persuasive which requires students to think critically. "We all should be able to come to reliable and trustworthy conclusions and rationally decide what to believe or do from the reading, for example, society's need for nuclear power plants, and the consequences of global warming." Manee explained. Jakarin thought that with the guidance and assistance of science teachers, critical reading can be promoted, "kids were not born with the ability to think critically, nor can they develop this skill on their own. It, on the contrary, is learned ability". Reading science also promotes creative thinking. Science fictions and comic books are the materials for this kind of lateral thinking. Jarunee admirably explained how "Doraemon", the all-time hit children's Japanese classic manga, encourage her creative thought. "I read Doraemon when I was a school student. I really wanted to have a Doraemon because he has a pouch on his front pocket, which contains all types of cool gadgets from the 22<sup>nd</sup> century".

#### **Reading is a tool for effective teaching (14 students from 18 students)**

To be an effective science teacher, the teacher needs to have a broad, deep and up to date knowledge about science. The teachers must be a skilled reader. They must read a lot to create attention grabbing lessons, challenge students with thoughtful questions, aware of students' alternative conception and effectively deal with students' conceptual difficulties. Reading, by this fashion, is a tool for the teacher to professionally develop pedagogical content knowledge.

## **2. Difficulties of reading science**

### **Scientific terms (All students)**

The students were struggled with technical terms the most. "There are too many to remember

and many of which, especially those of bio, do not have any clues such as neuron, dendrite, axon.", Jakarin said. He, in addition, said that was the big reason why he did not like biology. Jarunee recalled her first time hitting "momentum" in national physics textbook when she was in high school. She did not understand it at all even she had made a guess of the term from the surrounding text. She had searched its meaning in a dictionary but found nothing. Although, there has been a lot of attempt to translate many of technical terms into Thai since English is the international language of science, many of them were replaced by "freaky Thai words". Daranee said, "I think in most cases that (word formation) would make things worse, for example; the terms, การกระจัดหรือการขจัด (displacement), โหนด (node), ปฏิบัพ (internode), อันตรกิริยา (interaction) and พลวัต (dynamic). I truly get what lost in translation means". Rosarin then questioned the class if it was necessary to make such words sound complex and difficult.

### **Scientific symbols (12 students from 18 students)**

All students thought that the symbols used in science were another reading comprehension difficulty such as Greek alphabets, symbols and formula and mathematical operators. (Table 1)

### **Language issue (9 students from 18 students)**

Like English and other languages, the use of many scientific terms in Thai is problematic because of their distinct meanings depending on the context of discussion such as evolution, fitness etc. A number of studies show that the informal usage of many scientific terminologies is inconsistent with its use in scientific context.

"I think evolution is the gradual development of something such as evolution of aircraft, evolution of music, evolution of postal system..on and on", Ronnachai

Meen, "...Dominance and recessiveness in Genetics is another example. It is obvious that laymen would think of dominance is common, good

**Table 1** Some scientific symbols exemplified by the students

Greek alphabets	Symbols and molecular formula	Mathematical operators
$\alpha$ (Alpha), $\beta$ (Beta),	Fe (iron), Au (gold), Hg (mercury),	$\int$ (Integral), $f$ (Function),
$\gamma$ (Gamma), $\delta$ (Delta),	K (Potassium), $C_6H_{12}O_6$ (glucose),	$\approx$ (Almost equal to),
$\varepsilon$ (Epsilon), $\lambda$ (Lambda),	$CH_4$ (methane), $f$ (force), $m$ (mass),	$\sim$ (Proportional to),
$\mu$ (Mu), $\theta$ (Theta)	$a$ (acceleration), ■ (affected male),	$\Sigma$ (summation), $\infty$ (Infinity),
	○ (normal female), ⊙ (carrier female),	$\rightarrow$ (non-reversible reaction),
	X (mating), $\Delta$ (heat),	$\leftrightarrow$ (reversible reaction)

and perfect characteristics while recessiveness is in the opposite side”

In addition, the meaning of many scientific terms used in daily situation can vary from language to language. To illustrate this point, Joompon gave an example of acceleration. “In our language (Thai), we use this term to mean “hurry or rush” like I say “please do not accelerate me. I am pretty sure I can finish this assignment in time”. Jakarin explained the use of term, respiration that the respiration in Thai (หายใจ) was the only term for both breathing and cellular respiration so Thai people might have understood that these two concepts were equivalent. In English, however, he thought it would probably be the case since there were different terms specific to each one. The groups of three to four students were then encouraged to give the examples of scientific terms that are also used in Thai with different meaning.

