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ABSTRACT

The purpose of this study was to explore four classes of junior high school students' learning motivation toward a physical science course in central Taiwan. Both qualitative and quantitative methods were applied in the study. Students' physical science learning motivation questionnaire (SPSLMQ), modified from multiple dimensions of a motivation instrument (Uguroglu, Schiller, and Walberg, 1981), was developed in the study. It included achievement, affiliation, self-concept, mastery, and locus of control scales. Another questionnaire, consisting of 11 items, was designed to assess students' perceptions toward physical science. Findings from classroom observation, interviews and questionnaire surveys revealed that students think they need to take major responsibility for their own physical science learning. Although students had moderate curiosity about the nature phenomena around them, they did not persist in elaborating their understanding beyond classes, which influenced their physical science learning outcomes. Besides low mastery motivation, students also had a low score on their performance in physical science. Many students' reasons for learning physical science were related to instrumental interests such as knowing more information, preparing for tests, or for attending better schools. Students expressed that having low-pressure learning contexts and lab experiences could motivate them in learning. They agree that teachers' teaching can influence their motivation in learning. Suggestions for science teaching are discussed in the paper. (Contains 30 references.) (Author/ASK)

Students' motivation toward learning physical science – A case from four classes of Taiwanese students

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Abstract

The purpose of this study was to explore four classes of junior high schools students' learning motivation toward physical science course in central Taiwan. Both qualitative and quantitative methods were applied in the study. Students' physical science learning motivation questionnaire (SPSLMQ) modified from multiple dimensions of motivation instrument (Uguroglu, Schiller & Walberg, 1981) was developed in the study, it included achievement, affiliation, self-concept, mastery, and locus of control scales. Another questionnaire consisted of 11 items were designed to assess students' perceptions toward physical science. Findings from classroom observation, interviews and questionnaire surveys revealed that students think they need to pay major responsibility for their own physical science learning. Although students have moderate curiosity about the nature phenomena around them, they did not persist in elaborating their understanding beyond classes, which influenced their physical science learning outcomes. Besides low mastery motivation, students have low on their performance in physical science also. Many students' reasons in learning physical science were related to instrumental interests such as knowing more information, preparing for test or for attending better schools. Students expressed that having low-pressure learning context and lab experience could motivate them in learning. They agree that teachers' teaching can influence their motivation in learning. Suggestions for the science teaching were discussed in the paper.

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Introduction

The goal of science education is to enhance students' science learning by teaching, curriculum or assessment. Many science educators have explored various ways to enhance students' science learning, such as using conceptual change strategies, constructivist approach, history of science, etc. (Brickhouse, 1998; Duit & Treagust, 1998; Duschl & Hamilton, 1998; Scott & Driver, 1998). However, most of the efforts were mainly emphasized on students' cognition, instead of addressing on students' affective domain. Some researchers (Duit & Treagust, 1998; Lee, 1989, 1996; Pintrich, Marx, & Boyle,1993; Strike & Posner, 1983, 1992; West & Pine, 1983) have noticed the importance of examining the motivational and affective issues on students' learning which influenced students' willingness in making conceptual change or concepts learning. For instance, Duit and Treagust (1998) indicated that while conceptual change are very important in enhancing students' science learning, however, "conceptual supporting conditions"(p. 20) are also important to investigate, so that researchers could know more about the relationship between conceptual change and the many supporting conditions. They addressed the various conceptual change supporting conditions included "students' interests, motivation, self-concepts, classroom environment and power structure in school." (p. 20). Others (Boyle, Magnusson & Young, 1993; Pintrich, Marx, & Boyle, 1993) think motivation factor can lead to raising or lowering the status of a conception. Lee (1989, 1996) and Pintrich, Marx, and Boyle (1993) also advocated the importance to examine the motivation factors influenced students' in making conceptual change.

In fact, based on constructivist theory, students are assumed to be active engaged in learning, and in acquiring new experience to retrieve or revise their previous experience (von Glasersfeld, 1998). von Glasersfeld (1998) also mentioned only when teachers can create a circumstance which provides students' success experience with their new conceptual model and the pleasure they provide can motivate learners intellectually. We think students' previous experience did not only consist of cognition, which should also include students' perceptions and feeling in their previous learning experience. Therefore, whether students had pleasant experience or not is also important for stimulating them construct new knowledge or experience from the science classes or their daily life experience. Based on the literature (Halayna & Thomas, 1979; Main, 1993; Nichools, Nolen & Patashnick, 1985) students' motivation toward schooling or science learning decreased gradually as they engaged in the school. In Taiwan, the Ministry of Education (1995) also reported physical science as the second difficult subjects to study from most of junior high school students' perspective. These studies revealed one phenomenon that students' learning experience at the elementary level or lower grade in junior high school might influence their motivation toward learning physical science or further schooling. Thus, investigating students' motivation in learning physical science was important.

