THAI SECONDARY SCHOOL SCIENCE CLASSROOMS: CONSTRUCTIVIST LEARNING ENVIRONMENTS

(Sub-theme-6: The Future School)

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1. ABSTRACT

This paper describes the first study conducted in Thailand (2002-2003) that resulted in changes in science teachersô classroom environments. In the first phase of the study, the Constructivist Learning Environment Survey (CLES), an instrument for assessing studentsô perceptions of the actual and preferred classroom environment through the constructivist perspective, was validated for use in Thailand. Second, typical Thai secondary school science classroom environments were described using quantitative and qualitative methods. Finally, the effectiveness of constructivist teaching in promoting improvement in classroom environments was evaluated through an action research process, involving the use of feedback on actual and preferred classroom environments. The sample consisted of seven secondary science teachers and their 17 classes of 606 students in Nakornsawan Province, Thailand. Student Actual and Preferred Forms of the CLES, assessing Personal Relevance, Uncertainty, Critical Voice, Shared Control and Student Negotiation, were administered. Factor analysis and internal consistency measures supported a five-factor structure for both actual and preferred forms. Studentsô attitudes to science were also measured. The actual and preferred environments of different classes were described based on profiles of classroom environment scores. A number of teachers then participated in an attempt to improve their classroom environments, through the use of a constructivist teaching approach. Changes in classrooms did occur, thus supporting the effectiveness of constructivist teaching in improving learning environments and studentsô attitudes towards science in Thailand.

2. INTRODUCTION

Today, the achievement of a positive classroom environment is a valuable goal for education [1]. The curriculum of schools and universities consists ñnot just of content and outcomes, but also of classrooms where the business of learning takes placeò [1, p. vii]. At the global level, UNESCO has proposed its 2000 Project [2] to encourage countries around the world to provide science education for all people in order to let them have sufficient science knowledge to be able to live with happiness and safety in this age of globalization.

Similar to the UNESCOôs goal, is a statement in section 81 of the Thai National Constitution B.E. 2540, on the on role of science, which states that; ñThe government must pay great attention to developing science and technology in order to develop the countryò (p. 23). To reach such a goal requires strong development in science education.

In addition, the latest Thai National Education Act of B.E. 2542 [3, p. 12] section 22 states that:

> Education shall be based on the principle that all learners are capable of learning and self-development, and are regarded as being most important. The teaching-learning process shall aim at enabling the learners to develop themselves at their own pace and to the best of their potential.

Furthermore, some parts of section 23 go on to note that Thai science education needs to focus on scientific and technological knowledge and skills, as well as knowledge, understanding and experience in management, conservation, and utilization of national resources and the environment, in a balanced and sustainable manner.

Although teaching and learning in Thailand, particularly in science classrooms, tries to follow the above important principles, there are still problems. The low quality of provided education is one of the current critical problems in Thailand. Actual practices in classrooms have been dominated by teacher-centered and lecture-type instruction. One significant research study of the Thai Ministry of Education has shown that Thai students at grade 12 can pass only one of eight subjects in the examination with a score of more than 50% [4]. So, it can be said that the quality of education in the upper secondary school level is not good and should be improved, particularly in science and mathematics.

In order to overcome this critical problem, recent national education reform movements in Thailand have been grounded in a constructivist approach to learning. That is, students should find personal relevance in their studies, share control over their learning, feel free to express concerns about their learning, view science as ever changing, and interact with each other to improve comprehension [5, 6].

Constructivism has become a leading theoretical position in education and has become a powerful driving force in science education [7, 8]. The appeal of constructivism is that it provides a plausible, functional framework for understanding and interpreting experiences of learning and teaching. In this way, constructivism acts as a powerful theoretical referent ñto build a classroom that maximizes student learningò [9, p. 7). Furthermore, constructivism also has had a strong impact, internationally, on the educational field for over 20 years. In particular, science educators have been concerned with teaching strategies based on the notions of constructivism in an attempt to enhance students' conceptual understanding in science subjects. In many cases, these notions have been utilised as basic frameworks to reform traditional educational practices.

Fraser [10] noted that students spend a great amount of time (more than 15,000 hours) in the classroom environment. Therefore, he argued that the quality of the environment of these classrooms has a significant impact on studentsô learning. Classroom environments involve the shared perceptions of the students and teachers in a particular environment [11]. Although the concept of classroom environment is subtle, much progress has been made in conceptualising it, measuring and analysing it, and mapping its effects on students [11, 12, 13, 14]. Studies have indicated that studentsô perceptions of their classroom learning environments affect studentsô cognitive and affective outcomes [10, 11, 12, 13, 14]. Also, students have been found to achieve better in the types of classroom environments which they prefer [15, 16].

