World Academy of Science, Engineering and Technology
International Journal of Humanities and Social Sciences
Vol:8, No:7, 2014

Secondary Science Teachers' Views about Purposes of Practical Works in School Science

Kew-Cheol Shim, Sung-Hwan Moon, Ji-Hyon Kil, Kyoungho Kim

***Abstract*—**The purpose of this paper was to examine views of secondary school science teachers about purposes to use practical works in school science. The instrument to survey consisted eighteen items, which were categorized into four components as follows: 'Scientific inquiry', 'Scientific knowledge', 'Science-related attitude', and 'STS (science-technology-society)'. Subjects were 152 secondary school science teachers (male 70 and female 82; middle school 50 and high school 102), who are teaching in 42 schools of 8 provinces. On the survey, science teachers were asked to answer on 5-point Lickert scale (from 1 to 5) how they thought of using practical works on purposes with domains of science objectives in school. They had positive views about using practical works for improving scientific inquiry process skills, science-related attitudes, and perceptions about STS literacy, and acquiring scientific knowledge. They would have the most willingness of using practical works for 'Scientific Inquiry' among domains of science objectives in school.

***Keywords*—**Secondary school, science teacher, practical work, scientific inquiry, scientific knowledge, science-related attitude, STS.

I. Introduction

THE main aims of school science instruction are to help students acquire scientific concepts, improve scientific inquiry process skills and science-related attitudes, and actively engage in the process of acquiring scientific knowledge [1]-[5]. The practical wok has been very emphasized in teaching and learning of science at the school level, because it would be effective to develop students' scientific knowledge that should be seen, and a role as means of communication and opportunities of inquiry [5]-[11]. In addition, curiosity and interest in science, science-related attitude, and nature of science could be improved through practical works [10]-[13].

A practical work is useful to teach science, because of helping students use ideas associated with the phenomena they have produced [7]-[9]. Secondary school science teachers have difficulties to teach science using practical works, because they should devote a greater proportion of time and labor for the science lesson effectively to perform a practical work [14]. They should be aware of the ranges and types of practical work, and be clear about the purpose of practical activities carried out in school science [14]-[16]. They need to know how to assess learning outcomes through practical works, and to be trained of practical exercises for professional development [14], [15], [17], [18].

The aim of this research was to survey views of middle school and high school science teachers about using practical works on what purposes they have to teach school science. Through surveying their perceptions, their willingness of using practical works would be examined with domains of science objectives in school.

K. C. Shim is with the Department of Biology Education, Kongju National University, Gongju, Chungnam, 314-701 South Korea (corresponding author; phone: 82-41-850-8287; fax: 82-41-850-8842; e-mail: skcshim@kongju.ac.kr).

S. H.Moon is with the Department of Biology Education, Kongju National University, Gongju, Chungnam, 314-701 South Korea.

J. H.Kil is with the Environmental Resources Research Department, National Institute of Environmental Research, Incheon, 404-708 South Korea.

K. Kim is with the Department of Science Education, Gongju National University of Education, Gongju, Chungnam, 314-711 South Korea.

II. Methods

A. Participants

Participants consisted of 152 secondary school science teachers (physics 27, chemistry 37, biology 65 and earth science 23) from eight provinces containing three metropolitan city, South Korea (see the Table I). They were collected from forty two secondary schools of eight provinces.

TABLE I
PARTICIPANTS WHO RESPONDED ON QUESTIONNAIRE TO SURVEY VIEWS OF SECONDARY SCHOOL SCIENCE TEACHERS ABOUT PURPOSES OF PRACTICAL WORKS IN SCHOOL SCIENCE

School level	male	female	sum
Middle school	20	30	50
High school	50	52	102
total	70	82	152

B. Instrument

The views of secondary school science teachers about using practical works on purposes in school science were examined. Eighteen question items were selected considering educational objectives for science education on the basis of Science National Curriculum of Korea. They consisted of four domains, which were 'Scientific inquiry', 'Scientific knowledge', 'Science-related attitude', and 'STS (science-technology-society)', which were shown in the Table II.

'Scientific Inquiry' was made up of eight items that secondary school science teachers want to improve, which were 'Basic inquiry skill I: observing, measuring, and classifying', 'Basic inquiry skill II: predicting, and inferring', 'Perceiving a problem', 'Hypothesizing', 'Controlling variables', 'Transforming data', 'Interpreting data', and 'Drawing conclusions'. 'Scientific Knowledge' was made up of two items that they want to facilitate, which were 'Scientific concept comprehension', and 'Scientific concept confirmation'. 'Science-related Attitude' was made up of six items that they want to improve, which were 'Scientific curiosity', 'Career interest in science', 'Interest in science', 'Critical reasoning', 'Self-directed engagement', and 'Persevering performance'.