The current goal for science curriculum is to educate all people regardless of their social circumstances, career aspirations, ethnic, language minority and genders can have scientific literacy in future decision making (AAAS, 1990). In Taiwan, Ministry of Education also advocates the similar goals as science for all children. The underneath of the above goals is to reach all students' needs and motivation and stimulate them in learning and using science. Unfortunately, there are many students who did not have successful learning experience in science, whether they would continue using science they learned from school into their daily life is not explored before. Therefore, what are various achievers' motivation and reasons in learning science are very important to investigate in order to design better curriculum materials or teaching strategies to stimulate students' motivation in learning science in the new curriculum reform movement.

Although there are many motivation research done on psychology area (Main, 1993; Nicholls, 1984), these research were concentrated on using quantitative research design to explore the variables in motivational constructs, and had few implication for science teaching. Many researchers (Blumenfeld, 1992; Blumenfeld & Meece, 1988; Lee & Anderson, 1993; Lee & Brophy, 1996) suggested that there is a need to consider students' motivation within subject content, and the classroom contexts of curriculum, instruction, and teachers. Based on the above rationale, the purpose of this study is to explore four classes of junior high school students' motivation toward physical science course in Taiwan, using both qualitative and quantitative methods. Particular questions we are interested in are the different achievers' motivation in learning physical science, and factors influenced students' motivation in learning physical science.

Theoretical perspectives

Motivation and learning

Brophy (1983, 1987, 1989) outlined students' motivation to learn into two kinds: general motivation and situation-specific motivation. The former motivation refers to individual holding enduring disposition to value learning as worthwhile and satisfying activity, and to strive for knowledge and mastery in learning situation. For the situation-specific, motivation refers to the learning task was designed to acquire or mastery knowledge or skills whenever individual learners who engaged into the task. In Brophy's definition of motivation, he addressed the issue of learners' own curiosity in understanding, learners' tendency in mastery what they know, and learning activities, these are the factors influenced students' motivation in learning.

Martinez and Haertel (1991) summarized Dewey, Bruner, Maslow, Harter, Malone and Lepper's ideas of the reasons appeal students' motivation in learning, these were cognitive, mastery and social appeals. "Cognitive appeal refers to a range of situational characteristic that stimulate curiosity and fantasy, and comprises both sensory curiosity and the higher-level cognitive curiosity" (p. 471-472). Mastery appeal is derived from environments that lead a sense of effectiveness, and need for control. "Social appeal refers to the social characteristics of a task or event that engender interest and involvement" (p. 472), such as students feel pleasant to work with their friends.

Weiner (1990) indicated that the trend of motivation research has shifted from mechanical to cognition, future research needs to focus on achievement motivation, and concept of self in examining students' motivation in learning. Lee (1989, 1996) and Pintrich, Marx, and Boyle (1993) advocated the needs of integrating motivation component in understanding when would students make conceptual change. Pintrich, Marx, and Boyle (1993) suggested that four motivational constructs (goals, values, self-efficacy, and control beliefs) could be potential mediators of the process of conceptual change. They also advocated that understanding students' motivational beliefs about themselves as learners and their roles in classroom learning communities could be better to understand why and when students were making conceptual change.

Based on the above researchers suggestions we can categorized that individual's own curiosity (achievement motivation), self-control, concept of self, learning task and social factors would influence students' motivation to learn in the class. Thus, various motivation influenced students in constructing their knowledge.

Motivation and science learning

In terms of students' motivation related to science education, only few researchers addressed on this area (Lee, 1989, 1993, 1996; Pintrich, Marx, & Boyle, 1993). Lee (1989) used qualitative research methods to classify six types of students' motivation in conducing conceptual change learning, these were intrinsically motivated to learn science, motivated to learn science, intrinsically motivated but inconsistent, task completion, task avoidance and disruptive behavior. Later in another paper, Lee and Brophy (1996) reclassified students' motivation into five patterns, these were intrinsically motivated to learn science (pattern 1), motivated to learn science (pattern 2), intrinsically motivated, but inconsistent (pattern 3), not motivated to learn science (pattern 4), and negatively motivated (pattern 5). Different patterns of students have different goals in studying science. For instance, in pattern 1, students' goal was for scientific understandings with interests; pattern 2 students' goals was to scientific understanding; pattern 3 students' goal was for satisfaction of interest; pattern 4 students' goal was for task avoidance, and pattern 5 students' goal was for task resistance.

Barlia and Beeth (1999) applied Pintrich's four motivation constructs (goals, values, self-efficacy, and control beliefs), questionnaire (MSLQ) to investigate how 11 high school students' motivation in engaging conceptual change based on physics teaching. They applied Lee and Brophy (1996) model and categorized these students' motivation into the following patterns: (1) intrinsically motivated to learn, (2) intrinsically motivated to learn but not consistent per day, (3) extrinsically motivated to learn to fulfill an academic requirement. As authors compared 11 students' motivation profiles on MSLQ, they found out task value and control beliefs were most important for most students. However, based on interview with students, they also found out teachers' unique personality and teacher-student relationship also influenced students' motivation in learning. Hanrahan (1998) also reported that student-teacher relationship would influence students' motivation in learning. Teachers' expectation of students and their allowance of students' learning autonomy would influence students' engagement in learning. Although students have high motivation in learning science, teacher's teaching style and students' beliefs of the relationship between previous and new concepts would influence them in using superficial or deep cognitive engagement.

