Best management practice for understanding learning in sustainable water resource management (WRM) for secondary science teachers in Thailand

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The aim of this study is to investigate the effects of training teachers to enhance their students’ achievements in water resource and disaster course and to compare the effects of using the curriculum framework between training teachers or using curriculum framework in the secondary schools in Khon Kaen Province of Thailand. It was found that the 28-science teachers were able to manage their learning units and lesson plans on WRD. Statistically significance was differentiated between participating teachers and non participating teachers at .01 confidence levels (p < .01). Significant differences in students' achievements between the controlled and experimental groups were found.

Key words: practice, learning, water resource, management, science teacher.

INTRODUCTION

Teaching practice is the most important part of teacher training administrations for teachers who are going to prepare themselves for teaching. It should be the central focus and students’ center for learning that should be followed as the educational Thailand system to reform the education system, pivot professional training (The Ministry of Education, 2002). Teacher training is the practical aspect of teacher trainees and it is an assortment of factual and dramatic characteristics. During the teaching practice, teachers find an opportunity to use the acquired knowledge, to emphasize on water resource management, especially in the areas of their natural flood plain and disaster, and to polish teaching methods, teaching principles and teaching techniques. The most critical environmental problem that Thailand is facing presently is water pollution. Despite the annual southwest monsoon, Thailand is subject to drought, particularly in the northeastern region. As of 2002, Thailand had less available water per person than any other countries in Asia, and nearly one third of its water was “unsuitable for human consumption.” Inconsumable water was also a result of increasing untreated domestic sewage, industrial wastewater and solid hazardous wastes (ThailandOutlook.com, 2007).

Water should be considered an exhaustible resource because it is indispensable for human activities, food security and ecosystems, as well as for national economics. Unplanned uses of water can have
considerable negative impacts on humans and the environment. Uses of water include agricultural, industrial, household, and environmental activities. As much as 97% of the Earth’s water is salt water with only 3% fresh; and slightly over two thirds is frozen in glaciers and polar ice caps (United States Geological Survey, 2005). The remaining unfrozen fresh water is found mainly as groundwater with only a small fraction present above ground or in the air (GreenFacts Website, 2008).

On top of the environmental problem of water pollution is drought. Humans have coped with natural disasters affecting their well-being and future development. In the Asia-Pacific region, past natural disasters have included the tropical cyclone that swept Haiyan in the Philippines in 2013; the Great East Japan Earthquake in 2011 and its associated crippling tsunami; and the severe floods in Thailand in 2011. In 2011 alone, economic losses from global disasters amounted to US $366 billion with 80% occurring in the Asia-Pacific region (Centre for Research on the Epidemiology of Disasters (CRED), 2012).

After floods that inundated Bangkok in 1995, Thailand’s King Bhumibol Adulyadej proposed the building of a large network of canals on the outskirts of the capital that would lead to huge holding areas for water runoff called “monkey cheeks”. The project was never followed through, however, by successive governments. Following severe mass floods in Thailand in 2011, on Monday 5th of December and in a rare public appearance, King Bhumibol Adulyadej marked his 84th birthday by calling for an end to political conflicts. He asked his subjects to work together to help the millions of people affected by floods that had devastated the country. The government recruited water experts to serve on a committee that was tasked with devising a new water-management system for the country to try and ensure such a disaster would not be repeated. The Prime Minister claimed that all of Bangkok would be dry by the beginning of 2012, but many factories would not be operational for several months. Economic growth for 2011 was forecast at over 4% but is now expected to be only between 1.2 and 1.5% (Time News, 2014).

It is imperative to manage risks in water resources to alleviate damage, the consequences of natural disasters such as flooding and drought, and to increase agricultural production in order to ensure food security for the country. Understanding the types of risk in each area can help planers select appropriate policies and actions to be applied in order to reduce risks and mitigate damage. Thailand has frequently suffered from flooding during the monsoon season and from droughts in summer, or even from both in particular areas.

