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THE MULTICULTURAL SCIENCE LITERACY OF SCIENCE TEACHERS IN TAIWAN

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ABSTRACT

Addressing the policy of multiethnic science education, this investigation is about the multicultural science literacy of Science teachers. Qualitative data were collected by individual interviews from 12 science teachers across 5 ethnic geographical areas in Taiwan who were asked about their teaching experiences of knowing science, talking cultures and doing WMS or/and MSE among multiethnic groups. It concluded some cultural myths that teachers' views on science, textbooks and instruction are still dominated by western science, their perception on MSE is limited, and folk science is sometime added but not important. Multicultural tolerance for all students is generally in practice yet it is actually transformed into low expectations discouraging science learning. Teachers performed multicultural understanding rather than implementing MSE.

Key Words: Multicultural science literacy, Multicultural science education, Science teaching, Science learning.

1. INTRODUCTION

Regarding the mainstream multicultural and scientific fields of thought, teachers from primary school to university in Taiwan currently still have the culture-free myth of science. Most science teachers failed to perceive that students' cultural backgrounds and science learning are closely related (Wang, 2013). If science teachers failed to perceive cultural differences, they may retain a mainstream scientific belief with certain teaching methods and evaluation standards. In this circumstance, minority students might face learning inequality (Aikenhead & Lima, 2009). Addressing the policy of multiethnic science education with the focus of multicultural literacy for science teachers, this study explores the possibility, depth and width for developing Multicultural Science Education (MSE) in Taiwan, especially when Taiwan is becoming a multicultural and multiethnic society nowadays. MSE questions "science as a western institution" and "science as a modern culture" in order to provide an alternative standing point for rethinking the science-culture relations. This paper aims to present science teachers' views on Science, Science textbooks, science

teaching and learning within their science classrooms in Taiwan. The purpose of this study is to explore the cultural differences of teaching science for multi-ethnic students in order to understand the difficulty of science teaching and the phenomenon of bimodal distribution of learning differences.

2. LITERATURE REVIEW

The current curriculum and instruction for science education takes the standpoint of universal world view of Western Modern Science (WMS) (Zarry, 2002). WMS refers to white male science that dominates the privilege of scientific knowledge (Snively & Corsiglia, 2001). Nowadays scientists found MSE a new approach for oriental society of learner-centred (Luft, 1998). MSE is a process of science construction that provides equal opportunity for diverse students to approach qualified science learning (Atwater, 1996). MSE means that science teachers should have reconceptualised what science is according to ethno-cultural field study (Carter, 2006). Atwater and Crockett (2007) proposed a MSE programme which links social justice to the culture of diverse population and its corresponding scientific knowledge. MSE is to fulfill the project of "science for all" by creating different scientific knowledge (Madrazo, 2010). Southerland (2000) has divided two different epistemological patterns for MSE– instructional MSE and curricular MSE. By practicing the MSE programme, science teachers are expected to be disempowering the authority of science for students (Hogan & Craven, 2008). Woolnough (1996) points out that there is not only one worldview; most worldviews from other cultural contexts are working effectively. However, the relationship between worldviews and cultural myth of science is uncertain.

3. RESEARCH METHODS AND ANALYTIC FRAMEWORK

Qualitative data were collected by individual interviews from 12 science teachers across 5 ethnic geographical areas in Taiwan who were asked about their teaching experiences of knowing science, talking cultures and doing WMS or/and MSE. We explored science teachers' MSE beliefs by correlating their worldviews and multicultural literacy. Science teachers were asked about the difficulties of science instruction when it has to be linked with students' cultural contexts, the problems and dilemmas of implementing MSE. What is the structure of scientific knowledge that science teachers is able to correlate with cultural groups? How did they interpret the phenomenon of bimodal distribution in scientific performance? The participants were excellent science teachers selected from both urban and rural areas across the northern, middle, southern and eastern Taiwan. School levels such as primary, junior high and high school were also considered. In total, we involved 12 participants – 6 urban and 6 rural areas. Their ages ranged between 34-64 years old. The background information of the participants is shown as Table 1.

Table-1. MSE Object of Study

Code	Gender	Position	Teaching Subject	Age	Teaching Years	Highest Degree
A	Male	Principal	Primary School - Science and Technology	44	19	MA in Education
B	Female	Subject Teacher	Primary School - Science and Technology	40	12	MA in Science Education
C	Female	Principal	Primary School - Science and Technology	44	24	MA in Curriculum Studies
D	Male	Principal	Primary School - Science and Technology	41	18	MA in Science Education
E	Male	Director, Academic Affairs	Junior High School - Physics and Chemistry	46	23	BA in Physics
F	Male	Director, Academic Affairs	Junior High School - Physics and Chemistry	36	10	MA in Environmental Science and Engineering
G	Female	Subject Teacher	Junior High School - Biology	34	6	MA in Biology
H	Male	Director, Academic Affairs	Junior High School - Physics and Chemistry	48	19	MA in Special Education
I	Male	Director, General Affairs	Senior High School - Biology	42	18	MA in Life Science
J	Male	Subject Teacher	Senior High School - Physics	64	42	BA in Physics
K	Male	Subject Teacher	Senior High School - Biology	36	10	MA in Biology
L	Male	Subject Teacher	Senior High School - Physics	50	29	BA in Physics

4. RESEARCH FINDINGS

This study explored the science-culture relations in order to disclose the complexity of science teaching, the phenomenon of bimodal distribution in students' learning performance and its solution. Based on the data of personal interviews, this paper presented teachers' views on science, science textbooks, and science teaching, learning and its dilemma. The comprehensive results are shown as Figure 1.

