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ABSTRACT

This study reported how four science teachers used action research to promote their students' motivation in learning physical science. Four teachers with one of their 8th grade physical science classes participated in the study. A combination of qualitative and quantitative research design were used in the study, and data collection included Students' Motivation toward Science Learning (SMTSL) questionnaire surveyed in the beginning, middle and at the end of the study, interview with students and teachers, and classroom observation. Findings of the study indicated that four teachers had their preference teaching methods in promoting their students' motivation. However, they still shared common teaching activities which included having lab activities, making science relevant to the experiences of students' daily lives, providing opportunities for students to work and discuss together, giving more praise for students' good effort, and accepting students' responses without criticizing them. Toward the end of the study, students' scores showed a significant difference (p<.05) between pre- and post-tests on SMTSL, particularly on self-efficacy and achievement goal scales. The study concludes that, although the content covered in 8th grader's physical science class became more abstract and difficult, teachers can still promote students' motivation in science learning with long periods of improving teaching effort. (Author)

Promoting Students' Motivation in learning physical science—An action research approach

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Abstract

This study reported how four science teachers used action research to promote their students' motivation in learning physical science. Four teachers with one of their 8th grade physical science class participated in the study. A combination of qualitative and quantitative research design were used in the study, and data collection included Students' Motivation toward Science Learning (SMTSL) (Tuan, Chin & Hsieh, 2002) questionnaire surveyed in the beginning, middle and at the end of the study, interview with students and teachers, and classroom observation. Findings of the study indicated that four teachers had their preference teaching methods in promoting their students' motivation. However, they still shared common teaching activities which included having lab activities, making science relevant to the experiences of students' daily live, providing opportunities for students to work and discuss together, giving more praise for students' good effort, and accepting students' responses without criticizing them. Toward the end of the study, students' scores showed significant difference ($p<.05$) between pre and post test on SMTSL, particularly on self-efficacy and achievement goal scales. The study concluded that, although the content covered in 8th grader's physical science became more abstract and difficult teachers can still promoted students' motivation in science learning with long period of improving teaching effort.

Keywords: motivation, science learning, action research, science teaching

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Promoting students' motivation in learning physical science—An action research approach

Objectives of the study

The goal of science education has shifted toward educating all students with scientific literacy instead of educating few elite to be scientists (AAAS, 1990). "Science for all" indicated that all students with different gender, racial, social status and ability have the equal opportunity to learn science. After schooling, all students can still grasp science knowledge, thinking ability, and willingness to learn and apply science in their future life. The basic assumption underneath the above mission is that students must have motivation to learn science in order to reach this promising goal. However, many researchers (Keller, 1983; Main,1993) have indicated students' decreasing curiosity, interests and motivation after they enrolled in school. In fact students' motivation would direct them in concept learning (Ogborn, Kress, Martins & McGillicuddy, 1996; Tuan, Chin & Hsieh, 2002). Students' decreasing motivation in science learning directly influenced on the effect of their science learning, thus consequently impetus them to become scientific literate citizen. Therefore, to find the feasible ways for helping students improve their motivation in learning science is an important area to study. Although previous studies (Tuan & Feng, 2002; Megan & Songer,2000; Paris, Yambor, & Packard, 1998) have studied how to improve students' motivation in science learning, these studies were mainly short term experimental study, and all the treatments were designed by researchers instead of teachers. In fact, teacher plays an important role in promoting students' motivation (Tuan & Chin, 2001) and curriculum reform. Therefore, it is important to know how science teachers promote their students' motivation in the natural setting. Based on the above rationale, the purposes of this study were to report how four science teachers promote their students' motivation in science learning and the students' motivation after one-year-long effort.

