E·A·S·E East-Asian Association for Science Education

The Newsletter of

The East-Asian Association for Science Education

東亞科學教育學會通訊

http://theease.org

Vol.7, No.3

No. 0027

September. 30, 2014

Beijing Normal University
No.19, Xinjiekouwai Street
Beijing, China
+86-10-58805862
Fax: +86-10-58802075

We are delighted to invite you to participate in 2015 International Conference of the East-Asian Association for Science Education (the forth biennial conference of EASE) in Beijing Normal University, Beijing, China, during 9-11 October, 2015. The conference aims to build an international platform for science education practitioners, researchers and policy-makers throughout the East Asia regions and around the world to share and discuss how to promote science education reform through research.

Participants intending to present a paper, workshop, symposium or demonstration are requested to submit an abstract (150 – 500 words, in English) by 31 March, 2015. The topics of the conference include, but are not limited to, educational studies in science, mathematics, technology, and the environment. All abstracts are required to be submitted via the website of EASE 2015 (under construction, the format of abstracts will also be published on the website). Young scholar awards and outstanding paper awards will be presented during this conference. More information will be released later.

You are cordially invited to take part in this exciting international event, and to share your innovations, experiences, cutting-edge findings, best practices and visions of education reforms. You are welcome to distribute this information to your colleagues and students.

Main themes:

Promoting Science Education Reform Through Research

Sub-themes:

- Development of science curriculum
- Policy research in science education
- Learning and teaching science
- Assessment of students' science learning and development
- Science Teacher education and professional development
- Integrating science with other areas of learning
- ICT in science education
- Historical, philosophical, social, cultural, and gender issues in science education
- Science education in life-wide, authentic, and informal contexts
- Public understanding of science
- Research on didactics of physics, chemistry, biology and geography and Science education research in comparative perspective
- Development of experimental teaching and learning aids, experimental equipment and experimental activities

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

Important Dates:

March 31, 2015	Abstract submissions due
May 31, 2015	Notification to authors
June 30, 2015	Early bird registration deadline
August 31, 2015	Registration deadline

Contact Us:

Email: easebeijing2015@yeah.net

We look forward to meeting you in Beijing in October 2015.

More information will be released on the official EASE website (http://new.theease.org/) soon and the website of EASE 2015 conference is under construction. Please stay tuned.

Cross-subject Analysis on Questions in Elementary Science Textbooks and Japanese Language Textbooks in Japan

Manabu Sumida & Chika Shimomiya

Faculty of Education, Ehime University, Japan, Fukuyama Myoodai High School, Japan

Abstract: The purpose of this study was to investigate characteristics of "Scientific Questions" by comparing questions in elementary Science textbook with those in Japanese Language textbook in Japan. Japanese science education officially starts at grade three. In this study, 461 questions were extracted from grade three Science textbook and Japanese Language textbook published in 2011 under the new national course of study. The original framework was developed for cross-subject analysis on these questions. The results showed: 1) Science textbook contained fewer Yes/No type questions than those in Japanese Language textbook; 2) meta-questions (from others to others) were very few in Science textbook; and 3) there were more experience-based questions in Science textbook and more thinking-based questions in Japanese Language textbook. The study highlights that there was a different rate of certain types of questions asked in Science and Japanese Language, and this could have implications on studies related to nature of Science and other subjects. It is important both for children and teachers to take note that the characteristics of Science questions may differ from other subjects even when some subjects, such as Science and Japanese Language, are taught coordinately in the early grades.

1. Introduction

Good scientists are capable of asking good scientific questions. To use scientific language is to eschew personal feelings and fancies and aspire toward objectivity and universality in consistency and conformity with nature (Crosland 2006). In the science classrooms, the use of scientific questions and language in Science textbooks often constrains science teaching and learning. For instance, Hosono (1995) reported that more than half of elementary and junior high school teachers would use topics or concepts shown in their textbooks in their science classes.

On analyzing textbooks, Schmidt et al. (1997) and Valverde et al. (2002) used textbooks for cross-national analysis on curriculum as an important mediator between intended curriculum and implemented curriculum. Koulaidis & Tsatsaroni (1996) analyzed physics textbooks and chemistry textbooks of junior high schools in Greece from their own perspective and indicated that most of the questions contained in those textbooks were difficult questions or metaphorical questions, and that the chemistry textbooks, in particular, contained many metaphorical questions. Sumida (2008) noted that there were very few uses of the word *why*, but Yes/No questions and "noun-seeking" questions had high rates of appearance even in Science textbook for grade six in Japan.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

However, there were a few studies on nature of questions in science textbooks in the early grades, and study on the comparison between science textbooks and other subject textbooks seemed unfounded. Japanese science education officially starts at grade three. Thus, it may be crucial for young children to respond to scientific questions in their first stage of science learning. The purpose of this study was to investigate characteristics of "Scientific Questions" by comparing questions in elementary Science textbook with those in Japanese Language textbook for grade three under the new curriculum standard implemented from 2011 in Japan.

2. Methodology

This study analyzed an elementary Science textbook published by Publishing Company T and a Japanese Language textbook by Publishing Company K for grade three; these were inspected and authorized in 2011. In Japan, all published elementary school textbooks are inspected by the government's textbook publishing system to ensure quality and compliance with the national course of study. Thus, this study only analyzed a textbook published by a selected company, similar to the methodology employed by Schmidt et al. (1997).