'STS (Science-Technology-Society)' was made up of two items that they want to help students perceive, which were 'Science in society', and 'Relationship among science, technology, and society'.

Secondary school science teachers were asked to answer on how they thought of using practical works on purposes with domains of science objectives in school science with 5-point Lickert scales (1: strongly disagree, 2: disagree, 3: common, 4: agree, and 5: strongly agree) following an example of question items: "I am using practical works for secondary school students to improve curiosity and interest in science".

III. Result

Table III shows views of middle school and high school teachers about using practical works on 'Scientific Inquiry' domain of purposes they have for teaching science in school. They had a positive view about using practical works to improve scientific inquiry process skills. Especially, they had a tendency to use 'Basic inquiry skill I (observing, measuring, and classifying)' and 'Drawing conclusions' of integrated inquiry process skills. However, they would useless practical works for improving 'Hypothesizing' and 'Perceiving a problem' than on other integrated process skills. Considering school level of participants, high school science teachers had more positive views about using practical works to improve scientific inquiry process skills than middle school science teachers. On the question item of 'Controlling variables', there was a little bit of difference between them.

Views of middle school and high school science teachers about using practical works on 'Scientific Knowledge' domain are shown in the Table IV. They had a purpose to use practical works for more concept confirmation than concept comprehension. Middle school science teachers had more willingness to use practical works for both concept confirmation and concept comprehension of students than high school ones.

Table V shows middle school and high school science teachers' views about what purposes to use practical works on 'Science-related Attitude' domain. They had a lack of willingness to use practical works for improving science-related attitude except 'Scientific curiosity', and 'Interest in science' among question items of 'Science-related Attitude' domain. Middle school science teachers had more positive views about using practical works to improve 'Scientific curiosity', and 'Career interest in science', whereas high school science teachers had more positive views in 'Critical reasoning', and 'Self-directed engagement'. There was a little bit of difference between their views about using practical works on 'Interest in science', and 'Persevering performance'

TABLE II
Domains and Items of Questionnaire to Survey Views of Secondary School Science Teachers about Purposes of Practical Works in School Science

domain	item	No. of items
Scientific Inquiry	Basic inquiry skill I: observing, measuring , and classifying Basic inquiry skill II: predicting, and inferring Perceiving a problem Hypothesizing Controlling variables Transforming dada Interpreting data Drawing conclusions	8
Scientific Knowledge	Scientific concept comprehension, Scientific concept confirmation	2
Science-related Attitude	Scientific curiosity Career interest in science Interest in science Critical reasoning Self-directed engagement Persevering performance	6
STS	Science in a society Relationship among science, technology and society	2

TABLE III
Views of Secondary School Science Teachers about Using Practical Works in School Science on 'Scientific Inquiry'

item	Middle school	High school	total
Basic inquiry skill I: observing, measuring , and classifying	3.64±.83	3.75±.78	3.71±.79
Basic inquiry skill II: predicting, and inferring	3.44±.79	3.53±.93	3.50±.88
Perceiving a problem	3.08±.97	3.31±.88	3.24±.91
Hypothesizing	2.98±.91	3.21±.89	3.13±.90
Controlling variables	3.58±.81	3.54±.90	3.55±.87
Transforming dada	3.44±.88	3.70±.78	3.61±.82
Interpreting data	3.54±.84	3.74±.70	3.67±.75
Drawing conclusions	3.66±.82	3.84±.75	3.78±.78

1: strongly disagree, 2: disagree, 3: common, 4: agree, 5: strongly agree

TABLE IV
Views of Secondary School Science Teachers about Using Practical Works in School Science on 'Scientific Knowledge'

item	Middle school	High school	total
Scientific concept comprehension	3.18±1.08	3.04±.98	3.09±1.02
Scientific concept confirmation	3.56±1.03	3.35±1.01	3.42±1.02

1: strongly disagree, 2: disagree, 3: common, 4: agree, 5: strongly agree

TABLE V
Views of Secondary School Science Teachers about Using Practical Works in School Science on 'Science-related Attitude'

item	Middle school	High school	total
Scientific curiosity	4.02±1.00	3.86±.92	3.91±.95
Career interest in science	3.12±.77	3.05±.92	3.07±.87
Interest in science	3.88±1.02	3.86±.88	3.87±.93
Critical reasoning	2.84±1.00	2.98±.94	2.93±.96
Self-directed engagement	3.10±.95	3.59±.99	3.43±1.00
Persevering performance	2.90±.91	2.93±.93	2.92±.98

1: strongly disagree, 2: disagree, 3: common, 4: agree, 5: strongly agree

Table VI shows views of middle school and high school science teachers about what purposes to use practical works on 'STS (Science-Technology-Society)' domain. They had a purpose to use practical works for helping students perceive 'Science in society', but less 'Relationship among science, technology, and society'. High school science teachers had more willingness to use practical works for improving students' perceptions about both 'Science in society' and 'Relationship among science, technology, and society' than middle school ones.