The continued increasing exposure and greater losses associated with disasters demands a better understanding of their complex nature and common causes namely hazards, exposure, vulnerability and resulting risks. Many natural disasters that have occurred in Thailand have resulted in loss of life and economic damage. Most have been storm- and flood-related, while man-made disasters have also caused great losses (ADPC News, 2014). As for the Northeastern region of Thailand, the great flood spread throughout 20 provinces, for example, in Khon Kean province in the flood plain area of the Chi and Nam Phong rivers. Water streams overflowed and covered wetland district areas, such as Muang, Ubon Rattana, Chonnabot, Wang Yai, Wang Noi, and Manjakili Districts, resulting in destroyed rice fields and agricultural areas covered with huge acres of water. The people and their families who lived at the back of the Ubon Ratana Dam were forced to move into the hills or to higher ground temporarily and many schools were forced to close.

LITERATURE REVIEW

The last decade, in particular, has seen the development and reform of Thailand’s education system with the government changing the Basic Education Core Curriculum of 2008. Schools were asked to revise their curriculum aligning it with the Basic Education Core Curriculum. They were able to create additional courses relevant to their school mission and local area, for example, teaching about the natural resources of their surrounding environments, local water, minerals or forestry sources (The Center of Khon Kaen News, 2011). Local strands are in accordance with the community and local needs. However, some schools have faced problems trying to integrate local curriculum strands into their curriculum and teaching due to teachers’ insufficient knowledge for designing curricula and appropriate instruction.

In formal education, a curriculum constitutes the planned interaction of students with instructional content, materials, resources, and processes for evaluating the attainment of educational objectives. This process includes the use of knowledge, skills and attitudes that are interwoven, through the use of digital media and/or texts that address the complexities of learning (Kerr, 2009).

A curriculum also outlines the skills, performances, attitudes, and values students are expected to gain from schooling. It should include the content of courses (the syllabus), the methods employed (strategies) and other aspects such as school organization. Courses should be arranged in a sequence to make student learning easier. A curriculum normally spans several grades and can refer to entire programs provided by a classroom, school, district, state, or country. A classroom is assigned sections of the curriculum as determined by the school (Nairs and Fisher, 2001).

Secondary education in Thailand aims to improve the quality of life of learners and serves as the basis for further education. It aims to: (a) help learners discover
their own abilities, aptitudes and interests; (b) provide a
general education as the basis for securing honest
occupations or further education; and (c) respond to the
needs of the localities and the nation as a whole. Based
on these aims, the curriculum designed by the Ministry of
Education aims for learners to develop the following
characteristics: knowledge and skills in general education
subjects as well as the ability to keep up with academic
advances; the ability to maintain and enhance personal
and community health and hygiene; the ability to analyze
community problems and to choose suitable alternatives
for solving them, taking into account various limitations;
pride in being Thai; ability to live in peace with others and
to willingly help others within the limits of one’s capability;
creativity and ability to devise and improve (Ministry of
Education, 2008).

Of importance is the ability to analyze community
problems and choose suitable alternatives to solve such
problems. The most important problem here is how to
change learning and teaching behaviors towards the
environmental problem of water pollution, drought and
disaster effects. According to curriculum orientation
guidelines, teachers should be focusing on: (a)
integrating content from daily life; (b) making greater use
of activities, rather than textbooks; (c) using different
learning materials in a variety of ways; (d) making
learners the center of learning activities; and (e) reducing
explanations and helping learners. Such foci will take
more time to prepare and teach according to designated
teaching/learning curriculum orientations. It has been
anticipated, however, that such concerns will be solved in
the forthcoming process of reforming the curriculum and
learning activities (Ampra and Thaithae, 2008).

Educational policy has facilitated decentralization to
schools in developing their own curriculum aligned with
the Basic Education Core Curriculum of 2008. Of
importance is the collaboration of school personnel and
experts. The development of methodological curriculum
orientation guidelines starts with a needs assessment,
curriculum planning, teacher training, tryout and
investigating the outcomes.

METHODOLOGY

The process of research and development for this study was
conducted in three phrases.

Phase I: Contextual study

This study was administered in multi-stages. Two hundred and
seventeen (217) school administrators and teachers in the Khon
Kaen Educational Service Area Office 4 were randomly selected. In
addition, 21 specialists were purposively selected in the data
collection: 12 professional scientists specializing in WRD (4
professors in WRD, 2 researchers in WRD and 6 local experts in
WRD) were selected as well as 9 professional educators
specializing in curriculum and instruction (4 supervisors, 3 school
administrators and 2 secondary teachers with responsibility for the
school curriculum for at least 5 years. The instruments used to
collect data were:

1. A questionnaire comprising 48 items with a 5-point rating scale.
The questions enquired the participants’ current status, problems,
needs, and possibility of developing a WRD curriculum framework.
The Index of Congruence (IOC) was used for validation with an
average mean of 0.87. For reliability, the questionnaire had 0.93, by
using Cranach’s α-Coefficient.