Elementary school textbooks contain information presented in a variety of visual formats, such as text, pictures, figures, and tables. This study extracted the text included in the textbooks and used this as the primary source data. 289 questions in Science textbook and 172 questions in Japanese Language textbook were extracted for the analysis.

Framework for the analysis was originally developed for this study. Figure 1 summarizes the framework and steps used in the analysis.

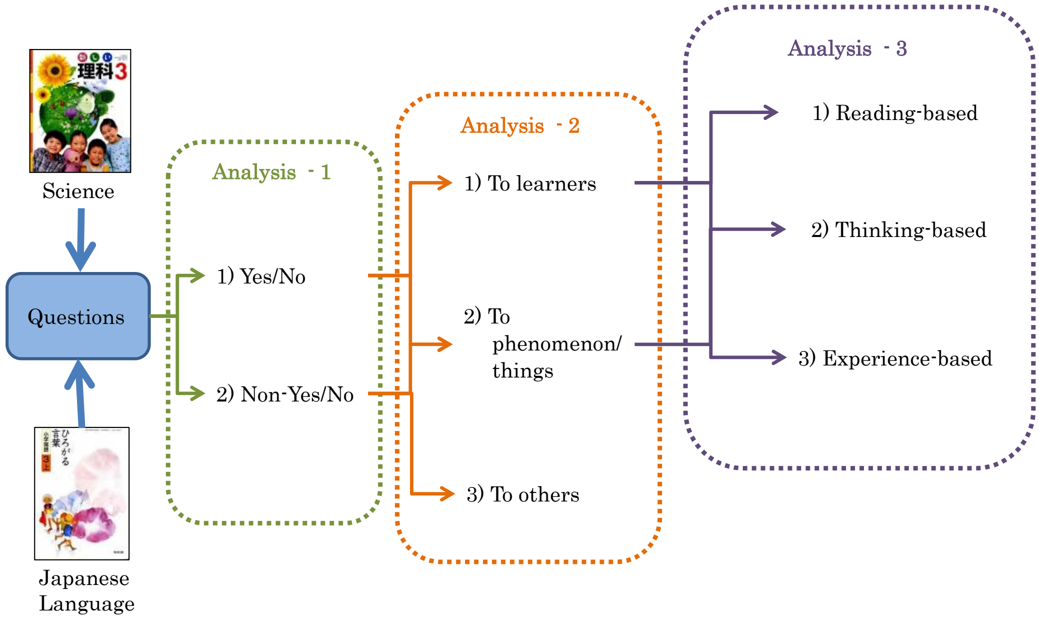


Figure 1. Framework and Steps of Analysis

First, questions extracted from Science textbook and Japanese Language textbook were classified into "Yes/No" questions or "Non-Yes/No" questions. Next, all questions were classified into three categories based on direction/target of the questions. These were questions directed: 1) to learners, 2) to phenomenon/things, and 3) to others. Questions directed "to phenomenon/things" were used to elicit answers that represented characters in textbooks; those that were directed "to others" would be involved conversation among characters in textbooks. The third analysis was allotted for "questions to learners" and "questions to phenomenon/things," which were extracted in during analysis 2. These questions were classified into three categories such as: 1) reading-based, 2) thinking-based, and 3) experience-based questions. These categories were developed based on the types of responses these questions would elicit. For instance, "reading-based" would require answers that could be lifted from the text, "thinking-based' encouraged students' inferential thinking, and "experience-based" questions had the children to answer based on their experiences.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

3. Results

Analyses were independently conducted by both of authors, and rate of consistency were checked. The total rate of consistency was 88.4% and inconsistent classifications were reclassified as agreed upon by both researchers.

1) Number of Yes/No questions in elementary Science and Japanese Language textbooks

In the first analysis, the number of Yes/No questions, included in elementary Science and Japanese Language were examined. Results are shown in table 1. Science textbook contained fewer "Yes/No" questions than Japanese Language textbook. A chi-square test using categories (2) ×subjects of textbook (2) produced statistically significant results (χ^2=12.25, df=1, p< .01).

Table 1. Number of "Yes/No" and "Non-Yes/No" questions in elementary Science and Japanese Language textbooks

( ):%

Subject	Yes/No	Non-Yes/No	Total
Science	83 (29)	206 (71)	289 (100)
Language Arts	77 (45)	95 (55)	172 (100)

2) Directions/targets of questions in elementary Science and Japanese Language textbooks

The second analysis was based on directions/targets of questions in textbooks. As shown in table 2, questions directed "to learners" and "to phenomenon/things" were more pervasive in Science textbook than in Japanese Language textbook.

A chi-square test using categories (3) ×subjects of textbook (2) produced statistically significant results (χ^2= 154.36, df=2, p< .01). A residual analysis revealed that in the analysis of questions directed "to learners" and "to phenomenon/things", the appearance rate of questions was significantly high in Science textbook, while the appearance rate of questions in "to others" was significantly high in Japanese Language textbook.

Table 2. Number of different directions/targets of questions in elementary Science and Japanese Language textbooks

( ):%

Subject	To learners	To phenomenon/things	To others	Total
Science	234 (81)	54(19)	1 (0)	289 (100)
Language Arts	80 (47)	14 (8)	78 (45)	172 (100)

3) What would be the base for answering questions in elementary Science and Japanese Language textbooks?