4.1. Views on Science

As Figure 1 shown, most teachers' scientific view was specific and evidence-based as they believed that science can be verified repeatedly. This view was also reflected in their view point of ethno science. All the researched teachers agreed that science exits only when evidence is found,

either “empirical evidence” or “quantitative evidence”. They consider science a truth-pursuing process if not the truth. Based on the above consensus, science teachers basically teach the fundamental science, a sort of daily life science. However, there was sort of professional authority on science hidden in mind.

Ethno-science, of course, could be a sort of science, if you’d like to say so. However, it is not a kind of science by calculation, it is not reasonable because they [those who call ethno-science a science] do science by experience and induction. In the far old time without science, people explain things according to their experiences. In this sense, experience can be seen as a kind of science (K, interview, 20120221).

Although science teachers believed science should be linked with everyday life, their science teaching eventually was detached from life due to examination and credentialism.

4.2. Views on Science Textbooks

Mostly teachers’ views on science textbooks were focused on western modern science and they were unable to suspect western science might be problematic. In their eyes, science textbook as well as western science is a systematic knowledge which is universal and dominant so that students must learn.

> It [Science textbook] is not problematic because it is nothing related to religious beliefs. Science is not materialism. It is not capitalism. It is neutral. I heard some scientists went mad in terms of their attitudes, spirits or outlook. It is because they were too crazy in their fields. Well, it anyway doesn't affect what science is. (L, interview, 20120502).

Most teachers agreed with folk science to be presented in science textbooks, but it was only there for decoration to prove that science can be used in diverse cultures. It was also only there for fun of science learning-“If we could add one more teaching material, why not?” (H, interview, 20120502).

4.3. Views on Science Teaching and Its Dilemma

Science teaching was seen as the most fundamental basic discipline and it is related to daily life. Therefore, the educational goals of science teaching are of course the completion of scientific knowledge, ability and affection. However, the pressure of examination abided by credentialism had already changed the essence of science teaching. Science teachers were forced to give away their teaching autonomy in order to fulfill exam standards. Science teaching had become a sort of delivering specific science knowledge that ceased teachers’ passion for science education. Furthermore, science teachers were often engaged with school administration or leadership that is why most science teachers couldn’t focus on teaching- school administration became their major work, yet science teaching was put down into the second priority. The worst thing is that we found some primary schools hired non-specific teachers to teach science.

4.4. Views on Science Learning Differences

Learning differences exist among students in all levels of schools but only junior high schools and high schools were found the bimodal phenomenon. Primary students performed evenly in terms of science learning. The main factor of learning differences came from family backgrounds. According to teachers' interviewing data, "parenting" was significant in primary children's science learning, while "parental interest" was critical in junior high or high school students. In other words, high school students would perform better if their parents were more interested in science specifically, yet primary school students would perform well if their parents had concerns in education generally. Teachers from all levels agreed with "parents SES (socio-economic status)" as the critical influence in science learning. For example,

Those parents with sufficient family capitals and higher SES can provide strong supportive resources for children's science learning. They also have higher educational expectation and strong interests in education as well as parenting. There is always a huge gap among students from diverse backgrounds (C, interview, 20120426).

Furthermore, most teachers agreed that individual talent of comprehension ability is of course important in science learning. They however had no consensus in "gender difference"—some female science teachers believed gender is unrelated to science ability but other teachers found the gender differences among students' science performance. Lastly but most importantly, science teachers consider students' ethnicity nothing to do with science learning at all. For aboriginal students and immigrant children in Taiwan, the poor performance in science classroom was due to their deprived family background. Regarding improving the bimodal phenomenon of science learning, primary school teachers adapt the strategy of cultural responsive teaching, junior high school teachers use heterogeneous grouping and remedial teaching which was actually ineffective, and high school teachers took no action at all.