Theoretical framework

Motivation and Science Learning

Brophy (1998) integrated several motivation theories—behavior reinforcement, needs, goals, intrinsic motivation, expectancy theory to construct motivational principles and strategies for teacher to use in the classroom. In Brophy's motivational principles, he suggested that teachers should construct motivated learning environment; they should also addressed teaching strategies in the following areas: supporting students' confidence as learners, connecting with students' intrinsic motivation, motivating through extrinsic incentives and stimulating students' motivation to learn; teacher needs to adapt the needs of individual students; and finally teacher help themselves as a motivator. In creating the motivated learning environment, Brophy suggested that teachers need to: create a learning community where all the students can learn from each other and work cooperatively; teach students to understand, appreciate and apply the content knowledge; and try to attend students' expectance and value aspect of motivation. Based on Brophy's motivation strategies, it revealed that teachers need to create learning community, to address on students' confidence in learning, to pay attention to both intrinsic and extrinsic motivation, to stimulate students' desires to learn, and to meet students' needs. Besides Brophy, Keller (1983) proposed ARCS model for promoting students' motivation, which consisted of attention, relevance, confidence and satisfaction. Keller suggested that teachers should arouse students' expectation and learning goal, make content relevant to students, help students have confidence on their learning performance and finally made students' feel satisfy on their learning outcomes.

Many researchers (Brophy,1998; Kelly, 1983; Pintrich & Schunk, 2002) agreed that teachers' addressing on motivation strategies could help students to reach their goal in learning. Pintrich and Schunk (2002) defined motivation is "the process whereby goal-directed activity is instigated and sustained." (p.5). Thus, teacher's motivation strategies did not only address on students' affective domain; it also emphasized how to help learners learn meaningfully.

On the other hand, constructivist theories played dominating role in science learning. The assumptions of constructivist theory were that students play active role in engaging learning, and acquiring new experience to retrieve or revise their previous experience (Mintzes, Wandersee, Novak, 1998; von Glasersfeld, 1998). Therefore, teachers need to use students' previous learning experience appropriately in teaching new content knowledge. Only when teachers and students have similar goal in learning and teaching, then new learning will occur. von Glaserfeld (1998) indicated that when teachers create a circumstance which provide students successful experience with new conceptual model and the pleasure, they can motivate learners intellectually. The above positions of constructivist theory addressed the points that students' learning should be meaningful; teachers need to create learning environment to spark students' interests and needs to learn. If so, students' learning goal will match the curriculum goals. Moreover, teachers should also create learning community so that students can learn from each other.

Although motivation and constructivist theories originally have difference focus, motivation teaching strategies can accommodate constructivist teaching in addressing more on students' own needs (such as confidence, value, and expectance) in order to help students learning in a meaningful and joyful environment.

In this study, constructivist learning and motivation strategies were provided to the research teams. These two theories were used as the theoretical framework for science teachers to implement and improve their teaching.

<u>Dimensions of Science Learning Motivation</u>

Studies related to students' motivation in science learning can be categorized into four areas (Archer & Scevak, 1998; Hanrahan, 1998; Jagcinski & Nicholls, in press; Nicholls, 1984; Hwang & Tuan, 2001). The first area is students' conception of their effort and ability. That is concerned with how students treated their success in science learning, i.e. effort or ability. The second is students' learning goals. For instance, student's learning goals generally include competing with others, attracting teacher's attention, and improving their own ability. The third area is instructional environment created by teachers. These environments usually categorized into cold competitive and warmly acceptable learning environment. Ogborn, el al. (1996) found students consistently checking his/her learning environment in order to decide the extent of efforts they put in learning. Finally, factors influencing on students' motivation like students' own interests, goals and teachers, peers and parents' responses is the fourth area.

Tuan, Chin and Shieh (2002) used both quantitative and qualitative research methods to develop students' motivation toward science learning questionnaire (SMTSL). Based on factor analysis, and its correlation with science achievement score from the group of 1200 junior high school students, six constructs in students' motivation toward science learning were identified. These were self-efficacy, active learning strategies, science learning value, performance goal, achievement goal, and learning environment stimulation. In fact, these constructs not only reflected on the previous research done on the motivation field but also addressed on constructivist science learning. Therefore, these constructs and questionnaire will be applied in evaluating the outcome of this study.