Wu (1999) investigated one class of ninth graders' with moderate ability their motivation toward learning physical science. Her findings indicated that most of students' motivation toward learning physical science were gaining good score, pleasing their parents and having opportunities to conduct lab activities. Very few students' reasoning to learn physical science was due to understanding their living world.

Design and Procedure

This study applied both qualitative and quantitative research methods in understanding various achievers' motivation toward physical science learning and factors influence their motivation in learning.

Four physical science classes from three different junior high schools were selected from Taichung and Changhua area in Taiwan. Two classes (C212 and C214) of students studying 8th grade physical science textbooks were from same city school in Taichung. Another two classes (C308, C309) of students studying 9th grade physical science textbooks are selected from two rural county schools in Changhua.

Students enrolled in C308 were labeled as low ability in academic achievement by their school. They can not pass any entrance examination to go to both high schools and good vocational schools. Students were expected to attend vocational schools without any entrance examination requirement, some of them would go directly to work after their graduation.

Students enrolled in C309 were labeled as moderate ability students by their school. They were expected to take entrance examination and go to good vocational schools after their graduation.

Students enrolled in C214 and C212 were in the same school but taught by two different female teachers, teacher Hsu and teacher Yang. Although these two classes of students were all mixed with high, moderate, and low ability students, C212 always had higher test scores in all subjects than in C214 students. Based on interviews with two teachers and examining students' test score, there were more high achievers in C212 than in C214, and more low achievers in C214 than C212.

Students' physical science learning motivation questionnaire (SPSLMQ) was modified from multiple dimensions of motivation instruments (Uguroglu, Schiller & Walberg, 1981). In SPSLMQ, there were several constructs such as achievement motivation (7 items), affiliation motivation (4 items), self-concept (6 items), mastery motivation (3 items), and locus of control (6 items). Another questionnaire consisted of 11 items are designed to collect students' perception toward learning physical science. The score ranged from highly agree (5) to highly disagree (1) on each item. The definition of each scale and representative items were listed in table 1.

Table I. SPSLMO

Scale	Example item
Achievement motivation: measure students' tendency to pursuit success in learning physical science and understanding nature phenomena	1. I want to know the reason why behind daily life nature phenomena. 2. If I face a difficult problem in physical science, I will continue to solve it.
Affiliation motivation: measure students' learning physical science due to wanting to be close to their friends or teacher	1. If my teacher and classmates can get along, I would like to study physical science. 2. My classmates' perceptions toward me will influence my learning toward physical science.
Self-concept: measure students' satisfaction toward their own physical science learning performance and their teacher's expectation	1. I feel satisfy on my own performance in physical science. 2. My teacher is satisfied by my learning performance in physical science.
Mastery motivation: measure students' tendency in elaborating their physical science understanding due to their wanting to acquire knowledge	1. At home, I will study physical science textbook or other relevant books by myself. 2. Once I start to solve a physical science problem, I will be attracted by the problem and try very hard to solve it.

Locus of control: measure students' tendency to treat their learning performance due to causes they can control or not.	1. If I receive praise for my performance in physical science, it is due to my effort. 2. If I study physical science hard, I will perform well.

After surveying 4 classes of students (n=149), the Cronbach α for the entire questionnaire is .85; Cronbach α for the above scales ranges from .77 to .58. All the items in the questionnaires were checked by experienced science teachers, science educators and junior high school students in order to verify content and facial validity.

Four classes of students responded the questionnaires after two months of classroom observations. After analyzing the questionnaire, 36 students (nine students per class) were chosen for interview. The criteria for chosen these students based on students' scoring high, middle and low on the questionnaire. Interview questions were based on students' responses on the questionnaire and their perceptions toward physical science, teacher's teaching and their learning motivation.

Classroom observations were conducted once a week for 8 months. During classroom observations, researchers focused on how teachers' teaching influence students' learning engagement as defined by Lee and Brophy (1996) "a state of motivation to learn science when students engage in science tasks with the goal of achieving a better understanding of science and activate strategies for doing so" (p.306).

Four teachers were also interviewed every two weeks for eight months. Interview addressed on students' motivations toward physical science learning, teachers' own teaching strategies, students' reaction, and clarify researchers' curiosity collected during classroom observations.