The third analysis was a subsequent step of the second analysis. Questions directed "to learners" and "to phenomenon/things," which were extracted in the second analysis, were classified into three categories. These categories were developed based on the expected response from that could be elicited from the students. These were "reading-based," "thinking-based," and "experience-based" questions, respectively. The results of the third analysis are shown in Table 3.

Table 3. Number of different basis of answering questions in elementary Science and Japanese Language textbooks

( ): %

Subject	Reading-based	Thinking-based	Experience-based	Total
Science	26 (9)	53 (18)	209 (73)	288 (100)
Language Arts	5 (5)	46 (49)	43 (46)	94 (100)

Table 3 shows that experience-based questions were more prevalent in Science textbook than in Japanese Language textbook, while Japanese Language textbook contained more thinking-based questions than Science textbook. A chi-square test using categories (3) ×subjects of textbook (2) produced statistically significant results (χ^2=34.43, df=2, p< .01). A residual analysis revealed that in "experience-based," the appearance rate of ques-

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

tions was significantly high in Science textbook, while the appearance rate of questions in "thinking-based" was significantly high in Japanese Language textbook.

4. Discussion

Based on the cross-subject analysis of questions in Science and Japanese Language textbooks, it was revealed that questions in Japanese Science textbook would require children to express their own answer based on experience. Elementary children in Japan study Japanese Language at grade one and Science at grade three. It might be a possibility that children would be confused in different modes of questions when they face scientific questions in science classrooms if they would not be instructed on what a good scientific question is, and how to respond to them. Niaz & Maza (2011) pointed out that there were very few chemistry textbooks that satisfactorily include the content of nature of science. Science questions could not be answered in a simple "Yes/No" form and neither only by a child's own thought. It is important both for children and teachers to take note that the characteristics of science questions may differ from other subjects even when some subjects, such as Science and Japanese Language, are taught coordinately in the early grades.

In this study, textbooks for grade three, at which Japanese children start to study science, were used for the analysis. There might be a possibility of those characteristics of Science textbook for grade three could differ from grade levels and contents in science. Further, questions in Science textbook could be considered from Language-Culture perspectives as well. Japanese elementary children study Western Science in Japanese using non-Western language. This study opens the door to discussing science questions across different Language-Culture communities and countries.

References

Crosland, M. (2006). *The language of science: From the vernacular to the technical*. Cambridge: The Lutterworth Press.

Hosono, J. (1995). Basic study on functions of textbooks as learning resources. *Report of Grant-in-Aid for Scientific Research*, Japan Society for the Promotion of Science.

Koulaidis, V., & Tsatsaroni, A. (1996). A pedagogical analysis of science textbooks: How can we proceed? *Research in Science Education*, 26 (1), 55-71.

Niaz, M., & Maza, A. (2011). *Nature of science in genera chemistry textbooks*. Dordrecht: Springer.

Schmidt, W., Eaizen, S., Britton, E., Bianchi, L., Wolfe, R. (Eds.) (1997). *Many visions, many aims volume 2: A cross-national investigation of curricular intentions in school science*. Dordrecht: Kluwer Academic Publishers.

Sumida, M. (2008). Characteristics of questions in elementary science textbooks. *Chu-o Institute for Educational Research Journal*. 4, 9-21.

Valverde, G., Bianchi, L., Wolfe, R., Schmidt, W., and Houang, R. (Eds.). (2002). *According to the book: Using TIMSS to investigate the translation of policy into practice through the world of textbooks*. Dordrecht: Kluwer Academic Publishers.

The STEM Education Research in Japan and Its Prospective

Tomoki SAITO, Jin-Ichi OKUMURA, Yoshisuke KUMANO

Graduate School of Science and Technology, Shizuoka University

1. Learn from the US study

PCAST reports like "*Prepare and Inspire:K-12 Education in Science, Technology, Engineering and Mathematics(STEM) for American's future*" (2010) or "*Engage to Excel: Producing One Million Additional College Graduates with Degrees in Science, Technology, Engineering, and Mathematics*" (2012) showed the US per-

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

spective to conserve the advantage in the area of science and technology. PCAST, one of the president's advisory committee, predicted that the US needs to *"Recruit and Train 100,000 Great STEM Teachers over the Next Decade Who Are Able to Prepare and Inspire Students*." Also the report of PCAST showed five Recommendations to activate the STEM field.

① *Catalyze widespread adoption of empirically validated teaching practices.*
② *Advocate and support replacing standard laboratory courses with discovery-based research courses.*
③ *Launch a national experiment in postsecondary mathematics education to address the math-preparation gap.*
④ *Encourage partnerships among stakeholders to diversify pathways to STEM careers.*
⑤ *Create a Presidential council on STEM education with broad leadership.*

"The Next Generation Science Standards" were released on the website in last April 2013. This new standard was based on "A Framework for K-12 Science Education"(2012) and following to "National Science Education Standards" (1996), "Science for All Americans" (1989), and "Benchmarks for Science Literacy" (1993). Now, States and districts are making their standards using this NGSS. So it means that the US had already prepared to make innovation of science education.

Not only Japan but also many other counties were interested in this US science education reform. So now we, the Asian researchers try to discuss the necessity of STEM Education in our country and its possible adaptation.