Several different classroom environment questionnaires have been devised for assessing classroom environments [17]. Examples of these include the *Constructivist Learning Environment Survey* (CLES) [5, 6] and the *What Is Happening In This Class* (WIHIC) [18, 19]. Many of these questionnaires are available in an Actual Form that measures perceptions of the actual classroom and a Preferred Form that measures perceptions of the ideal or desired classroom environment. Using both Actual and Preferred Forms of educational environment instruments permits exploration of whether students achieve better when there is a higher similarity between the actual classroom environment and that preferred by students [20]. By using this person-environment interaction framework, it is possible to investigate whether student outcomes depend, not only on the nature of the actual classroom environment, but also on the match between studentsô preferences and the actual environment [21, 22]. The practical implication of the findings is that class achievement of certain outcomes might be enhanced by attempting to change the actual classroom environment in ways, which make it more congruent with that preferred by the class. This study used the student actual and preferred forms of the CLES to assess the science classroom environment.

The Constructivist Learning Environment Survey (CLES) [6] was developed based on constructivist learning principles to investigate studentsô perceptions of their learning environments from constructivist views and to assist teachers to reshape their teaching practice. Initially, Taylor (1991) constructed this instrument based on social and personal notions of constructivism whose main concerns are to enhance studentsô conceptual understanding. Through an extensive and rigorous process, this version was found to be valid and reliable for use within classroom situations. However, the developers concluded that this version did not include some important points. Therefore, they elaborated and revised the CLES by adding notions of radical constructivism and critical theory [6]. This new version was thought to be useable with a wide range of samples, including different subjects and year levels and has five six-item scales, namely, Personal Relevance, Uncertainty, Critical Voice, Shared Control and Student Negotiation. This 25-item version was used in the present study. Table 1 provides a description of each of these scales together with a sample item.

Two forms of the CLES, the Student Actual and Student Preferred [24], were adopted to gather studentsô perceptions of science classrooms. Although item wording is almost identical in the Actual and Preferred Forms, words such as óI wishô were included in the Preferred Form to remind students that they were rating their preferred or ideal classroom, rather than the actual classroom environment. For example, the statement, "In this class, I learn about the world outside of school" in the Actual Form of the CLES is changed in the Preferred Form to, " In this class, I wish that I learned about the world outside of school".

This study is timely and valuable due to the importance of constructivist teaching in influencing classroom environments. It also adds needed research data on constructivist teaching and its influence on studentsô perceptions of their classroom learning environments in Thai upper secondary school science classrooms. Because of the critical needs in Thai education to develop science teaching and learning in all schools, especially at the upper secondary level, this research is also useful for showing ways in which teachers can use constructivist teaching to improve classroom environments in the hope of facilitating improved studentsô academic achievement.

Table 1
Scales and Sample Items for the CLES

Scale Name	Description	Sample Item
Personal Relevance	Relevance of learning to studentsô lives	In this class, I get a better understanding of the world outside of school.
Uncertainty	Provisional status of scientific knowledge	In this class, I learn about the world outside of school.
Critical Voice	Legitimacy of expressing a critical opinion	In this class, it's OK for me to ask the teacher "Why do I have to learn this?"
Shared Control	Participation in planning, conducting and assessing of learning	In this class, I help the teacher to plan what I'm going to learn.
Student Negotiation	Involvement with other students in assessing viability of new ideas.	In this class, I explain my ideas to other students.

3. METHODOLOGY

Aim and Objectives of the Study

The overall aim of this research study was to determine whether teachers can use constructivist teaching through an action research process in order to improve their classroom environments. This study attempted to answer the following four research questions:

1. Is the Constructivist Learning Environment Survey (CLES) a valid and reliable questionnaire for use in Thailand?
2. What are studentsô perceptions of their actual and preferred learning environments from a constructivist perspective?
3. Are teachers able to make use of learnersôresponses to the CLES to improve their own classroom learning environments?
4. Does constructivist teaching improve studentsô attitudes towards science learning activities and self-efficacy?

Research Design

This study was divided into three phases, namely, the validation of the CLES in Thailand, its use in describing science classroom environments in Thailand, and the effectiveness of constructivist teaching on improving classroom environments. The methodology used to answer the research questions was a multi-method approach utilizing both quantitative and qualitative methods. Four measures were employed to obtain an understanding of studentsô perceptions of their constructivist science classroom learning environment: survey, interviews, observations and case- study approach. The questionnaires provided quantitative data to answer the research questions. Classroom observations and student interviews were then used in order to explain and clarify the quantitative data.

Two questionnaires were chosen for use in this research study. The first one was the Constructivist Learning Environment Survey (CLES) [6] used for investigate studentsô perceptions of their learning environments through

constructivist views. The second one was an *Attitude Questionnaire* consisting of two scales. One scale was Attitude to Science Learning Activities [25] and the second scale was Self-Efficacy [26]. All instruments were translated from the English version into a Thai version for use in science classes in Thailand, following a back-translation procedure.