2. An unstructured interview about learning objectives and learning
areas was conducted as a focus group discussion with the 21
specialists. Content analysis and inductive reasoning were used to
analyze the data in order to identify the scope of the curriculum
framework. The data were summarized into conceptual categories
relating to the learning objectives and learning areas in the
curriculum framework.

Phase II: Tryout and revision of the curriculum framework and
teachers’ training manual

Five secondary school teachers in the areas of science and social
studies were selected from the sample in phase I. The criteria
included the willingness of teachers to be involved in this research
project and a full attendance record in the teacher training program.
These five teachers were assigned to teach students at the 9th grade
level under the Khon Kaen Educational Service Area Office 4.

A one group pretest-posttest design was applied in order to
determine the quality of teacher training manual and compare the
ability of the 5 teachers before and after their training. The
instruments used were: (1) the teacher training program and
manual; (2) an achievement test designed by the researchers and
(3) an evaluation form consisting of 20 items with a 5-point rating
scale to evaluate the quality of learning units and lesson plans on
WRD (4) a Likert five-point scale to rate teachers’ satisfaction in
respect of the teacher training program.

Phase III: To investigate the efficiency of teacher training
curriculum

The efficiency of teacher training curriculum was to administer with
the sample size of 56 science teachers, 2 separated groups of the
28-controlling teachers and the 28-experimental teachers groups
with a multi-stage sampling technique. A non-equivalent control
group, pretest-posttest design was applied to 6 classes of 147
students at the 9th grade level from large, medium, and small sized
schools under the Khon Kaen Educational Service Area Office 4.
The experimental group and control group consisted of 68 and 79
students respectively. The instruments used were: (1) an
achievement test (with a reliability of 0.75 by KR21, level of difficulty
of 0.20-0.77, and discrimination power above 0.2) focusing on
learning areas relevant to WRD designed by the researchers for the
pre- and post-test (2) project-based assessment for assessing
students’ projects relevant to WRD, consisting of 13 items and
measured on a four-point scale of very good, good, fair and needs
improvement.

Research instruments

1. The unstructured selection interview instrument used for teachers
interviews
2. The conservational guide book instrument for reporting data
records.
Table 1. Means and Standard Deviations for Pre and Post Training Achievements of Science Teachers of the WRD.

<table>
<thead>
<tr>
<th>Group</th>
<th>Pre-test Scores</th>
<th>Post-test Scores</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>n</td>
<td>M</td>
</tr>
<tr>
<td>Experiment</td>
<td>28</td>
<td>27.92</td>
</tr>
<tr>
<td>Control</td>
<td>28</td>
<td>27.53</td>
</tr>
</tbody>
</table>

Note. The maximum score is 50.

3. Training teacher curriculum document for practicing teachers to learning units
4. Practicing documents for training teachers
5. Pre and post training teacher tests
6. Training teacher satisfaction questionnaire instrument for teachers’ perceptions on their satisfied training teacher awareness and understanding on WRD.
7. Quality assessment document instrument was assessed to learning units of curriculum trainee.
8. The pre and post evaluations of students’ achievements were assessed.

RESULTS

Teachers’ and administrators’ perceptions of the current conditions of schools policy about teaching and learning in WRD and teachers’ opinions on the teaching and learning problems of WRD were found to be at the medium level. In addition, teachers’ opinions on the teaching and learning requirements for WRD were at the high level. Thus, to summarize, the curriculum framework in WRD needed a high level and had the possibility of developing the school curriculum at the medium level.

The two times focus group with 12 professional scientists specializing in WRD and 9 professional educators specializing in curriculum and instruction found that the learning areas of WRD should consist of seven themes including water, water resources, water resources management, disaster management, proactive approach for managing WRD, local wisdom on resources management and a definition of WRD terms.

A contextual study found that teachers most preferred a five days’ workshop. For knowledge and skills, teachers wanted to know more about how to design learning units and assessments on WRD, as well as information about community learning resources on WRD.