2. Japanese context, to innovate the STEM education

Fortunately, our lab got simulative information about STEM education reform in the US like previous paragraph. (Kumano, 2012) In the beginning, we tried to find out why the US started reform of Science Education, from books, papers, or website information.

As found out from the investigation, deficiency to keep advantage of the US in global economics has been central issues, such as. "*4 percent of the nation's workforce is composed of scientists and engineers; this group disproportionately creates jobs for the other 96 percent.*"(Successful K–12 STEM Education, NRC 2011), then the US made decision to reform the science education. *"Science, technology, engineering, and mathematics (STEM) are at center stage in the education reform movement. Most people share the vision that a highly capable STEM workforce and a population that understands and supports the scientific enterprise are key to the future place of the United States in global economics and politics and to the well-being of the nation."(Successful STEM Education: A Workshop Summary, NRC 2011, P-ix)*

How can we take an action to this situation in Japan as an Asian country? We also need to be a well-being country around the world. And also we need new perspective.

First of all, many countries, not only in Asia but also in Europe need innovation which similar to STEM education like the US. England, South Korea and Australia take action to apply this STEM reform to their countries educational researches and policies. The primary reason for these countries to adopt STEM education reform is the economic competition. For example, one professor in University of York, UK wrote that "*Governments are realizing the importance of science and technology to their future in the knowledge economy.*" (John Holman, 2012) Granted, the economic advantage is also important for Japan. However, it is not enough reason to Japan, it is?

We knew the failure of economic war. We knew the failure of competition. Learn from the past experiences, we have to **design a new perspective to be coexistence of competition and cooperation.**

On the other hand, Japanese Ministry of Education (www.mext.go.jp/english) had revised a latest national curriculum named "Course of Study" (2008). This course of study is a kind of Standards which include contents and revised every ten years. And hand craft activities were put into many parts of this latest course of study. This is the other context to include STEM activity to our science education.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

In Japan, our laboratory also have had focused in STS approach as an integrated context to learn Science, Technology, and Society. This STEM reform includes many components which are very similar to STS. As this first year trial, we developed Japanese models of STEM education like STS approach. Some of the examples were introduced by Dr. Bybee in his books (Bybee 2013). Next chapter will show you the Japanese approach which learned from him and the US reform.

3. Transdisciplinary Approach on "Tsunami" in STEM Summer Camp

What is the point like STS? As far as we were concerned, it is the subjects which are taken up in the lessons. The subjects should be "issues" which exist in transdisciplinary area. These issues can draw students into STEM activities.

Last summer, we developed a Summer Camp at an establishment where is managed by the prefecture. This camp gathered the participants from the cities around our Shizuoka, and we also invited the participants from our special science classes in informal setting. (We have been developing many science classes in science museum and city halls at Shizuoka city and Fujieda city.)

In this camp, we prepared an issue which the students could certainly interest in. That is "Tsunami". In 2011, we experienced the huge disaster and despaired of its situation. "Why did we not have enough technology which can against the disaster?", "Why did not we predict these kinds of phenomena?" Many of regrets remain in our hearts. One of the government carriers said "It beyond our expectation." This unexpected situation became the huge problems for us and it brought students strong motivation to solve the problems. [Issues: Problems which are related complicatedly, cannot solve easily, and have many ways of solution]

(1) Sequences of our lessons in this summer camp

① Instruction of the Summer Camp.

At first, we explained the purpose of this Summer Camp and introduced the participants about our STEM project.

② Designing a solution

After the introduction, as the pretest we ask the participants to design the solution for "huge tsunami" like 3.11 using STEM. They designed a product such as drawing or writing sentences based on their ideas.

③ Engaging in 9 STEM learning materials

After that we provided them 9 STEM learning materials which were prepared as helping segments to solve the main issue of preventing tsunami hazards by STEM disciplines methods. (Refer next (2))

④ Small scientists(participants) meet the real scientist & engineer

We prepared opportunities to meet students with the real scientist and engineer who are doing research in university, and to attend their science and engineering lessons.

⑤ Redesigning the solution

The end of the activities, they are asked to redesign their solution using their new findings through this summer camp STEM activities and to have discussions with other students.

(2) The nine STEM learning materials

We prepared 9 STEM learning materials for this summer camp from the US websites and some books explained about STEM Education. The materials were as following:

① Old corrugated cardboard chair

Students developed a chair with thinking about how to use it. For example, one of their chairs made for rest or the others made for sitting with their friends. Students need to discuss about a better design first.

② Water craft

This material required the students to make water floater which keep 10 coins on it for more than 10 seconds.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

It made by wrap and straws.

③ Roller coaster

This coaster made by plastic rail which a marble rolls down on it. Students were required making a coaster which needs just 3 seconds to go down.

④ Suikin-kutsu

This is a traditional Japanese garden material which can generate sounds by water drops striking the surface of the water in it. Students try to make reverberant sound in a space which made between a bottle and water surface. (Brows "Suikin-kutsu" on the web.)

⑤ Pumpkin Launcher

A sponge is thrown by plastic spoon. Students tried to make effective foundation and mechanism by rubber band and corrugated cardboard. (A model of old Greek weapon)

⑥ Paper bridge

This STEM material requires the students to make Paper Bridge which supports an amount of weight. To make a bridge, they used only 2 sheets of newspapers and tape.