Data analysis

For the quantitative data, researchers used descriptive statistic to count the mean and standard deviation for each item and each scale per class. One-way ANOVA was also used to analyze the difference of scale means among four classes. Scheffe posteriori comparison was used to compare the difference mean score between two classes. For the qualitative data, all the interviews were tape-recorded and transcribed verbatim. Researchers read transcripts individually and wrote done temporary findings. Later researchers discussed with and debated on their findings by providing further evidence. After several consensus meetings, assertions accompanying with both qualitative and quantitative data were generated.

Findings

Table 2: Four classes students' SPSLMQ results（N=149）

Scale	Item #	α	Mean	SD.	Mean/Item
Entire questionnaire	26	0.85	113.87	19.74	4.38
Achievement motivation	7	0.77	21.6	5.20	3.08
Affiliation motivation	4	0.58	12.4	3.34	3.10
Self concept	6	0.74	16.57	4.13	2.76
Mastery motivation	3	0.73	7.35	2.80	2.45
Locus of control	6	0.59	20.03	4.11	3.34

Table 3. F-test among four classes of students' SPSLMQ results

Scale	C309 Mean SD	C308 Mean SD	C214 Mean SD	C212 Mean SD	F-test	P value	Scheffe posteriori comparisons
Achievement motivation	19.00 4.51	19.46 4.35	22.71 4.94	24.78 4.27	13.62	.00**	C214>C308*; C214>C309* C212>C308*; C212>C309*
Affiliation motivation	11.45 3.09	11.73 3.72	12.53 2.62	13.69 3.23	3.76	.01*	C212>309*
Self concept	15.78 4.28	15.08 3.89	16.97 4.36	18.05 3.54	4.04	.01*	C212>C308*
Mastery motivation	6.45 2.74	5.89 2.26	7.87 2.73	9.00 2.60	11.1	.00**	C214>C308* C212>C308*; C212>C309*
Locus of control	19.32 4.31	18.22 3.73	19.32 3.34	22.31 2.58	4.87	.00**	C212>C308*

Note: * mean p<0.05 ** mean p<0.01

Table 4: Four classes of students' perception toward physical science

Item	4 classes n=149 Mean SD	C308 n=37 Mean SD	C309 n=32 Mean SD	C214 n=38 Mean SD	C212 n=42 Mean SD	F-test	P value
1. I feel depress when facing difficulty in learning physical science.	2.72 1.01	2.35 1.11	2.56 1.05	2.84 0.93	3.07 0.85	3.95	0.01*
2. I will think hard when taking physical science tests.	2.66 1.14	2.59 1.21	3.06 1.19	2.79 0.93	2.31 1.12	2.99	0.03*
3. I am very serious in conducting lab experiment.	3.77 1.12	3.27 1.10	3.03 1.33	4.18 0.69	4.40 0.73	17.48	0.00**
4. If I find my performance on the test declined, I would study hard.	3.78 1.05	3.30 1.05	3.44 1.27	4.00 0.77	4.26 0.83	8.29	0.00**
5. I feel my classmates like to learn physical science.	2.69 1.03	2.49 1.04	2.78 1.10	2.87 0.84	3.05 0.99	1.69	0.17
6. I wish the content covered in physical science textbook is more interesting.	3.95 1.34	4.00 1.27	3.81 1.45	3.50 1.62	4.43 0.83	3.50	0.01*
7. I wish the content covered in physical science textbook can be simpler.	3.79 1.36	4.19 1.17	3.81 1.38	3.39 1.50	3.79 1.30	2.20	.09
8. I think learning physical science is very useful.	3.41 1.08	2.84 0.93	3.20 1.28	3.53 0.89	4.00 0.88	10.04	0.00*
9. I think physical science is an interesting subject.	3.32 1.19	2.65 1.01	3.10 1.22	3.61 1.26	3.81 0.94	8.52	0.00**
10.I think physical science is for smart people to learn.	2.95 1.27	2.54 1.26	2.97 1.22	2.84 1.32	3.40 1.17	3.31	0.02*

11.I think teacher's teaching can make me interests in learning physical science.	3.51 1.17	3.02 1.19	2.94 1.12	3.76 1.02	4.12 0.94	10.79	0.00**

In Table 2, the entire questionnaire has α=.85 which indicated high reliability on the questionnaire. Among five scales, achievement motivation, self-concept and mastery motivation have high α value (α>.70), both affiliation motivation and locus of control have lower α value (estimation 0.60). This means the SPSLMQ have adequate reliability and validity.

Comparing the mean per item, the result indicated that four classes of students have highest score on locus of control (Mean per item =3.34), which indicated students think they need to take responsibility on their success in learning physical science. The second highest mean score per item is affiliation motivation, which indicated that students feel whether teacher or their classmates accepted themselves are very important for their learning. Students have moderate agreement (Mean per item=3.08) on their curiosity about the nature phenomena surrounding them (Achievement motivation). Two scales have lower than 3.00, these are self concept and mastery motivation. Students have negative view on their own performance in studying physical science, and they do not elaborate their understanding after class.