“Liquid. when I was young, I thought that all liquid was water regardless of what it really was because I was taught to describe any liquid as water like.”, Meen from Group 1.

“Stream (ไอน้ำ ละอองน้ำ) and water vapor (ไอรเหยของน้ำ), I was so confused about them. I had thought the two terms were the same but taking Gen Chem brought me a light they were actually not. I don't think that I had heard water vapor in Thai before.”, Rom from Group 3.

“Hard and Solid are another example. In Thai, both are homonyms. We then put any hard objects without regarding other physical properties into solid”, Lanna from Group 4.

## IMPLICATIONS OF THE STUDY

The students' perspectives on reading to learn science were consistent with the arguments of a number of science educators that reading could help students achieve scientific literacy. By reading scientific texts, students familiarize themselves with conceptual relations that form the basis of real scientific enterprise and understanding. Reading is a fundamental conceptual tool for analyzing, interpreting, and reasoning of scientific ideas. However, reading science was viewed by all student teachers as a complex meaning making process. It was an interaction between readers' prior knowledge, concurrent experience, and information accessed from print and other sources. Therefore, reading in science is constructive in nature rather than rote. It is meaningful, conceptually integrated, and active rather than irrelevant, isolated and passive. In addition, the student teachers recognized that scientific texts tend to have structures not found as frequently in other texts and everyday situation suggests that one approach to instruction would be to teach explicitly how to identify the various structures in science texts.

Apart from that, science teachers should train students a variety of powerful skills to facilitate comprehension of science texts which are consistent with general reading -comprehension model such as metacognition, word recognition, lexical access, semantic and syntactic analysis, identification of text relations (patterns) etc. These strategies will be suggested as a thread of inquiry for further study to

find out whether they can assist students to read science more effectively.

## CONCLUSION

The student teachers thought reading was a way to learn science. This skill was used for gaining understanding of science concepts and nature of science. However, reading science was regarded as being difficult and unmotivated and required training and continuous support and encouragement from teachers. The researcher would like to call science education community upon the extension of research on this area in terms of the roles of language in science learning and how Thai students interact with science portrayed by texts. This would make contribution to integrating instruction of science and reading at all levels in Thailand.

## LITERATURE CITED

- American Association for the Advancement of Science (AAAS). 1989. *Project 2061: Science for All Americans*. Washington, DC: Author.
- Glynn, S. M. and K.D. Muth. 1994. "Reading and Writing to Learn Science: Achieving Scientific Literacy". *Journal of Research in Science Teaching*. 31: 1057-1073
- Graesser, A. C., J. A. León and J. Otero. 2002. *Introduction to the Psychology of Science Text Comprehension*. Mahwah, NJ: Lawrence Erlbaum Associates, Incorporated.
- Holliday, W.G, L.D. Yore and D.E. Alvermann. 1994. "The Reading-Science Learning-Writing Connections: Breakthroughs, Barriers, and Promises". *Journal of Research in Science Teaching*. 31: 877-893.
- Novak, J.D., D.B. Gowin and G.T. Johansen. 1983. "The Use of Concept Mapping and Knowledge Mapping With Junior High School Science Students". *Science Education*. 67: 625-645.
- Spiegel, G.G. and J.P. Barufaldi. 1994. "The Effects of Combination of Text Structure Awareness and Graphic Postorganizers on Recall and Retention of Science Knowledge". *Journal of Research in Science Teaching*. 31: 913-932.
- Thelen, J. 1984. *Improving Reading in Science*. International Reading Association: Delaware.
- West, L. H. and D.J. Fensham. 1976. "Prior Knowledge or Advance Organizers as Effective Variables in Chemical Learning". *Journal of Research in Science Teaching*. 13: 297-306.
- Wright, J. 1982. "The Effect of Reduced Readability Text Materials on Comprehension and Biology Achievement". *Science Education*. 66: 3-13.