⑦ Dippers

Dippers include some polymer in it. The polymer can absorb water more than 100-1000 times of its amount. Students tried to design good dippers which could absorb enough amount of water.

⑧ Solar Cooking

By the huge earthquake and tsunami, all of the energy source will be terminated. But, the solar cooking material can receive solar energy after disaster period. This material required the students to make enough thermal energy only from sun light.

⑨ Otolith

Students dissected dried sardines. And they could find two $CaCO_3$ stones named “Otolith” in the head. This activity required students to think about fish body and its functions which we didn’t usually notice.

These learning materials were introduced in a website, e-GFI, and we modified it into Japanese context.

These STEM learning materials were freely chosen by students groups. Through the experiences with these STEM learning materials, students got certain ideas to solve the problem which they could prevent hazards from tsunami. And also they could experience both of the Science & Engineering processes with these materials. And also we found that STEM materials made students got in to solve the problem effectively. Although, we provided 4 hours for the students to engage in the 9 STEM activities, most of them spent 3 hours for one material. They had much fun to solve the problem and make one product (Technology) together.

(3) Engineering processes which we had analyzed before this Summer camp

As far as we noticed before, there were many perspectives of STEM education. It was realized that one of the major characteristic of STEM education was including the Engineering processes.

In order to find out the methodology for including the Engineering Design into science education and also for including authentic assessment, we investigated Next Generation Science Standards (2013) and its’ Appendixes. Engineering is included in NGSS as a “Disciplinary Core Idea” and it also explain in its “Appendix I”.

As the processes for “Engineering Design”, Appendix I includes cycle likes below.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

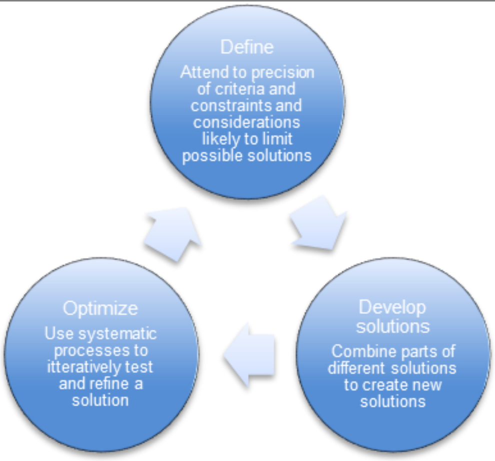


Figure1: Engineering Design which described in NGSS

From these NGSS contents, we adopted a learning cycle such as Define-Develop-Optimize. So, we tried to make a DDO learning cycle model.

We also referred a book named "STEM Lesson Essential" which explained how to develop a lesson of STEM Education. It also showed us some cues as a process which is usually used in Science, Engineering, Technology, and Mathematics. (See Appendix 1) This table also provided us some images how we could include engineering processes into our lessons. From these kinds of findings, we prepared a worksheet for each 9 lessons.

At first, students identified the "Technology" in the context of students' everyday life. We asked students such as, "How do we use it?", and "What do we need to the technology?" Next, they made their products by themselves. Then, they could identify each problem which was included in each product. After identified the problem, students tried to renovate their products. Finally, they made their own best product.

(4) The real scientist & engineer provided fundamental materials

We also prepared encounters for the participants (we call them small scientists) with the real scientist & engineer from Shizuoka University. The professors who provided some learning materials for our small scientists were the experts in Developmental Biology and Robotics. The biologist provided the practice of "the dissection of frog", and the robotic engineer provided a lesson for "the manufacture of Autonomous".

In these activities, we didn't require them to solve the problem by science and engineering processes. But, the real scientist & engineer related their disciplines with Engineering. They basically explained about forefront of science. So, small scientists could be inspired by these activities.

Students described some impressions as following;

- I liked frog, but I scared the dissection. However, I had been getting used and did a lot of sketching. I would like to thank the frogs. Because, I wanted to see the nerve which sent the electricity.
- It was interesting that robot became to be able to walk smoothly. I found that a small adjustment can be the great change for robotics.

(5) Solutions developed by the participants

These students developed innovative solutions.

One student developed "Rugby House" as a building to evacuate. The other one developed a "Tsunami Power Plant" with protuberances which reduce the energy of Tsunami.

This student had completely changed the solution. At first this student tried to improve the science to ride on a bird. It was just an imagination. After the activities, the solution was based on science knowledge about surface area and its pressure. It was a kind of scientific solutions.

This student tried to make an underground shelter. This student found many of problems and questions like bellow.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

- How to get budget?
- How about people who lives in an apartment?
- If we stand at the outside?
- How about homeless person?
- We cannot look at the outside.
- How about electricity & water?

During the activities, this student developed also many kinds of solutions to these problems and questions such as

- Make support by government.
- People who live in above the 2nd flours will go upstairs.
- Found shelter in shops & schools.
- Everybody can go into the shelter.
- Clear cover can help look at outside.
- Develop solar panels and water supply.

These solutions were developed to respond to needs and wants in our society, especially in the disaster period. Some of the participants developed such kinds of Needs-Familiar solutions.

(6) Conclusion of these Summer Camp activities

Our Summer Camp created concurrently achieved not only our goals but also developing STEM learning materials, and those assessments. Because, this STEM Summer Camp was the first opportunity for us to exam our STEM activities. We didn't have appropriate methods to assess our activities and those effects to our students. There were some viewpoints which were founded in this camp.