Based on Table 3, four out of five scales showed significant difference among four classes of students. For instance, among achievement motivation, self-concept, mastery motivation, and locus of control scales, four classes of students showed significant difference ($p<.001$, or $p<.05$). In achievement motivation scale, both C212 and C214 have higher motivation score than C308 and C309, which showed that these two eighth graders are more interested in learning or exploring nature phenomena around them. In affiliation motivation, there is significant difference among four classes of students. C212 is significantly higher than C309. In self-concept scale, C212 is significantly higher than class C308, which indicates that students in C212 are more satisfied with their performance in physical science than C308. In mastery motivation scale, both C212 and C214 are significantly higher than class C308. In addition, C212 is significant higher than C309. These findings revealed that these eighth graders would elaborate their learning than ninth graders. In locus of control scale, C212 is significant higher than class C308, which means students in C212 shows strong confidence that they can control their learning performance than C308.

In Table 4, four classes of students strongly expect the content cover in the physical science can be interesting and simpler (M=3.95; 3.79). Two items have lowest scores, these are, item 2 "I will think hard when taking examine (M=2.66)" and item 5 "I feel my classmates like to learn physical science" (M=2.69). In C308, students strongly expect that the content of the physical science textbook can be disagree are that item 1 "I feel depress when I face difficulty in learning physical science" (M=2.35) and item 5 "I feel my classmates like to learn physical science". In C309, students show similar results as C308 in both strongly agree and strong disagree items. In C214, two items students showed strongly agree are item 3 "I am very serious in conducting lab experiment"(M=4.18), and item 4 "If I find my performance on the test declined, I will study hard"(M=4.00). For C212, two items students show strongly agree are item 6 "I wish the content covered in the physical science textbook is more interesting."(M=4.43), and item 3 "I am very serious in conducting lab experiment" (M=4.40). One item showed least agreement is item 2 "I would think hard in taking physical science"(M=2.31). Basically, two eighth graders have positive perceptions toward learning physical science than two ninth graders. C212 showed positive perception toward learning physical science than other three classes of students. C308 showed the least perception toward learning physical science. Both ninth graders expected the subject matter knowledge covered in the textbook are simpler and interesting. C214 and C212 showed their positive perceptions toward learning by conducting lab experiment. In fact, C308 and C309 students are also like to conduct lab activities in enhancing their learning.

The following assertions are generated by both qualitative and quantitative data:

1. **Most of students' goals in learning physical science were related to instrumental instead of emancipated interests.**

When we interviews students' about their motivation toward physical science, only few of students mentioned the useless in studying physical science, most of the students thought physical science is a useful subject to study. These findings also matched with table 4 item 8"I think learning physical science is very useful (total Mean=3.41)". Only C308 gave disagree (M=2.84); the other three classes of students agreed with this statement. Particularly in class C212, students showed strongly agree on the usefulness of physical science (M=4.00). When we interviewed students in C308, only one student mentioned:

> *It is very important [to learn physical science]. In our daily life, many things related to physical science. For instance, petroleum and refining of petroleum and the refining products. There are many things in daily life not only petroleum products but other things are very useful in our daily life.(C308, S11 high achiever).*

For the other students, they do not know how useful of studying physical science, thus, many of them keep silent without giving any responses. On the contrary, in C212 (the one with strong motivation in learning physical science among four classes of students), students with various achievers and motivation expressed various reasons why studying physical science is very important. For instance, "physical science is fun", "I want to know more knowledge on the world around me". These students showed their own desire in understanding and exploring the nature phenomena simply satisfy to their own curiosity. In C309, students care more about on their test performance; therefore, they think studying physical science can help them get good score on test and help them to attend better school after graduation. Same as C214, many students also care about if they achieve the high test scores as to attend better school after their graduation. Some of them would like to gain some knowledge about physical science. Generally speaking, for the majority of students, they explained reasons for studying physical science were "for passing the examination", "for attending good schools in the future", and "for applying what they learn in daily life". These reasons for studying physical science are more toward instrumental interests in knowledge instead of emancipate their minds are the major goals for students to study physical science.

2. **Students with various achievements and motivation treat their success toward learning physical science on the effort they put instead of their luck.**

Among these four classes of students, they varied in terms of their learning abilities, achievement and motivation toward learning physical science. When we interviewed students in class C308 and C309, many students expressed they do not like to study physical science because of calculation and themselves not having good memory to remember many scientific theories or knowledge. These findings are also existed in low motivation and low achievers in C214 and some students in C212. But when researchers asked them how to improve their performance in the class, most of students expressed that they should study hard by themselves. None of students complained the difficulty of content nor the teacher's teaching which impeded them not having success in the physical science class. Similar findings are also revealed in table 3. Four classes of students gave the highest scores on locus of control (Mean per item ranged from 3.04 to 3.72) than on other scales, which showed that students thought the efforts they put are the key factor influenced their success in learning physical science. In question "If I study hard, I would performance well in the class", students in both C212 and C308 gave high score on it (M_{C212}=4.21; M_{C308}=3.69). In Table 4, item 10"I think physical science is for smart people to learn". Students in both C308 and C309 disagreed with this statement (M_{C308}=2.54; M_{C309}=2.97). These findings revealed the fact that students think their effort put in studying physical science can dominate their success/failure in the physical science learning.