<u>Studies in science learning motivation</u>

Although students' motivation had been an important field addressed in educational psychology, it was still young in science education. Reviewing literature done in the motivation related studies in science learning were not many (Lee, 1997; Lee & Brophy, 1996; Schoon & Boone, 1998; Tuan & Feng, 2002; Hwang & Tuan, 2001; Wenner, 1993). Generally, these studies addressed on revealing the characteristic of students' motivation in science classes (Lee, 1997; Lee & Brophy, 1996; Hwang & Tuan, 2001; Wu & Tuan, 2001), identifying the correlation between science knowledge and motivation (Stephans & McCormack, 1985; Schoon, & Boone, 1998; Wenner, 1993), and using experimental study to find out short term effect on students' motivation outcome (Tuan & Feng, 2002). Few studies investigated how teachers used action research in the natural setting and identified students' learning motivation outcomes. The following literature addressed results helpful for conducting this action research.

Tuan, Chin and Shieh (2000) investigated the characteristic of four classes with different abilities of 9th graders' motivation in learning physical science. Results revealed that students treated their failure in science learning to the effort they put instead of luck. Most of students held more extrinsic motivation—enroll in good school and please their parents-- to study physical science. Finally, both low and high achievers agreed that teachers' teaching could change their learning motivation. Similar results also found in Wu and Tuan (2000) study on one class of 9th graders with moderate ability, their motivation toward physical science learning.

Tuan and Chin (2000) investigated four classes 8th graders' motivation toward teachers' teaching, the results showed students preferred group discussion and the opportunities for them to design and conduct the experiments. In addition, Hwang and Tuan (2001) found students' motivation in learning science was enhanced if the teacher made science concepts related to daily life, provided hands-on activities for students to manipulate, and created the opportunities for group discussion on the content.

The above empirical findings and literatures provided both theoretical and empirical framework for this study to conduct an action research to promote students' motivation in science learning.

III. Design and Procedure

In order to reach the goal of this study, the action research was applied. A research team was formed which consisted of three graduate students, four case teachers (TA, TB, TC & TD) and two science educators. All the team members met every two weeks to study literature related to motivation (Brophy, 1998; Lee & Brophy, 1996; Keller, 1983), constructivist teaching, and previous empirical motivation studies (Hwang & Tuan, 2001; Tuan & Chin, 1999, 2000; Tuan, Chin & Shieh, 2000; Wu & Tuan, 2000). After reading the literature, teachers were encouraged to share the condition of their students' motivation, learning characteristic, and their own teaching strategies with other team members. Teachers also used brainstorming in designing lesson together. Researchers helped teachers to collect data to reflect their effort in promoting students' motivation.

Data collection procedures included both qualitative and quantitative data. For the quantitative part, SMTSL was implemented in the beginning, middle and at the end of the study. SMTSL was developed by Tuan, Chin and Hsieh (2002) which aimed to assess students' motivation toward science learning, the Cronbach Alpha for the entire questionnaire was 0.89, and for each scale ranged from 0.70 to 0.87. The questionnaire consisted of self-efficacy (SE, 7 items), active learning strategies (ALS, 8 items), science learning value (SLV, 5 items), performance goal (PG, 4 items), achievement goal (AG, 5 items), and learning environment stimulation (LES, 6 items). In this study, the Cronbach Alpha was re-analyzed as 0.83. Qualitative data consisted of weekly video-taping of class teaching for each class, semi-structured interview with students, interview with teachers and audio-taping team meetings.

Data analysis consisted of two parts. For quantitative data analysis, all the negative items were reversed, and MANCOVA was used to analyze the improvement of students' motivation after the action research. For the qualitative data, all the interview data and team meeting were transcribed verbatim. Researchers used analytic inductive methods to analyze various sources of data in order to identify the change of teachers' teaching. These data were also used to verify the quantitative findings.

Subjects

Among four science teachers, TA and TC were female teachers while TB and TD were male teachers. Both TB and TC taught at a same suburban school. TA taught at an urban school and TD taught at a rural school. Each teacher chose one moderate ability class to participate in the study. These classes would be labeled as CA (34 students), CB (31 students), CC (29 students), and CD (26 students) to represent TA, TB, TC and TD's classes.