First, successful STEM activities provide the participants "Engineering Design" opportunities. And students could learn about engineering design processes and improve their products on science and mathematics.

Second, the transdisciplinary issues like "Tsunami" will be solved by themselves with innovative ways, scientific way, and needs familiar way. These design outcomes will become the points of view to assess their STEM learning.

Third, the real scientist & engineer had important roles to improve their motivations.

References

AAAS (1989) Science for All Americans Oxford University Press

AAAS (1993) Benchmarks for Science Literacy Oxford University Press

Alexandra Beatty, Rapporteur (2011) SUCCESSFUL STEM EDUCATION A WORKSHOP SUMMARY National Academies Press

Executive Office of the President President's Council of Advisors on Science and Technology (2010) REPORT TO THE PRESIDENT PREPARE AND INSPIRE: K-12 EDUCATION IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATH (STEM) FOR AMERICA'S FUTURE

Executive Office of the President President's Council of Advisors on Science and Technology (2012) REPORT TO THE PRESIDENT ENGAGE TO EXCEL: PRODUCING ONE MILLION ADDITIONAL COLLEGE GRADUATES WITH DEGREES IN SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS

Kumano, Y. (2012). Learning abilities elaborated in the middle school science curriculum, Chapter 3, Section 2, Questioning learning abilities for science instructions, now, Society of Japan Science Teaching Committee, p98-105

National Research Council (1996) National Science Education Standards, National Academy Press

National Research Council (2011) Successful K-12 STEM Education Identifying Effective Approaches in Science, Technology, Engineering, and Mathematics, National Academies Press

Rodger W. Bybee (2013) The Case for STEM Education Challenges and Opportunities, NSTA press.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

TANGIBLE VISUALIZATION AS BRIDGE FOR BARKHAUSEN EFFECT

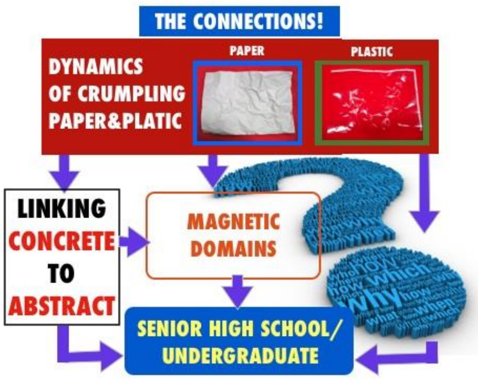
Gerald G. Tembrevilla (tembrevillagerald@gmail.com)
University of Cebu – Banilad, Philippines, Okayama University, Okayama, Japan

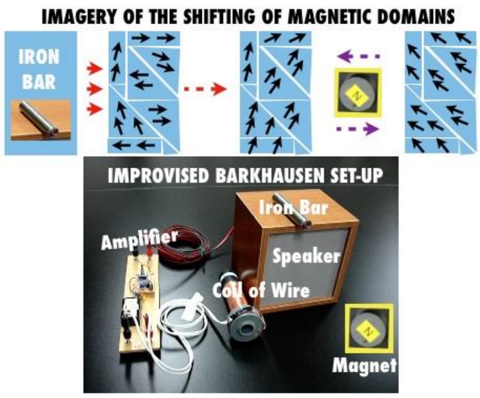
Researches in physics learning investigated cognitive mechanisms, which underlie construction of pictorial representations of physical phenomena. Reiner has shown that students communicated with each other through pictorial representations in order to construct meaning to electromagnetic phenomena. Other studies also have pointed out that pictorial representations are effective for conceptualization and problem solving in physics. These representations might reflect mental models held by students and hence might serve as evaluation tools.

In physics and physics learning, cognitive processes relating to visualization require a form of 'seeing with the mind's eye', visualizing an event, mentally exploring an event, or comparing pictorial mental representations, i.e. thinking in pictures. For example, understanding electromagnetic phenomena involves construction of mental models of microscopic structures. Specifically, the Barkhausen effect is utilized as demonstration tool to help students visualize the shifting of invisible magnetic domains inside a ferromagnetic material. Although attractive and extensively studied experimentally, to directly visualize the fluctuations of magnetic domain using the set up of Barkhausen effect may proved difficult for high school physics students or even undergraduate students who will directly start to visualize the connection of the clicking sound to the invisible shifting of magnetic domains.

If visualization can function as a bridge between scientific theory and the world-as-experienced, can another tangible visualization provide an effective link with Barkhausen effect in order for the students to visualize the shifting of magnetic domains effectively?

In order to increase the level of effectiveness of Barkhausen effect in visualizing the shifting of magnetic domains, exploring concrete and tangible demonstrations aided with pictorial representations could prove helpful in establishing the link. For this purpose, I designed a modified set-up appropriate for a classroom setting to produce a crackling noise from both crumpled paper and plastic sheet that will serve as a familiar 'bridges' for high school physics students prior to the demonstration of Barkhausen effect. The choice of these two materials is supported by a study detailing the dynamics of the crackling noise from the crumpled paper and Mylar sheet as related to that of Barkhausen noise.