3. Although students are curious about the nature phenomena around them, their lacking of motivation in elaborating their understanding influenced their

science learning outcome.

During contexts such as teachers showed lab demonstration, real objects (such as various kinds of battery) or have students conduct lab activities, the number of students' engagement increased. Students also were attracted by what phenomena showed in front of them. They gave more responses when teacher asked them questions related to the phenomena they expressed. All of these are unlikely happened during traditional lecture contexts. In table 3, mean scores per item on mastery learning scale from four classes ranged from 1.96 to 2.94 on achievement scale ranged from 2.51 to 2.97. These data indicate that students do not have habit in elaborating their understanding of physical science after class. Eighth graders are more interested in the nature phenomena surrounding them than ninth graders. Based on interview with students on what they did after school, most of students in C308 and C309 spend time in watching TV, playing computer game, playing around instead of reading books related to physical science. Only high motivation achievers in C212 would study science encyclopedia or watching discovery program after class. Others students would finish teachers' homework or study for the test. Teachers from C214, C308, C309 constantly mentioned their students do not study after class. They like to play around instead of to study. As researchers observed students' performance in the class, only few students from class C212 would continue to study or discuss with their friends on physical science problems. Other students quickly closed the book when hearing the class bell ringing. Although they may have some seatwork to be solved, students care playing more than finishing their physical science work. These findings revealed that most of students lacking motivation in elaborating their learning after class.

4. Students with various achievement in learning physical science are motivated by non-pressure, relax learning context.

As mentioned before, C212 has the highest learning achievement and motivation. On the contrary, C308 has the lowest motivation and achievement in learning physical science. During classroom observations, students in C212 constantly interacted with teacher Yan. In some occasions, teacher Yan creates learning context for students to discuss questions on the worksheets. The number of students participated in the discussion increased. The same phenomena also happened in C214, C308 and C309. Usually the latter two classes of classroom learning environment were very calm and dull; only in the non-pressure and free expression context, students are willing to participate in the learning activities. When researchers asked students how group discussion influenced of their participation in the class, they responded:

S3: During group discussion, I am more active in participation...I will try to quickly solve my questions...then I can chat with my friends. (C212 low motivation & low achiever)

S12: [During group discussion] we can discuss together, and I can remember more important points in the chapter, which is better than listening the [teacher's teaching] whole chapter. (C212 moderate motivation & moderate achiever)

S11: I like group discussion, because I can talk (C309 high motivation, moderate achiever).

S9: Group discussion did not influence my willingness in studying...But my others of classmates, they would pay attention on the group discussion... (C212 high motivation & high achiever).

S10: Group discussion can help me understand difficult concepts.(C308 moderate motivation & moderate achiever)

Based on the above interview, students like group discussion context. It is because students can learn from each other, and they can find pleasure in talking with each other. Other students addressed the lower learning pressure in the discussion group context. In terms of non-pressure learning environment, many students particularly in C308 mentioned constantly they expect teacher to provide low-pressure learning environment to them:

S3: [The learning atmosphere I like is when] My teacher can tell some jokes.(C308, low motivation & low achiever)

S1: The learning context is more interested now than before, because my teacher smile and joke with us. He did not force us to learn physical science. You can feel relax to learn without any pressure."(C308, low achiever & low motivation)

S5: [I like] group discussion, because we can have relaxed conversation. (C308 moderate motivation & moderate achiever)

Even in a high motivation and high achievement class, students addressed constantly that their teachers (Yan and Hsu) smile to them, care about them and tell them many information out of textbook which made them feel learning climate is vivid, so they like to study physical science.

5. Most of students are motivated by conducting lab activities, but their reasons various from searching sensual excitement, clarifying their understanding to explore the nature phenomena.

Four classes of students all expressed their enjoyment in doing lab activities. In table 4, item 3 "I am very serious in conducting lab experiment" is scored from 3.03

to 4.40. However, when researchers observed students' behaviors in lab situation, many students in C308 and C309 would play around the lab equipment and manipulate equipment; few of them would follow lab procedures in conducing the lab and tried to come out some results. Usually, one or two students in a group would take the leadership in conducting the lab. For the rest of students, they simply watched the phenomena. For the students in C212 and C214, more students would conduct lab experiment carefully followed by the lab manual. They had more discussion on lab results than ninth graders. Students' responses to their perceptions toward lab activities are following:

S1: [Conducting lab activities] can help me understand [concepts] better, and can help my learning [physical science]. (C308 moderate motivation & moderate achiever).