Phase One

The purpose of this phase was to validate the Thai version of the CLES in both Student Actual and Preferred Forms in order to answer the first research question. The total sample comprised 606 upper secondary school science students in 17 different classes from Nakornsawan Province in Thailand.

Phase Two

The Actual and Preferred Forms of the CLES in the Thai version were administered to the above sample in order to obtain a general image of Thai secondary school science classes. The collected data were used to determine what are studentsô perceptions of their actual and preferred learning environments from a constructivist perspective. Furthermore, scale scores from the studentsô average actual and average preferred forms of the CLES questionnaires were tabulated and reported to each teacher in a graphic format. These charts included comparisons of student actual and preferred environment.

In addition to the questionnaire, interviews and observations were also used. Several students from the sample were interviewed to complement the quantitative findings from the survey in a semi-structured manner. For instance, interview questions were based on the questionnaire items and were slightly rephrased to make it easier for interviewees to respond.

Based on the teachersô willingness to participate, three classes from different schools were selected for observation which was done by the researcher. An unstructured approach, referred to as óparticipant observationô, was used by the researcher. The observations served to crystallise a comprehensive image of constructivist classrooms. Furthermore, observations were used as a means of ethnographic inquiry where by the natural setting was the classroom. Observations were also used to examine aspects which might have been missed using the survey and interview methods. During observations, data were collected in the form of field notes.

Phase Three

This phase involved answering the third and fourth research questions whether teachers could make use of learnersô responses to the CLES to improve their own classroom learning environments and whether constructivist teaching can improve studentsô attitudes towards science learning activities and self-efficacy. In this phase, four methodologies (survey, interviews, observations and case studies) were employed. At the same time as they responded to the two versions of the CLES, students responded to the Attitude Questionnaire to assess studentsô learning outcomes on the attitude dimension.

Three case-study teachers, all of whom were female, were invited to improve their classroom environments. Each of these teachers chose one of her classes that she believed needed a better classroom environment. Based on the results obtained from the Actual and Preferred Forms of the CLES, each teacher developed an action plan in an attempt to alter her own classroom environment. The teachers agreed to follow the methodology for promoting change used in prior learning environment studies [27, 28, 29] which involved:

1. assessing the studentsô actual and preferred classroom environments;
2. providing the results to the teacher and assisting the teacher in making action plans to improve teacherôs own classroom environment;
3. collecting qualitative data from students about the class, activities and the teacher;
4. holding weekly individual meetings with the teacher concerning class occurrences and specific techniques that could be used in an attempt to change the actual environment; and
5. re-assessing the studentsô actual environments.

Each teacher selected an area of specific concern, based on the differences between the scale means of the studentsô actual and preferred scores from the CLES, and the discussion with the researcher, to design a plan of action for improvement. The researcher visited each class about once a week during the semester prior to the posttest at the end of the semester, in order to observe classes and interview the students. Teachers were assisted by the researcher who acted as a coach in implementing constructivist teaching in their classrooms. All students completed the Student Actual version of the CLES as a posttest. The results were analysed by the researcher who presented them to each teacher privately for discussion and possible explanations. Students also were asked to complete the Attitude Questionnaire as a pretest during the fourth week of the school term, and as a posttest two weeks before the end of the school term. Students were requested to include their names on the questionnaires so that the researcher could choose students, who had interesting and/or extreme views, for interview in which they could elaborate and explain their answers.

During each classroom visit, the researcher interviewed up to five students about his/her learning activity, both in and out of class. A different student was chosen each time, and the data collected from these interviews served as an additional source of data to enrich the description of what was occurring in the classroom. The interviews were done in a face-to-face approach.

Observations of science lessons in the case study teachesô classrooms were employed to gather information about the constructivist classroom environments and studentsô perceptions of their learning activities and self-efficacy which might have been missed during the survey and interviews. The selecting of specific lessons for observation was done weekly or bi-weekly depending on the teacherôs willingness.

4. CONCLUSION

In the first phase of the study, the Constructivist Learning Environment Survey (CLES), an instrument for assessing studentsô perceptions of the actual and preferred classroom environment through the constructivist perspective, was validated for use in Thailand. Second, typical Thai secondary school science classroom environments were described using quantitative and qualitative methods. Finally, the effectiveness of constructivist teaching in promoting improvement in classroom environments was evaluated through an action research process, involving the use of feedback on actual and preferred classroom environments. The sample consisted of seven secondary science teachers and their 17 classes of 606 students in Nakornsawan Province, Thailand. Student Actual and Preferred Forms of the CLES, assessing Personal Relevance, Uncertainty, Critical Voice, Shared Control and Student Negotiation, were administered. Factor analysis and internal consistency measures supported a five-factor structure for both actual and preferred forms. Studentsô attitudes to science were also measured. The actual and preferred environments of different classes were described based on profiles of classroom environment scores. A number of teachers then participated in an attempt to improve their classroom environments, through the use of a constructivist teaching approach. Changes in classrooms did occur, thus supporting the effectiveness of constructivist teaching in improving learning environments and studentsô attitudes towards science in Thailand.

