PLACE-BASED SCIENCE EDUCATION FOR FIVE ELEMENTARY SCHOOLS IN RURAL THAILAND

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ABSTRACT

This research was designed to study the effect of a professional development program in place-based science education on teacher and student learning in rural elementary schools in Thailand’s northern Lampang province. Based on the results of a pilot study conducted in 2008 at one school, which was then followed by a needs assessment conducted with principals and teachers in 2009, four key findings were confirmed: (1) teachers lacked the confidence and ability to teach science, (2) students were not engaged in active science learning, (3) the schools lacked resources for teaching science, and (4) there was a lack of community support for the schools. A professional development program in place-based science education was subsequently designed and implemented in 2010 to provide a support network for teachers to develop and teach lesson plans that connected science to the local community resources and daily lives of the students. The study focused on five schools, seven teachers, and their students from diverse cultural backgrounds who spoke multiple languages.

The data examined in this study included principal, teacher, and student interviews before and after training; teacher lesson plans; researcher, peer, and outsider observations of teaching; student work and projects; standardized student test scores in science; and interviews with parents. The key findings suggested that teachers were able to improve their science teaching by connecting science to the local knowledge in the community. Teachers’ attitudes toward teaching science improved. The students became more curious, outgoing, and confident over time. The students also developed reasoning skills and were able to problem-solve and design projects that connected with the local community. Importantly, the students’ scores on standardized science tests significantly
improved in six months between the 3rd and 4th grade at all five schools. Because it was very important to connect science taught in the Thai National Curriculum with local funds of knowledge, the support of the administrators and community was critical to the success of the place-based science education lessons. In short, place-based science education helped to close the gap between local knowledge and global knowledge.
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# TABLE OF CONTENTS

<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENTS</td>
<td>iv</td>
</tr>
<tr>
<td>LIST OF TABLES</td>
<td>ix</td>
</tr>
<tr>
<td>LIST OF FIGURES</td>
<td>x</td>
</tr>
<tr>
<td>CHAPTER 1: INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>Organization of the Dissertation</td>
<td>1</td>
</tr>
<tr>
<td>Background of the Problem</td>
<td>1</td>
</tr>
<tr>
<td>Pilot Project in 2008</td>
<td>6</td>
</tr>
<tr>
<td>Findings from the 2008 Pilot Project</td>
<td>10</td>
</tr>
<tr>
<td>Research Question</td>
<td>16</td>
</tr>
<tr>
<td>Purpose of the Study</td>
<td>17</td>
</tr>
<tr>
<td>Definition of Terms</td>
<td>18</td>
</tr>
<tr>
<td>CHAPTER TWO: LITERATURE REVIEW</td>
<td>20</td>
</tr>
<tr>
<td>The Context of Thai Education</td>
<td>20</td>
</tr>
<tr>
<td>Economic (Industrialization) Structure</td>
<td>21</td>
</tr>
<tr>
<td>Geographic (Urbanization) Structure</td>
<td>22</td>
</tr>
<tr>
<td>Government (Political) Structure</td>
<td>23</td>
</tr>
<tr>
<td>Social/Spiritual Structure</td>
<td>24</td>
</tr>
<tr>
<td>The Educational Structure of Thailand</td>
<td>26</td>
</tr>
<tr>
<td>Imbalanced Allocation of Qualified Teachers to Urban and Rural Schools</td>
<td>27</td>
</tr>
<tr>
<td>Inadequate Teacher Training</td>
<td>28</td>
</tr>
<tr>
<td>Funding Imbalances and Disparities between Urban and Rural Schools</td>
<td>29</td>
</tr>
<tr>
<td>Counterbalancing the Flight to Urban Area Schools</td>
<td>29</td>
</tr>
<tr>
<td>Neglect of Thai Culture, Traditions and Community</td>
<td>29</td>
</tr>
<tr>
<td>Non-Learner Centered Curriculum and Learning Mismatches</td>
<td>30</td>
</tr>
<tr>
<td>Recent Historical Context of Thailand’s Education Policies</td>
<td>31</td>
</tr>
<tr>
<td>The First Decade of Education Reform in Thailand (1999-2008)</td>
<td>32</td>
</tr>
<tr>
<td>The Second Decade of Education Reform (2009-2018)</td>
<td>32</td>
</tr>
<tr>
<td>Thai National Curriculum</td>
<td>33</td>
</tr>
<tr>
<td>Curriculum Options</td>
<td>36</td>
</tr>
<tr>
<td>Place-Based Education</td>
<td>36</td>
</tr>
<tr>
<td>The Origin of Place-Based Education</td>
<td>37</td>
</tr>
<tr>
<td>Connection of Environment, Culture, and Citizenship</td>
<td>38</td>
</tr>
<tr>
<td>Themes of Place-based Education</td>
<td>40</td>
</tr>
<tr>
<td>Sense of Place in Rural and Urban Areas</td>
<td>43</td>
</tr>
</tbody>
</table>
School Profile: PCW Elementary School ................................................................. 93
Teacher Profile: PCW-T1 ...................................................................................... 95
School Profile: PW Elementary School ............................................................... 95
Teacher Profile: PW-T1 ....................................................................................... 96
School Profile: BHP Elementary School ............................................................. 97
Teacher Profile: BHP-T1 ...................................................................................... 99
Teacher Profile: BHP-T2 ...................................................................................... 99
School Profile: PNT Elementary School ............................................................. 99
Teacher Profile: PNT-T1 ...................................................................................... 101