S5: Many students are playing around in lab activities...[Lab activities] can help me comprehend what teacher has taught in the class. (CC309 moderate motivation & high achiever).

Researcher: Are you willing to study physical science now?
S15: I like physical science better than before. Because, I can understand more [concepts than before].
Researcher: Which parts of the physical science do you like it better?
S15: Lab part.
Researcher: Do you understand all the concepts behind lab activities?
S15: Some. (C308 low motivation & low achiever).

Although students give various reasons in engaging in lab activity, it can still motivate students in engaging in physical science learning.

Conclusion and Discussion

The purposes of this study are to explore various achievers' motivation toward learning physical science, and factors motivated students' learning, using both qualitative and quantitative methods. Two eighth graders and two ninth graders in central Taiwan participated in the study. Barlia and Beeth (1999) found students' control beliefs are one of important the factors which motivates students' learning. We confirm their findings, out findings further revealed that students' internal locus of control is the high one among all motivation constructs (achievement motivation, affiliation motivation, self-concept, and mastery motivation). Taking major responsibility for one's own learning might be influenced on Taiwanese culture that "if you work hard, you will success". These culture belief also happened in the study done by Huang, Aldridge and Fraser (1998) that Taiwanese students respect their teachers; thus, they treat their success to themselves instead of to demand on teacher.

Although teachers would tell students how scientific knowledge applied into students' daily life and students enjoyed in listening, students' mastery motivation was still the lowest construct among all constructs. This means students thinking and studying physical science as a duty, they do not have habit in elaborating their understanding after class and out of school. It really impedes the goal "science for all people", because science is still isolated in the class not reach to students' daily life. The second lowest score is students' self-concept. Few students think they are good enough on their performance in the class. Even when we interviewed the highest motivation students in C212, they still think other students are better than they are. Students' lacking of self-concept might be influenced by not having successful physical science learning experience in schooling. In addition, we also found four teachers in the study seldom gave verbal praise to students in teaching. Without strong self-concept, students would not like to make conceptual change (Pintrich, Marx, & Boyle, 1993), nor would they willing to touch anything relate to science after schooling.

Most of students' goals in learning physical science are mainly for testing and for attending good schools, which is also similar in Huang, Aldridge and Fraser (1998) and Wu (1999) studies. Their studies further explained Taiwanese students' motivation in learning science usually matched their parents' and teacher's expectation and to attend better school after graduation. Their instrumental knowledge interests would also impede them emancipate their thinking. For science educators, conducting lab activity is a good opportunity to have students appreciate the nature of science, and for them to emancipate their mind (Matson & Parsons, 1998). Though many students like to conduct lab experiment, only few high achievers with strong motivation appreciate this aspect of the lab experiments. As Freedman (1997) indicated lab instruction provided positive attitude and achievement. In our study, having lab activities is a good motivation for majority students to have sensual experience, to confirm their understanding and to have a good time to chitchat with their friends. The discrepancy between science educators' goals and students' goals on science made a challenge for science educators to solve this kind of problem in the future.

Compare with ninth and eighth graders, students without any previous failing experience are interested in the nature phenomena around them. However, in ninth graders, they have being failed in their lower grade, thus, they lack of motivation in exploration the nature phenomena, nor do they have strong self-concept in learning physical science. Fortunately, four classes of students think their teachers' teaching can motivate them in learning physical science. In addition, many students think teacher providing a non-pressure learning environment, making them feel relax to learn science can motivate them to learn. Maybe this is a good start for students who had failing experience before to stimulate their motivation in learning physical science. Another way to improve students' motivation might be for teacher to making connection of what are in the textbook related to students' daily life. Briefly speaking, helping students understanding their learning is meaningful not only for test but also for having a better life can motivate students in constructing their knowledge. In addition, proving a pleasant learning context for students to construct their knowledge is also important so that they can heal their bad experience and have good experience to build up students' self-confidence in their willingness to construct new experience and knowledge.

Is the goal "science for all people" a impossible mission? We think if we want to teach all abilities of students to engage in scientific activities, have scientific thinking, and scientific literacy, probably we need to provide more simple and concrete activities for students to have successful experience in exploring activity instead of memorizing scientific facts. In addition, how to design the curriculum that really make students feel relevance to their daily life would be another tasks for science teachers and science educators.

References

American Association for the Advancement of Science (1990). *Science for all Americans*. New York :Oxford university press.

Barlia, L. & Beeth, M.E. (1999). *High school students' motivation to engage in conceptual change learning in science*. Paper presented at the annual meeting of the National Association for Research in Science Teaching, Boston, MA, March 28, 1999.

Blumenfeld, P. C. (1992). Classroom learning and motivation. Clarify and expanding goal theory. *Journal of Educational Psychology, 84* , 272-281.

Blumenfeld, P. C., & Meece, J. L. (1988). Task factors, teacher behavior, and students' involvement and use of learning strategies in science. *The elementary school journal, 88*, 235-250.