Findings

The organization of this section was: firstly, to present the change of four teachers; secondly, to present the change of students' motivation along the studying period. In the beginning of the study, TA's teaching concentrated on classroom management, rote memorization, content coverage and dogmatic lecture. She addressed on students' mastery of science knowledge and achievement in science course. For instance, in reviewing students' quiz on the topic of density, there was one question stimulated from competence test. The content of the test was related to a graph showing the relationship between temperature and volume of water. Students needed to identify the density of water based on the graph listed in the test. TA used different formula to calculate the density of water under different temperature. TA said:

Let's look at [test] number 6... Did I tell you before one is peak another is valley (increase her *voice)... I had taught this item before, but you still made mistake. Your response really forced me to punish you. Pay attention to the board. Let me repeated it again (TA was mad and repeated the formula once more) (9.24.01)*

Toward the end of second semester, TA addressed on group discussion and hands-on activities, tried to make science more relevant to students' experience, and motivated them by providing extrinsic award for their good performance. For instance, TA let each group of students to report their thoughts on the worksheets in Pressure unit. Today TA praised the groups with good performance in previous lessons. TA tried to use different gifts which embedded science knowledge to students.

OK! Open your eyes, Ko-Ming Chen, your group behavior well, so you can get one point. In addition, you can get fluoresce stars, which you can post in your apartment. These stars will shine in the dark...She-Way Lu, this is magnifier, I want to give it to you (for your good performance).. Ming-Huang Yang, I think you are very serious on your study. Keep working hard. (11.29.02)

However at the end of the second semester, both students and TA faced the pressure from taking the competence test, and students would be re-assigned to different classes based on their academic performance. These situations made students thought traditional lectures were more efficient for them to perform better. However, such made the atmosphere of the classroom dull.

After analyzing TB's teaching for two semesters, it was found that TB's teaching highly addressed on cooperative learning. His teaching followed the patterns such as stimulation, posing questions, encouraging students to response, class discussion, the introduction and explanation of content knowledge. TB's teaching was very stable. Thus, he did not made dramatic changes as TA. However, during the researching process, TB increased the substance of both group discussion and whole class discussion by providing challenging questions and by designing good questions on worksheets. Usually in his class, students presented their reports frequently. In the presentation, TB and students asked questions back and forth. TB provided freedom for students to discuss content besides textbook. In order to enhance students' participation, he used bonus points to encourage students' proposing questions and possible answers without judging the appropriateness of the questions. After the first semester, TB incorporated the nature of science into his science teaching. He encouraged students to make inquiry and find out variety of information outside the class. TB tried his best to make science relevant to students' daily live and reduce his own emphasis on grades. The following excerpt is TB's talk in relation to his changes in teaching while research team meeting:

TB: Right now, when I am planning worksheets, I want my students to work cooperatively in exploring the potential questions embedded in the worksheet and try to find out the solution of the questions. [What I want to address] is inquiry ability... Although science can not always find the relevance to the daily life, you can find something related to science in the daily life. For instance, while teaching the topic of electricity, I tried to avoid the difficult calculation part, and tried to find relevant daily life events to electricity. (Meeting, 8.9.02)

TC's teaching was characterized as the traditional lecture in the beginning of study. She explained all the content knowledge in a very systematic and detail way. During the researching process, TC incorporated group discussion in her teaching. Although she provided opportunities for students to discuss on the group basis, TC always led the discussion and dominated the discussion. At the end of the lesson, she still explained the content knowledge in a detail way so that students would not loss any necessary science content. TC was very caring for students' grades because of the pressure for helping students enter good high school. However, unlike TA, who constantly addressed the importance of grade in the class, TC seldom mentioned about grade in the class. She carried the test pressure by herself only. Therefore, she would rather tell students all the detail content knowledge. When TC explained her role and teaching in the research team meeting, she said:

> *I think I did not give autonomy to my students in designing learning activities. Because when I led activities in the class, I still organized and integrated the information for students... There is still pressure for entering high school, therefore I am afraid that students could not do well on the test. I would rather lead many activities, organize the content covered in the textbook, indicate the important points, and helped underline the important points in the textbook for my students. (Meeting, 8.16.2001)*

To the end of the study, TC also increased the frequency of doing lab activities in the class to stimulate students' motivation. She followed the traditional way in conducing lab activities such as introducing the lab activities, explaining and demonstrating the procedures, having students to work on the lab by themselves, and explaining the results to students to verify science concepts covered in the textbook. In addition, TC also knew how to appreciate students' good work.