TABLE VI
VIEWS OF SECONDARY SCHOOL SCIENCE TEACHERS ABOUT USING PRACTICAL WORKS IN SCHOOL SCIENCE ON 'STS (SCIENCE-TECHNOLOGY-SOCIETY)'

item	Middle school	High school	total
Science in a society	3.38±.95	3.48±.89	3.45±.90
Relationship among science, technology and society	2.92±1.05	3.04± .94	3.00±.98

1: strongly disagree, 2: disagree, 3: common, 4: agree, 5: strongly agree

Secondary school science teachers had positive views about using practical works on all domains of science objectives in school science. High school science teachers had more positive views about using practical works on 'Science Inquiry', 'Science-related Attitude', and 'STS', but middle school science teachers had more positive views on 'Scientific Knowledge' among domains of science objectives in school science (see the Table VII). However, there was no significant difference between views about using practical works on four those domains.

TABLE VII
VIEWS OF SECONDARY SCHOOL SCIENCE TEACHERS ABOUT USING PRACTICAL WORKS IN SCHOOL SCIENCE ON DOMAINS OF SCIENCE OBJECTIVES AND RESULTS OF T-TEST WITH SCHOOL LEVEL

domain	Middle school	High school	total	t value
Scientific Inquiry	3.42±.64	3.58±.61	3.52±.62	-1.45^{ns}
Scientific Knowledge	3.37±.92	3.20±.87	3.25±.89	1.13^{ns}
Science -related Attitude	3.31±.70	3.38±.67	3.36±.67	-.59^{ns}
STS	3.15±.89	3.26±.83	3.22±.85	-.75^{ns}

1: strongly disagree, 2: disagree, 3: common, 4: agree, 5: strongly agree
The t value is the score obtained when performing the independent t-test between means of middle school and high school teachers' views about using practical works.
ns: p> .05

IV. DISCUSSION

The results of this research showed that Korean secondary school science teachers had positive views about using practical works for improving scientific inquiry process skills, science-related attitudes, and perception about STS literacy, and acquiring scientific knowledge. Especially, they had a view to need to use practical works for improving scientific inquiry ability. That is because they thought of that the most important thing in school science would be improving scientific inquiry ability through performing practical works [1], [3]-[5].

Considering big difference between views according to school level even though there was not significant, high school science teachers had more willingness to use practical works for improving scientific inquiry skills, and middle school science teachers had more willingness to use them for acquiring scientific knowledge. That is because high school students should use various inquiry skills in the process of teaching and learning according to science curriculum than middle school ones [2]-[4], [8]-[9]. In addition, middle school students should learn much more scientific concepts than what they should do in elementary school science [2], [8], [19].

The results of this study suggested that there is a demand on teaching secondary students science to improve science-related attitude, and perception about STS in school. To do this, it is necessary to contain more scientific learning content concerned about science and technology in the society in school science [20]-[24]. It will be effective to enhance scientific reasoning as well as to learn scientific knowledge [20]-[21], [24].

Science teachers are a group that has a primary role on science-related attitudes, perception about science, and science learning behavior of students [1], [13]-[14], [25]. Their views could be a major influence what and how to learn school science, and their teaching [1], [25]. It is necessary to make training program for secondary science teachers get more positive views about using practical works in school science teaching, and to facilitate their students engaging in science learning.