After a five-day-workshop training, it was found that the voluntary 28 teachers were able to write learning units and lesson plans on WRD. Five teachers produced material of a high standard (mean=3.54) and 23 teachers did so of a good level (mean=3.35). In addition, all of them achieved post-test scores at 70.0%, which was the passing grade (Table 1). There were significant differences between teachers who attended and the ones who did not attended a training program on WRD in aspect of knowledge about how to design a learning unit on WRD (Table 2).

When comparing students’ achievements of their learning and non learning to their local curriculum framework, using the learning unit of water source and natural disaster content of the two groups between the experimental learning and normal or controlling learning groups in the 3-school sizes, large, medium, and small, it was found that the students in the experimental group had a much higher learning achievement than the students in the control group, with a statistically significant difference at level .01. However, there was no significant difference among students in the control group in relation to their school sizes (Table 3).

DISCUSSION

The study indicated that from the training on efficiency for using this local curriculum framework on management of water source and disaster for the basic education commission of teachers, trainees were able to learn and make the learning units efficiency. They were able to complete their assignments at their training processes of this curriculum by the dissemination of thinking, the importance and necessity of learning management framework for teachers and school administrators, and to direct emphasis on the same thinking to acquiescence. It confirmed the study of Chaiyapan (2005) and Sittisomboon (2003) who reported that the volunteer and network trainers’ efficiencies were highly satisfied.

The study was to compare between the 2-student groups, the experimental learning group and the normal learning group, who sat in the different school sizes; large, medium, and small schools for assessing students’ achievements. Statistically significant difference was
found between groups of their learning achievement. The achievement of the experimental group was higher than that of the normal group at level .01. Students’ solving problem projects were presented and academic on WRD exhibition of students were satisfied by the communities and local folk wisdoms. Some of the exhibitions were: Drought in Our Home Project, Drought at Ubon Rattana Dam Project, Modernized Children on Nam Phong River Conservation Project, and etc. These students’ projects were confirmed with the studies of Silanoi et al. (2005), students’ mind consciously to environmental conservation (World Bank, 2003), students’ achievement of their learning with the post-assessment was greater than pre-assessment (Australian Qualifications Framework, 2011), and training teachers before their using the curriculum was more understanding learning activities than normal teaching of teachers (Fullan and Stiegelbauer, 1991; Nuttrawong, 2010; Utthan, 2009).

Conclusion

In 2011, Thailand coped with massive flooding. This was caused by a tropical storm named NOCK-TEN and followed by seasonal monsoon rains. Such weather usually falls from August to October. Nearly 3 million acres of farmland were under water and 65 provinces were affected. Approximately 680 people were killed with a US 6 billion estimated costs. The results of the catastrophe indicated that it was very important that teachers and administrators be aware of the need for a curriculum framework in WRD.

The Educational Act of Thailand in 1999 mandated that teachers should conduct classroom research for promoting their career path. For this reason, many teachers wanted curriculum innovation for their classroom research in order to consider possibilities to develop WRD for school curriculum at the medium level. Moreover, a curriculum framework in WRD would ensure school curricula contained updated information and would be of relevance to existing needs in the community. A curriculum framework in WRD would help teachers to easily integrate the content of WRD in every subject within the Basic Core Curriculum. Teachers would, as a result, be able to teach students and develop their knowledge and awareness.

In order to develop a curriculum framework on WRD for the basic education, Walker’s Naturalistic Model was adopted. The Model includes three basic phrases termed platform, deliberation, and design. Walker’s three-step model has since been used at various levels of curriculum development with pre- service teachers (Bonser and Grundy, 1988); with in-service teachers (Holt, 1990; Ross, 1993); and large-scale programs (Ben-Peretz, 1990; Dev and Walker, 1990 cited in Marsh and Willis, 2007). A platform is used for describing any consensus of concepts, knowledge or learning experiences on WRD. Deliberation is used to identify which concepts or knowledge; and learning experiences are needed or are essential on WRD.