TD' teaching was traditional. He highly addressed on students' grade and seldom gave students opportunities to conduct lab activities. After he joined the research, TD quickly adapted cooperative learning strategies in his class, provided learning autonomy, created free learning environment, and increased the frequency of conducting lab activities for students. In doing lab activity, unlike TC who constantly monitored students' detail lab procedures, TD let students have all freedom to do the lab activities. For instance, in making soap activity, TD took students to the lab, and reminded students to watch the lab safety. Then students brought all kinds of oil from home, and tried their own ways in making soap. He expected students to be creative and challenged for their thoughts and also encouraged students to believe that they have ability in learning science. No matter students' responses to his questions were right or wrong, he would praise students for their participation and their creative ideas. Sometimes TD would reduce the learning difficulty by either covering less calculation part or using verbal explanation relevant to students' prior experience. TD never mentioned the importance of achieving good grade to his students.

When TD expressed his changes in science teaching while meeting with the research team, he said:

> *I apply cooperative learning in my class this semester. [Before this semester], I did not let students do lab activities very often [due to lack of equipments and students' misbehaviors]. But now, I gave students the opportunities to conduct lab activities. But I did not tell them the detail lab procedures. Both students and I had good time in doing lab activities... Before*

> *this year, I tried my best to tell students how to learn and how to do lab activities. Now, I gave them freedom to try out in the lab setting. I only asked them to watch their own safety. For instance, when students come to the lab, I told them there are salt, sulfur, and sodium hydroxide, you should watch the lab safety [then let students do all the experiment by themselves]. (Meeting, 3.2.01)*

Based on the above four teachers' action, they tended to create social constructivist leaning environment for students. Such environment was to be interwoven by group cooperation, discussion and negotiation among students and teachers. Among four teachers they had different degree of changing role from knowledge controller to facilitator. This kind of improvement matched Brophy's (1998) suggestion that teachers need to create cooperative learning community. The other common teaching strategies shared by four teachers were: making science relevant to students' life (Keller, 1983); having more opportunities for students to conduct experiments; and accepting students' all kinds of responses. These findings were similar to some previous researching results (Hwang &Tuan, 2001; Tuan & Chin, 2000), and matched Brophy's (1998) suggestion for improving students' interests and self-confidence in leaning science, too. However, although all four teachers seemed to use social constructivist as a framework in their teaching strategies, they had their own unique teaching strategies and teaching characteristic. For instance, four teachers all addressed on lab activities, but TA and TC were more toward verify science concepts, TB and TD were addressed on inquiry and knowledge construction. All four teachers used group discussion. However, TA and TC addressed on closed-ended questions, but TB and TD used open-ended questions. In terms of the teaching characteristic, TB established constructivist learning environment for students; TC addressed on experiment and discussion; TA decreased competitive learning atmosphere and TD emphasized optimal difficult content level for students.

In terms of four classes of students' motivation toward physical science learning during one year of study, the results were listed in Table I, II and III. Table I indicated that students' motivation toward science learning have increased gradually from pre-, mid- and post- tests. Although, in some scales such as science learning value, performance goal and learning environment stimulate, their mid- or post- tests were lower than their pre- tests. However these decreased scores did not show significant difference. In fact, students' entire motivation scores increased significantly between pre- and post- test ($p<.01$). Among six scales, students' self-efficacy (SE) changed significantly between pre- and post- test ($p<.01$). Students' achievement goal (AG) changed significantly between mid- and post- test; pre- and post- tests ($p<.01$). These results indicated that four teacher's teaching changes did improve students' motivation in science learning, especially on students' self-efficacy and achievement goal.