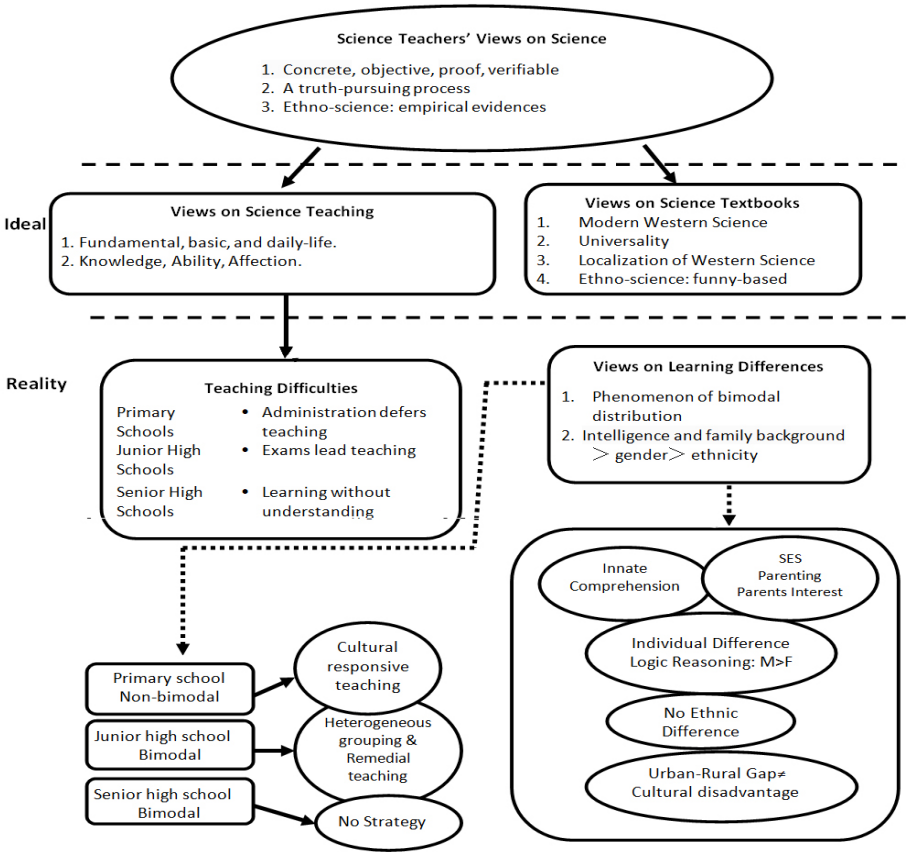
I ever taught an aboriginal student who used to live in indigenous tribal. He may establish good knowledge in life but he cannot manage any exam. He was disadvantaged in writing and reading. His main problem is the language of professional term in Science. However, as a teacher, my pressure comes from students' poor performance in exams. We have to face the reality that the exam scores matter (G, interview, 20120425).

In a word, credentialism and examination is why science teaching is problematic and why teachers cannot practice MSE. Students learn science for the sake of examination so that science became dead knowledge without understanding. For students and teachers, achievement beats interest. It turns out that science teachers cannot put MSE into practice. They behaved like a teaching machine which only fulfilled the requirement of passing exams. Science learning equalized to memorize scientific knowledge without meaning and implementation; not to mention that teachers and students have opportunity to generate genuine interest and enthusiasm for science. Alienation occurred instead of vivid learning.

5. DISCUSSIONS

Most teachers consider science western and universal; WMS is given a high value over folk science. Western modern science is seen the only one science, yet folk science is described as science without proper methods or it is just a way of experience prediction with irrational reasoning. Teachers perceive no problem of teaching western science within the local-cultural contexts. As Hodson (1993) mentioned, science curriculum is usually understood within western cultural context. It is implied that only western science is science. According to Wolcott, science learning is to obtain the culture of science; students shall learn about science from the daily lives; however, science taught in school implies western knowledge superior to local culture (Ogunleye, 2009: 64). Aikenhead and Lima (2009) take the term of neo-colonialism to explain the phenomenon of western science domination. It means that when we try to impose a completely Eurocentric science curriculum on local students, we are conducting neo-colonialism. Therefore, the problem of science learning is not simply learning difficulties, yet it is the problems of defining science due to cultural difference. As long as teachers define science as western, science curriculum will be dominated by western science. Folk science then is neglected and simply added within science curriculum for the sake of fun and pleasure.

F1 Science Teachers' Views on Science, Teaching, Textbooks, and Learning Differences.



6. CONCLUSION

Based on the researched science teachers' discourses, this paper concluded some cultural myths that teachers' views on science, textbooks and instruction are still dominated by western science, their perception on MSE is limited, and folk science is sometime added but not important. The researched science teachers appear to be multicultural tolerance for all students yet it actually becomes a sort of low expectations discouraging students' science learning. Science teachers often performed more multicultural understanding rather than implementing multicultural science education. Teachers' views in science disclosed the main problems in science education and it indicates the importance of MSE. Multicultural issues shall be reconsidered. Teachers shall realize some ideologues hidden in scientific knowledge and curriculum. They also shall avoid modern science hegemony in order to cut down neo-colonial instruction. As Tsai (2003) advocates that science teachers cannot neglect gender and cultural contexts within science curriculum, they also shouldn't assume "science is neutral" and see the production, propagation and representation of scientific knowledge irrelevant with science. Indeed, the progress of production, propagation and representation of scientific knowledge cannot be separated from its linguistic, gendered and cultural contexts. Therefore, science teachers must situate "culture" back into science curriculum in order to present and respond to cultural issues and tackle students' cultural differences and transform western science to multicultural science so that the bimodal phenomenon in science may be solved.

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