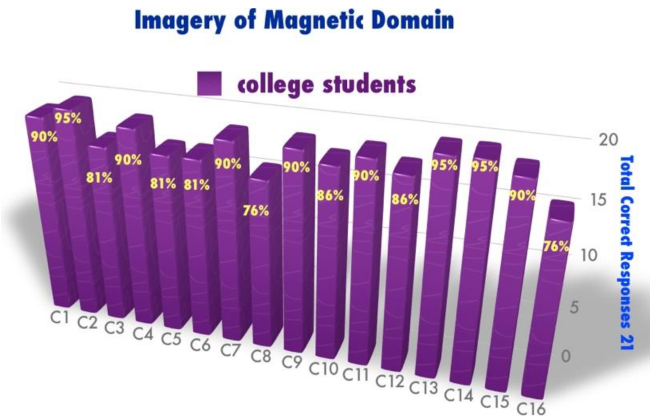


In this study, a group of 16 2nd year college science majors and non-science majors of Okayama University (Japan) College of Education were randomly chosen. The group was asked to participate in a series of Predict-Observe-Explain activities using the modified Barkhausen effect set-up. For Predict (P), the group predicted and guessed the kind of sound heard, for Observe (O), the group drew and sketched the image of the sound heard after watching the demonstration and for Explain (E), individually, each member explained the dynamics of the sound heard as he or she had drawn. Written responses, diagrams and drawings were collected and ana-

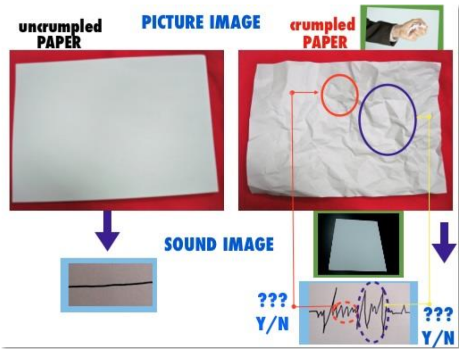
You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

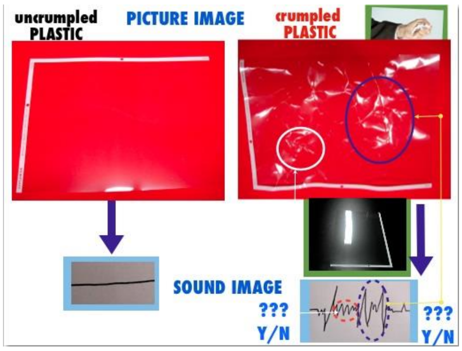
lyzed. A science professor from the university validated the questionnaire. The questionnaire aimed to find out the imagery of magnetic domains of the college students. Responses of the subjects' were tallied against the total number of questions through a simple percentage tally. If I had more time, I should have had initiated individual and short interviews on the individual sketches.

The results of the study revealed that the 16 2nd year college science majors and non-science majors attained remarkable tallies ranging from 76%-95% and with a general average of nearly 82%. This indicates that the visualization and dynamics of crumpling paper and plastic sheet can provide link to Barkhausen effect. Moreover, the images of crumpled paper and plastic sheet drawn by the participants provide a closer link to the 'motions' of 'shifting magnetic domains' as shown by their illustrations of what is happening inside the iron bar while relating the sound they have heard produced by the improvised Barkhausen set-up.



This initial approach to create connections on the mechanics of Barkhausen effect using the improvised set-up for ordinary science classrooms are: 1.) integrating interactive visualizations in physics learning can facilitate qualitative understanding of physical phenomena [3], and 2.) tangible and interactive visualizations in physics learning can link pupils' imagery of physical phenomena from concrete to abstract. This "linkage of imagery can serve as 'windows' into students' ideas and can provide with communication and evaluation tool".





Recommendations for further studies would cover such as 1.) refinement of the lecture-demonstration and POE mechanics would provide maximum participation and opportunities for the students to think, interact and explore the dynamics of crumpling paper and plastic sheet, 2.) introduction of this visualizations to an actual high school physics class with greater emphasis and enhancement of POE methods, and finally, 3.) presentation of this visualization with inclusion of quantitative measurements with the use of oscilloscope and audio recordings can also be encouraged.

References

Clement and Monagham (2000), In Gilbert, J. (2007) Visualization in Science Education. Dordrecht, Netherlands. Springer

Gilbert, J. (2007) Visualization in Science Education. Dordrecht, Netherlands. Springer

Houle, P. and Sethna, J. (1996) Phys. Rev. E 54(1), 278-283

Kramer, E. and Lobkovsky, A. (1996) Phys. Rev. E 53(2), 1465-1470

Lewin, W.,8.02 Electricity and Magnetism, Spring 2002. (MIT Open Course Ware: Massachusetts Institute of Technology), http://ocw.mit.edu/courses/physics/8-02-electricity-and-magnetism-spring-2002/ (Accessed May 17, 2010) License: Creative commons BY-NC-SA

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

Perković, O., Dahmen, K. and Sethna, J. (1995) Phys. Rev. Lett. 75(24), 4528-45

Rapp and Kendeou (2003), In Gilbert, J. (2007) Visualization in Science Education. Dordrecht Netherlands. Springer

Reiner (1997), In Gilbert, J. (2007) Visualization in Science Education. Dordrecht, Netherlands. Springer

Sethna, J.,Dahmen, K. and Myers, C. (2001) Nature 410, 242-250

Science & Education

Science & Education

Call for Submissions

International History, Philosophy and Science Teaching Group

IHPST

Science & Education (http://link.springer.com/journal/11191), the official journal of the IHPST Group (http://ihpst.net), publishes research on how history, philosophy, and sociology of science (HPS) can inform and enrich approaches aiming at improving science teaching. The journal publishes both theoretical and empirical papers, which are characterized by robust theoretical frameworks stemming from scholarship from the history, philosophy, and sociology of science.