5. DISCUSSION

The CLES questionnaire which was proved to be valid and reliable of for use in Thailand could be used by Thai science teachers and researchers to conduct further investigation leading to improvements in science classroom environments and consequently studentsô achievement in science. Moreover, it was found that the CLES took little class time to administer and could be quickly hand-scored. It is also possible to design and use a CLES score sheet which can be scored via the computer. The CLES is easily accessible, inexpensive, reliable, and easy to score and interpret making it of considerable value to classroom teachers.

It is also noteworthy that students perceived that their science classes *Sometimes* and *Seldom* reflected constructivist aspects, with the average item mean ranging from 2.01-3.28 (a mean of 3 and 2 corresponds to *Sometimes* and *Seldom*. The mean score of Personal Relevance, Uncertainty and Student Negotiation is close to 3.0, which suggest that the learning environment in science classrooms of Thailand emphasises relevance to everyday life, inquiry-centred learning, and student negotiation. In the case of *Shared Control* and *Critical Voice* students perceived that their science lessons are slightly more than *Seldom* but close to 2 in both cases. This suggests that Thai students perceived that their teachers were not sharing aspects of learning science with their students and students do not

often express their thoughts and criticisms about their learning and how it might be improved. They also suggested that social interactions have an effect on the classroom environment, but that this positive effect is not great enough to change traditional science classrooms into highly constructivist-oriented ones. The finding implies that Thailand needs more teacher development programs, particularly those regarding teachersô readiness to implement a new science curriculum based on constructivist principles, for improving science learning environments.

The findings confirmed that teachers are able to make use of learnersô responses to the CLES to improve their own classroom learning environments. Therefore, teachers who receive support and training can consider studentsô views about their classrooms and improve their classroom environments. Consequently, teachers can develop and apply their own plans to induce classroom environment changes based on their studentsô actual and preferred CLES results. The CLES results can remain confidential or teachers are able to compare their results with other teachers or educators in an attempt to receive professional opinions concerning ways to change what they are dong. After a desirable time, the teachers can reassess their environments with the CLES and compare the information with that in the previous assessment to see if their applied methods do improve their classroom environment.

It is highly desirable to combine quantitative and qualitative methods in future research in Thailand, as was done in this study. Recently, increasing numbers of classroom environment studies are using both quantitative and qualitative methods in the same study [30, 31]. While quantitative methods involve predetermined classroom environment constructs, qualitative research makes assertions to highlight some salient aspects of classroom environment that emerge during the study [31]. In this way, the highly complex nature of a study in which teaching and learning takes place is maintained and data are not lost. In addition, data from qualitative methods help to explicate trends and patterns that arise from quantitative methods.

Longitudinal studies involving teachers who routinely use a constructivist teaching approach could also provide interesting data. The research topics could be about changes in teachersô beliefs, attitudes and teaching behaviours in implementing constructivist teaching in their classrooms.

Since the learning reform in Thailand related to the Thai National Education Act of B.E. 2542 [3], this is the first study exploring the effectiveness of constructivist teaching approaches in improving science classroom learning environments. An unique feature of this study is that it is an attempt to understand and demonstrate how teachers used constructivist teaching approaches to improve their own classroom environments. The findings hold special interest for the science teachers of secondary schools where the study was conducted, because the study encouraged teachers to improve their psychosocial environment.

The experience of the researcher would indicate that a great deal of sensitivity must be shown to teachers in any schools when using the instrument. Clearly, if teachers want changes to occur, before the instrument is used, they must understand what are some of the expected outcomes, why studentsô accurate responses are required, what responsibility they will have, and what processes will be set up to interpret data and develop strategies for classroom improvement. When strategies they had are used in their classrooms, they should pay more attention on them.

It may be possible to successfully implement constructivist teaching approaches and the CLES in science classrooms if there is a more coordinated effort among Rajabhat Institutes or universities, school teachers, schools and the community. Rajabhat Institutes or universities should have the capability to train preservice and inservice science teachers to implement constructivist teaching approaches consistent with the CLES and the model for improving the classroom learning environment and studentsô learning outcomes. Also, with the teachersô own willingness and support given by the school and community, it is hoped that science teachers will use a constructivist teaching approach and the CLES to improve their science classroom environment, studentsô academic and attitude outcomes.

6. REFERENCES

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