REFERENCES

[1] H. Cho, I. H. Yang, and H. Lee, "Comparison between secondary school science teachers' and students' perceptions about the important aims of laboratory activities in science instructions", *Journal of Korean Elementary Science Education*, vol. 32., no. 2, pp. 103-120, Dec. 2008.
[2] MOE (Ministry of Education), *Science Curriculum*. Seoul, Republic of Korea: Daehangyogwaseo, Inc., Dec. 1997.
[3] MOEST (Ministry of Education, Science and Technology),*Science Curriculum for High School Students.* Seoul, Republic of Korea: Ministry of Education, Science and Technology, Dec. 2009.
[4] MOEST (Ministry of Education, Science and Technology),*Curriculum for Middle School Students.* Seoul, Republic of Korea: Ministry of Education, Science and Technology, Dec. 2009.
[5] R. Millar, *The role of practical work in the teaching and learning of science.* Washington, DC, USA: National Academy of Science, Oct. 2004.
[6] E. Woodley, "Practical work in school science - why is it important?", *School Science Review*, vol. 91, no. 335, pp. 49-51, Dec. 2009.
[7] R. Watson, The role of practical work. In M. Monk & J. Osborne, *Good practice in science teaching: What research has to say*, Buckingham, UK : Open University Press. 2000, pp. 57-71.
[8] K. C. Shim, Y. S. Kang, J. B. Shin, and H. S. Kim, "An analysis of learning contents in the life science textbooks under the 7th curriculum: on the unit of stimuli and response", *Biology Education*, vol. 32, no. 2, pp. 114-123, Jun. 2004.
[9] K. C. Shim, H. S. Kim, and Y. C. Park, "Analysis of inquiry activities presented in the 7th grade life science textbooks based on the 7th curriculum", *Journal of the Korean Association for Research in Science Education*, vol. 22, no. 3, pp. 551-560, Sep. 2002.
[10] D. Hodson, Is this really what scientists do? Seeking a more authentic science in and beyond the school laboratory, In J. J. Wellington, *Practical work in school Science*, London, UK: Routledge, 1998, pp. 93-108.
[11] D. Hodson, "A critical look at practical work in school science", *School Science Review*, vol. 71, no. 256, pp. 33-40, Mar. 1990.
[12] A. Hofstein, Practical Work and Science Education II. In P. Fensham, *Development and dilemmas in Science Education*, New York, USA: The Farmer Press, 1998, pp. 194-195.
[13] R. Lazarowitz, andP. Tamir, Research on using laboratory instruction in science. In D. Gabel, *Handbook of research on science teaching and learning*, New York, USA : Macmillan, 1994, pp. 94-130.
[14] S. Y. Bae, and Y. Park, "Teachers' perceptions about priority and

hinderance of science objectives", *Journal of the Korean Association for Science Education*, vol. 20, no. 4, pp. 572-581, Dec. 2000.
[15] SCORE (Science Community Representing Education), Practical work in science: a report and proposal for a strategic framework, London, UK : Gatsby Technical Education Project, Dec. 2008.
[16] V. N. Lunetta, and A. Hofstein, Simulations and laboratory practical activity, In B. E. Woolnough, *Practical science: The role and reality of practical work in school science*, London, UK : Open University Press, 1991, pp. 125-137.
[17] H. L. Kim, and S. H.Yeau," An analysis on scientific inquiry process in the middle school 8th grade science textbook published by 7th national curriculum and students", *Biology Education*, vol. 32, no. 4, pp. 390-397, Dec. 2004.
[18] M. K. Kim, J. L. Hong and N. K. Chang, "Development of the instrument for assessing the degree of ambivalence of the attitudes of high school students", *Biology Education*, vol. 29,no. 1, pp. 27-33, Mar. 2001.
[19] K. C. Shim, B. Y. Lee, and H. S. Kim, Analysis of learning concepts related to metabolism presented in the life field of science textbooks according to the national common basic curriculum, *Journal of the Korean Association for Research in Science Education*, vol. 23, no.6, pp. 627-633, Dec. 2003.
[20] S. C. Song, and K. C. Shim, "Study on perception of high school students of biotechnology", *Environmental Education*, vol. 23, no. 1,pp. 99-111, Mar. 2010.
[21] S. C. Song, H. J. Kim, C. H. Lee, J. M. Kim, and K. C. Shim, "Study on high school students' interest in biology", *Biology Education*, vol. 35, no. 3, pp. 384-393, Sep. 2007.
[22] H. L. Hong, K. C. Shim, and N. K. Chang, "A study of Korean middle school students' interests in biology and their implications for biology education" *International Journal of Science Education*, vo. 20, no. 8, pp. 989-999, Sep. 1998.
[23] R. Yager, "STS : Thinking over the years", *The Science Teacher*, vol. 57, no. 3, pp. 52-53, Mar. 1990
[24] J. H. Kim, K. C. Shim, S. C. Song, K. Kim, N. I. Kim, J. Bae, and K. H. So, "Secondary school students' perceptions about biological issues in South Korea", *World Academy of Science, Engineering and Technology*, vol. 6, no. 6, pp. 440-442, Jun. 2012.
[25] E. Yildiz, E. Akapinar, B. Aydogdu, and O. Ergin, "Science teachers' attitudes towards aims of the science experiments', *Journal of Turkish Science Education*, vol. 3, no. 2, pp. 1-6, Dec. 2006.