In this research, two rounds of focus groups were used. The consensus of deliberation found that the essential learning areas of WRD should consist of seven themes including water, water resources, water resources management, disaster management, a proactive approach for managing WRD, local wisdom on resources management, and definition of terms on WRD. We used the seven themes to design a local curriculum framework on WRD. The planned curriculum included: 1) the introduction; 2) definition of terms; 3) goal for developing learners; 4) strands of WRD; 5) learners’ assessment; 6) guidelines for schools to integrate WRD into the school curriculum; and 7) suggestions. In this curriculum framework, WRD is relevant to the Basic Education Core Curriculum at Grade levels 1–12, where schools can apply to develop teaching and learning so that students are given experiences of WRD, communities and local wisdoms. This result matches that of the study by Padsin (2008), who reported on the development of a learning unit with the Lam Pao Flood Plain Environment school group.

Evaluation of teacher perceptions and readiness to adopt and carry out the innovation is crucial to the success of the program. Teacher training programs should be an integral part of the curriculum development stage. Fullan and Stiegelbauer (1991) reported that teachers and connected personnel were the foundational factor propelling educational innovation and the curriculum successfully. Teachers should adjust their thinking and teaching to be aligned with the curriculum and always update their knowledge and skills.

Focusing on the training and practicing of teachers in a WRD curriculum framework found that teachers were satisfied with a five days’ workshop. The workshops gave them enough knowledge and skills of how to design learning units and assessments on WRD, as well as information about community learning resources on WRD. A model for training was a balance of being external to school and a personal mission to teachers (Goodson, 2000).

This study indicates that the new WRD curriculum framework needs to be composed of substantial knowledge for teachers who are in leadership roles in their teaching. These results revealed that the 28 voluntary science teachers who received training were able to design learning units from the WRD curriculum framework. The model and personal mission of teachers to efficiently design and write learning units was shown to enhance their competence.

Comparisons between the two learner groups (experimental learning and control) for assessing learners’
achievements who sat in different school sizes (large, medium, and small) can be made. Of statistical significance were differences found in the learning achievements between the two groups; the experimental group was higher than the control at level .01. Students in the experimental group could create projects focusing on solving problems relevant to WRD. The students' problem solving projects were presented and exhibited to the community. For example, the "Drought in Our Home" Project, "Drought at Ubon Rattana Dam" Project, and "Smart Children on Nam Phong River Conservation" Project. These projects showed that students have knowledge and attitude concerns about WRD and have thinking skills. The results are substantiated with the studies of Silanoi et al. (2005) who reported learners' minds being conscious to environmental conservation. In the last decade, previous research have reported that learner achievements in the post-assessment were greater than pre-assessment; learners' training and using the curriculum had more understanding towards learning activities than to conventional teaching (Australian Qualifications Framework, 2011; Fullan and Stiegelbauer, 1991; Nuttrawong, 2010; Utthanan, 2009; World Bank, 2003).

Based on the findings of this study, a number of suggestions can be offered. Organizations, institutes, the Primary Educational Service Area Office, and the Secondary Educational Service Area Office should specify policies that support and promote the propagation of the local curriculum framework concerned with the management of water resources and disasters into every school's curriculum of the basic education (Grades 1-12). Knowledge, skills and attitudes of WRD have cultivated moral traits for primary and secondary educational learners who are able to emphasize acknowledge and appreciation and include experiencing skills in their daily life. Teachers should be trained and practiced in the curriculum framework in order to promote the investigation, improvement and adaptation of their teaching within the core curriculum system. Educators and professional occupations should investigate a curriculum framework for suitability and possible learners' achievements.

In terms of applications for developing and using a curriculum framework on WRD such as the basic education commission, Primary Educational Service Area Office and Secondary Educational Service Area Office, educational institutes need to be cautious in covering the sub-content of the core curriculum. The needs of schools and the community should be considered. Human resources need to be continually developed in terms of knowledge, skill and experience in teaching and learning management. The administration should support the curriculum prototype; understand the point of the curriculum; learner participation; and revise data assessment. School administrators should aim build a friendly, cooperative school environment, and plan towards sufficient budgets in order to develop their curriculum on WRD within the basic education core curriculum.

It is suggested that further research to demonstrate the need for curriculum frameworks be administered throughout all educational levels and be continually monitored and developed. The suitability of the curriculum framework may change in response to, for example, time and changes in its content. The new curriculum should study its effects and determinants in order to be further adapted and improved with other learning subject groups.

Conflict of Interests

The author has not declared any conflicts of interest.

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