Table I: MANCOVA analysis on the entire SMTSL among pre, mid and post tests

SMTSL	No of Items	Pre test M/SD	Mid test M/SD	Post test M/SD	F	Pre-Mid (P-value)	Mid-Post (P-value)	Pre-Post (P-value)
SE	7	22.17/3.64	22.74/4.67	23.76/4.83	4.44 **	0.30	0.07	0.003 **
ALS	8	29.18/4.35	29.28/3.78	29.56/4.61	0.27	0.85	0.61	0.48
SLV	5	18.53/2.63	18.69/2.64	18.40/2.82	0.38	0.63	0.38	0.69
PG	4	14.30/2.57	14.35/2.711	14.47/2.74	0.16	0.86	0.72	0.59
AG	5	14.98/1.77	15.07/1.69	16.39/1.89	5.67 ***	0.67	0.001 ***	0.001 ***
LES	6	20.69/3.12	20.45/2.87	20.36/3.47	0.38	0.55	0.82	0.40
TOTAL	35	119.84/11.10	120.75/11.36	122.93/13.04	2.39	0.54	0.14	0.03**

(*, *P* value<0.05; **,*P* value<0.01; ***,*P* value<0.001)

Table II: MANCOVA analysis on four classes' total questionnaire among pre, mid and most tests

Entire SMTSL	Class	Pre-test M/SD	Mid-term M/SD	Post-Test M/SD	Pre-Mid (*P* -value)	Mid-Post (*P* -value)	Pre-Post (*P* -value)
Total	CA	114.23/12.41	121.74/11.52	119.68/16.87	0.006**	0.46	0.04*
	CB	125.12/10.45	121.58/11.57	125.21/11.98	0.22	0.21	0.98
	CC	122.84/8.89	120.39/9.86	124.55/10.78	0.40	0.15	0.56
	CD	118.15/7.96	118.85/12.86	122.69/10.75	0.83	0.21	0.14
F		7.99	0.39	1.29			
P value		0.000***	0.76	0.28			

(*, *P* value<0.05; **,*P* value<0.01; ***,*P* value<0.001)

Based on Table II, it revealed that among four classes, only CD has increased motivation gradually from pre-, mid- to post- tests. CA increased significantly from pre- to mid- tests (p<.01), but their motivation score decreased from mid- to post- test. When we interview students, they gave the following responses:

R: What's the purpose of studying physical science in the first semester?

SA1: For acquiring knowledge.

R: Why did you change your physical science learning purpose as getting good grade in the second semester?

SA1: There is pressure for entering high school.

SA2: I was very nervous for the competence test that was why I want to study for this examination. (Interview 5.24.02)

Both CB and CC classes decreased their motivation during mid- test but their post- test was increased. In fact, during mid- term interview, many students constantly mentioned that science content covered in the physical science were very difficult for them to learn. In analyzing students' textbook, the topics covered in physical science were: scientific methods, air, density, pressure. The abstractness and difficulty of content knowledge have been increased, thus reduced students' motivation. Our finding supported Tuan and Chin's (2000) previous findings on investigating 8th graders' motivation toward physical science learning. When researchers interviewed students in CB and CC, they showed intrinsic motivation and understand the value of learning physical science. Although students from both CA and CB aware of the pressure from the competence test, they still kept their intrinsic motivation and understanding the purpose of leaning physical science.

R: What's was the value in studying physical science?

S_{B1}: It can be used in daily life.

R: What else?

S_{B2}: It can make you thoughtful, and then you would want to find out why. I think physical science is very interesting course, especially we can conduct experiments. (Interview: 12.18.02)

R: Comparing with the first semester, could you evaluate your own changes in the motivation to learn science?

S_{B3}: I think my motivation has been increased.

R: Why?

S_{B3}: I think it is because of test [having good performance on tests] and curiosity. I [would] try to comprehend the questions. (5.24.02)

R: How did you learn in the lab setting?

S_{C1}: First, I need to know what I should do, and then know what kinds of equipments I need to use. When I conduct the experiment, I need to concern all kinds of variables and variance. After the experiment, I need to discuss the results and then try to find way to improve it (Interview, 12,27, 01)

In terms of TD, his students' motivation did not change during mid- test, however, in post- test, his students' motivation has been increased.

In fact, in the previous study Tuan and Chin (2000) found out students' motivation toward physical science dropped significantly after one-year regular teaching. However, in this study, based on the above findings, it could conclude that four teacher's changes in science teaching have helped students increase their motivation in learning physical science.