Boyle, R. A., Magnusson, S. J., & Young, A. J. (1993). *Epistemic motivation and conceptual change.* Paper presented at the meeting of the National Association for Research in Science Teaching, Atlanta, GA.

Brickhouse, N. W. (1998). Conceptual change in science and in the learning of science. In B. Fraser, & K. Tobin (eds.) *International handbook of science education (pp.1047-1066).* Dordrecht, The Netherlands: The Kluwer academic publisher.

Duit, R. & Treagust, D. (1998). Learning in science—From behaviorism towards social constructivism and beyond. In B. Fraser, & K. Tobin (eds.) *International handbook of science education (pp. 3-26).* Dordrecht, The Netherlands: The Kluwer academic publisher.

Duschl, R. A. & Hamilton, R. J. (1998). History and Philosophy of science in the science curriculum. In B. Fraser, & K. Tobin (eds.) *International handbook of science education (pp.1027-1046).* Dordrecht, The Netherlands: The Kluwer academic publisher.

Freedman, M. P. (1997). Relationship among laboratory instruction, attitude toward science, and achievement in science knowledge. *Journal of Research in Science Teaching, 34*(4), 343-357.

Haladyna, T., & Thomas, G. (1979). The attitudes of elementary school children toward school and subject matters. *Journal of Experimental Education, 48*(1), 18-23.

Hanrahan, M.(1998). The effect of learning environment factors on students' motivation and learning. *International Journal of Science Education, 20*(6),737-757.

Huang, T. C. , Aldridge, J. M., & Fraser, B. (1998). A cross-national study of perceived classroom environments in Taiwan and Western Australia: Combining qualitative and quantitative approaches. *Chinese Journal of Science Education, 6*(4), 343-362.

Lee, O. (1989). *Motivation to learning science in middle school classrooms. University Microfilms International.* Michigan State University Ph.D.

Lee, O. & Anderson, C. W. (1993). Task engagement and conceptual change in middle school science classrooms. *American Educational Research Journal, 30*(3), 585-610.

Lee, O., & Brophy, J. (1996). Motivational patterns observed in sixth-grade science classrooms. *Journal of Research in Science Teaching, 33*(3), 585-610.

Main, R.G. (1993) Integrating motivation into the instructional design process. *Educational Technology* , **33**(12) , 37-41

Martinez, M . E. & Haertel, E. (1991). Components of interesting science experiments. *Science Education, 75*(4), 471-479.

Matson, J. O. & Parsons, S. (1998). The nature of science: Achieving science literacy by doing science. In W. F. McComas (Ed.). *The nature of science in science education: Rationales and strategies (pp. 223-230).* The Netherlands: The Kluwer Publisher.

Nicholls. J.G.(1984). Achievement Motivation: Conceptions of Ability, Subjective Experience, Task Choices, and Performance. *Psychological Review, 91*(3), 328-346.

Nicholls, J. G., Nolen, S. B., Patashnick, M. (1985). Adolescents' theories of education. Journal of Educational Psychology, 77(6), 683-692.

Pintrich, P. R., Marx, R. W., & Boyle, R. A.(1993). Beyond cold conceptual change: The role of motivational beliefs and classroom contextual factors in the process of conceptual change. *Review of Educational Research, 63*(2), 167-199.

Reeve, J. (1998) Autonomy support as an interpersonal motivating style: Is it teachable, *Contemporary Educational Psychology*, 23, 312-330.

Scott, P. H. & Driver, R. H. (1998). Learning science through models and modeling. In B. Fraser, & K. Tobin (eds.) *International handbook of science education (pp.53--66).* Dordrecht, The Netherlands: The Kluwer academic publisher.

Strike, K. A., & Posner, P. J. (1983). On rationality and learning: A reply to West and Pines. *Science Education, 67*, 41-43.

Strike, K. A., & Posner, P. J. (1992). A revisionist theory of conceptual change. In R. A. Duschl & R. J. Hamilton (Eds.), Philosophy of science, cognitive psychology, and educational theory and practice (pp. 147-176). Albany: State University of New York Press.

Uguroglu, M. E., Schiller, D. P. & Walberg, H. J. (1981). A Multidimensional motivation instrument. *Psychology in the Schools. 18*, 279-285.

Von Glasersfeld, E. (1998). Cognition, construction of knowledge and teaching. In M.R. Matthews (Ed). *Constructivism in science education (pp. 11-30).* Dordrecht, The Netherlands: Kluwer academic publishers.

Weiner, B. (1990).History of Motivational Research in Education. *Journal of Educational Psychology. 82*(4),616-622.

West, L. H. T., & Pines, A. L. (1983). How "rational" is rationality? *Science Education, 67*, 37-39.

Wu, H. C. (1999). Ninth graders' motivation toward physical science learning. Unpublished master thesis at National Changhua University of Education.

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