The journal currently welcomes submissions on two topics of interest:

a. Scientific explanation: theoretical and pedagogical issues

Science teaching does not simply aim to transmit knowledge to students but, rather, to help them learn how to develop scientific explanations for natural phenomena, and also realize that their intuitive explanations are often insufficient. HPS scholarship has provided detailed analyses of the structure of scientific explanations that could provide coherent frameworks for teaching. Science & Education invites submissions on any aspect of scientific explanation that is relevant to science teaching and learning, including both theoretical and pedagogical aspects.

b. Learning Progressions/ Pathways about Nature of Science

Nature of Science (NOS) is a topic that has been a major focus of science education research over at least the past 20 years. Different perspectives have been developed and discussed. However, debates have focused mostly on normative issues with less attention on what aspects of NOS are appropriate for each educational level. Science & Education invites submissions on this topic from a developmental perspective, focusing on which aspects of NOS should be taught and could be learned at each educational level. Submissions from different parts of the world are strongly encouraged, in order to enhance appreciation of the similarities and differences of NOS education in different social and cultural settings.

The deadline for submissions on the aforementioned topics is January 1st, 2015. Queries should be addressed to the editorial team of Science & Education: Kostas Kampourakis (Kostas.kampourakis@unige.ch), Alice Wong (aslwong@hku.hk) or Ross Nehm (ross.nehm@stonybrook.edu).

All submissions should be made directly to the journal at www.editorialmanager.com/sced.

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.

Upcoming Conferences

1. 2nd International History, Philosophy and Science Teaching Asian Regional Conference. Dec. 4-7, 2014 @ Taipei, Taiwan.
2. The Thirteenth International History, Philosophy and Science Teaching Conference will take place 22-24 July 2015 at Rio de Janiero, Brazil. http://conference.ihpst.net/
3. The Association for Science Teacher Education 2015 conference will be held 7-10 Jan 2015 in Portland, OR. Conference proposals are generally due in mid July of the preceding year. http://theaste.org/meetings/2015-international-meeting/
4. The European Science Education Research Association will hold its 2015 conference in Helsinki, Finland. http://www.sails-project.eu/portal/event/esera-european-science-education-research-association-conference-2015
5. The 2015 conference will be held February 26-28, 2015 in Grand Rapids, MI. (Submissions are generally due the preceding October.) http://www.msta-mich.org/
6. 2015 EASE Science Education Conference, October 9-11, 2015. @ Beijing, Mainland China

EXECUTIVE MEMBERS OF EASE

President

Lei Wang, Beijing Normal University

Vice President

Yoshisuke KUMANO, Shizuoka University
Sheau-Wen LIN, National Pingtung University of Education

Secretary

Alice Siu Ling WONG, The University of Hong Kong

Treasure

Shinho JANG, Seoul National University of Education

Executive board

Hong Kong

Alice Siu Ling WONG, The University of Hong Kong
Winnie Wing Mui SO, Hong Kong Institute of Education
Yau Yuen YEUNG, Hong Kong Institute of Education
Pun Hon NG, The Chinese University of Hong Kong

Japan

Hiroki FUJII, Okayama University
Yoshisuke KUMANO, Shizuoka University
Hisashi OTSUJI, Ibaraki University
Manabu SUMIDA, Ehime University

Korea

Shinho JANG, Seoul National University of Education
Chan-Jong KIM, Seoul National University
Youngmin KIM, Pusan National University
Sun Kyung LEE, Cheongju National University of Education

Korea

Youngmin KIM, Pusan National University
Sun Kyung LEE, Cheongju National University of Education

Taiwan

Sheau-Wen LIN, National Pingtung University of Education
Hsiao-Lin TUAN, National Changhua University of Education
Chia-Ju LIU, National Kaohsiung Normal University
Sung-Tao LEE, National Taichung University of Education

China Mainland

Lei WANG, Beijing Normal University
Weiping HU, Shaanxi Normal University
Jian WANG, Beijing Normal University
Yanning HUANG, Capital Normal University

Visit Beijing Normal University at: www.bnu.edu.cn

Headquarters

Executive director

☺ Rui WEI, Beijing Normal University (Jan 1, 2014 -)

Chief Editor of E-Newsletter

☺ Jian Wang, Beijing Normal University (Jan 1, 2014 -)

Editors of the EASE Newsletter

Issues to be in charge	Responsible editor	Region
Sep., 2014	Prof. Shiho Miyake (miyake@mail.kobe-c.ac.jp)	Japan
Dec., 2014	Prof. Hsin-Yi CHANG (hsinyichang@nknucc.nknu.edu.tw)	Taiwan
Mar., 2015	Prof. So, Wing Mui Winnie (wiso@ied.edu.hk)	Hong Kong
Jun., 2015	Prof. Jian Wang (wangj@bnu.edu.cn)	China Mainland

You are welcome to distribute this newsletter to your colleagues and students. But do not use portraits and logos without permission.