Table II showed the significant difference ($p < .01$) among four classes of students' motivation in the pre- test. It showed that four classes of students had different degree of motivation toward science learning. However, after teachers' improvement in teaching, four classes of students did not show any significance difference in the mid- and post- tests. These results again provided an empirical evidence to support the success of improving different students' motivation through action research by the efforts from four teachers.

Table III showed the results of further analysis on the subscales of SMTSL among four classes. In the pre-test, besides the significant difference of entire SMTSL among four classes (See Table II), three scales showing significant difference ($p<.01$) were active learning strategies (ALS), science learning value (SLV) and learning environment stimulation (LES). ALS showed CB > CC > CD > CA; SLV showed CB > CC > CD > CA; and LES showed CB > CC > CD > CA. These results revealed that CB and CC have higher motivation than CA and CD in the pre test. In the mid- test, there was no significant difference for the entire SMTSL and six scales among four classes.

In the post- test, although there was no significant difference for the entire SMTSL, there were significant differences ($p<.05$) in two scales: performance goal (PG) and learning environment stimulation (LES). PG showed that CA > CC > CD > CB. The reason behind these results was probably because TA and TC highly focused on students' achievement, and competence test. However, TA expressed these issues to her students directly; TC put pressure on herself. Thus their students changed motivation from competing with other students to caring about their own understanding and own performance.

Table III: MANCOVA analysis on pre, mid and post SMTSL tests among four classes

		SE (M/SD)	*ALS (M/SD)*	*SLV (M/SD)*	*PG (M/SD)*	*AG (M/SD)*	*LES (M/SD)*
Pre-Test	CA	21.33/4.03	26.93/5.10	17.53/2.66	14.83/2.06	14.68/1.97	18.95/3.52
	CB	23.48/3.46	31.03/3.27	19.67/2.46	13.52/3.25	14.91/1.67	22.52/2.41
	CC	22.34/3.47	30.50/3.48	18.94/2.68	14.28/2.20	15.53/1.68	21.25/2.51
	CD	21.59/3.12	28.70/3.77	18.15/2.18	14.48/2.62	14.85/1.63	20.37/2.54
		2.48	7.67	4.83	1.65	1.51	10.08
	P	0.06	0.000***	0.003**	0.18	0.22	0.000***
Mid-Test	CA	22.79/5.02	29.35/3.59	19.09/2.64	15.38/2.30	15.18/2.29	19.94/3.06
	CB	22.82/4.08	29.88/3.76	18.55/2.62	13.79/2.93	15.21/1.27	21.33/2.62
	CC	22.68/4.86	28.90/3.71	18.39/2.56	14.26/2.19	15.39/1.17	20.16/2.58
	CD	22.65/4.95	28.88/4.25	18.73/2.81	13.85/3.18	14.38/1.68	20.35/3.14
		0.01	0.47	2.53	1.95	1.54	0.39
	P	0.99	0.70	0.06	0.13	0.21	0.76
Post-Test	CA	22.59/6.34	28.27/6.32	18.05/3.61	15.59/2.49	16.16/2.29	19.00/4.11
	CB	24.48/4.13	30.30/4.04	19.00/2.44	13.76/2.86	16.06/1.62	21.61/3.07
	CC	24.09/4.28	30.30/3.35	18.42/2.56	14.52/2.20	16.67/1.81	20.55/2.72
	CD	24.00/3.91	29.50/3.74	18.16/2.38	13.88/3.06	16.69/1.71	20.47/3.32
		1.04	1.56	0.76	3.52	1.01	3.56
	P	0.38	0.20	0.52	0.02*	0.39	0.02*

(*, *P* value<0.05; **,*P* value<0.01; ***,*P* value<0.001)

The above findings in this study revealed that different teachers' teaching strategies influenced students' different motivation dimensions. TA addressed on extrinsic award, so her class (CA) increased their motivation dramatically in the mid- test. Though, at the end of the second semester, when students aware of the testing pressure from taking competence test, their motivation dropped quickly in the post- test. TB, TC, and TD were much more addressed on students' intrinsic motivation, so their students' motivation increased gradually through research period without being influence by testing pressure.

Conclusion

Based on year long action research, this study found that four science teachers preferred using social constructivist, such as providing group discussion, negotiation, and cooperation in the class, to promote students' motivation. Besides group works, they also increased the opportunities for students to conduct lab activities. Although teachers have such commonality, they also showed different preference in promoting students' motivation in their classes.

In terms of students' motivation outcomes, the study found out students do increase their motivation toward science learning significantly at the end of the year study, especially on self-efficacy and achievement goal. In other words, at the end of the study, students improved their perceptions on their ability and confidence in learning science. Although this study found out two factors impetus 8th grader's motivation in learning physical science, the increasing content difficulty, and the pressure for taking competence test, our study showed that four classes of students initially with different motivation turned out to improve their motivation in leaning physical science. Thus, finding of this study reconfirmed that as long as teachers put efforts in their teaching, they can improve students' motivation in learning science.

Finally, this study also found out teachers' teaching preference interacted with students' needs which caused different degree of improvement in motivation. This is why some classes showed significant improvement while others were not. However, this study did not provide evidence on the detail and specific interaction between teacher's teaching and students' needs. Future studies need to investigate in this area.

References

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

Archer, J. & Scevak, J. J. (1998) Enhancing Students' Motivation to Learn: achievement goals in university classrooms. *Journal of Educational Psychology, 18*(2), 205–233.

Brophy, J. (1998). Motivating students to learn. Boston: McGraw-Hill Company.

Lee, O. (1997). Diversity and equity for Asian American students in science education. Science Education, 81, 107-122.

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

Hwang, S. C. &Tuan, H. L. (2001). Investigation of the relationship between teacher's science teaching strategies in relation to students' motivation. *Science Education (in Chinese), 11*, 1-15.

Keller, J. M. (1983). Motivation design of instruction. In C. M. Reigeluth (Eds.), *Instructional-design theories and models: An overview of their current status.* Hillsdale. NJ: Lawrence Erlbaum Associates.

Lee, O., & Brophy, J. (1996). Motivational Patterns Observed in Sixth-Grade Science Classrooms. *Journal of Research in Science Teaching, 33*(3), 303-318.

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

Mintzes, J. J., Wandersee, J. H., & Novak, J. D. (1998). *Teaching science for understanding.*

Orlando, FL: Academic Press.

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

Ogborn, J., Kress, G., Martins, I. & McGillicuddy, K. (1996). *Explaining science in the classroom.* London: Open University Press.

Paris, S. G.,Yambor, K. M. & Packard, B. W. (1998). Hands-on biology: a museum-school-university partnership for enhancing students' interest and learning in science. *The Elementary School Journal, 98* (1), 267-88.

Pintrich, P. R. & Schunk, D. H. (2002). *Motivation in education (2nd edition).* Upper Saddle River, New Jersey: Pearson Education, Inc.

Schoon, K. J. & Boone, W. J. (1998). Self-efficacy and alternative conceptions of science of preservice elementary teachers. *Science Education, 82*, 553-568.

Tuan, H. L. & Chin, C. C. (2000). An action research of promoting students' motivation toward physical science learning. Final report for National Science Council. (NSC 89-2511-S-018-030)

Tuan, H. L., Chin, C. C. & Shieh, S. H. (2002). *The development of a questionnaire for assessing students' motivation toward science learning.* Paper presented at the National Association for Research in Science Teaching, April 7-10. San Louis, USA.

Tuan, H. L., Chin, C. C., & Shieh, S. H. (2000, April). *Students' motivation toward learning physical science- A case from four classes of Taiwanese students.* Paper presented at the National Association for Research in Science Teaching, April 28 to May 2, New Orleans, Louisiana.

Tuan, H. L. & Feng, S. L. (2002). Using ARCS Model to promote 11th graders' motivation in learning acids and bases. Paper presented at third International Chemical Education Conference. Pei-King, China.

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.

Wenner, G. (1993). Relationship between science knowledge levels and beliefs toward science instruction held by preservice elementary teachers. *Journal of Science Education and Technology,* 2, 461-468.

Wu, S. J. & Tuan, H. S. (2000). A case study of students' motivation in a ninth grade's physical science class. In Fisher, D. & Yang, J. H. (Ed.) *Proceedings of the Second International Conference on Science, Mathematics and Technology Education* (pp. 341-350). Taipei, Taiwan.

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