Interviews Before Training in 2010 ................................................................. 101

WTT-T1 Interview ............................................................................................... 101
WTT-T2 Interview ............................................................................................... 103
PCW-T1 Interview ............................................................................................... 104
PW-T1 Interview .................................................................................................. 105
BHP-T1 Interview ............................................................................................... 107
BHP-T2 Interview ............................................................................................... 108
PNT-T1 Interview ............................................................................................... 109

Classroom Observations of Teachers and Students Before Training .......... 110

WTT-T1 Observation ........................................................................................... 111
WTT-T2 Observation ........................................................................................... 111
PCW-T1 Observation ........................................................................................... 111
PW-T1 Observation .............................................................................................. 112
BHP-T1 Observation ........................................................................................... 112
BHP-T2 Observation ........................................................................................... 113
PNT-T1 Observation ........................................................................................... 113

Teacher Participation and Reflections about Training Activities .......... 113

Place-based Education Applications After Training ........................................ 116

Classroom Teaching and Student Learning Using Place-based Education 117

Observations of Classroom Teaching After Training ..................................... 118

Overview of BHP-T2 Lesson Observation ....................................................... 118
BHP-T2 Lesson 1: Peer Observations (summary of 2 observers) .................. 119
BHP-T2 Lesson 1: Outsider Observations ......................................................... 121
BHP-T2 Lesson 1: Teacher Reflection ................................................................. 123
BHP-T2 Lesson 1: Researcher’s Observations and Reflections ...................... 123
Overview of BHP-T2 Lesson 2 ........................................................................... 127
BHP-T2 Lesson 2: Peer Observations (summary of 2 peer observations) ...... 130
BHP-T2 Lesson 2: Outsider Observations ......................................................... 131
BHP-T2 Lesson 2: Teacher Reflections ............................................................... 133
BHP-T2: Researcher Observations and Reflections ........................................... 134
Summary of Other Classroom Observations ................................................ 137
TEACHER INTERVIEWS AFTER IMPLEMENTING PLACE-BASED SCIENCE EDUCATION... 145
STUDENT WORK SAMPLES ................................................................. 147
STUDENT INTERVIEWS AFTER PLACE-BASED SCIENCE EDUCATION .......... 153
EVALUATION OF STUDENT’S STANDARDIZED TEST SCORES .................... 155
INTERVIEWS WITH PARENTS AND COMMUNITY INVOLVEMENT ............... 156
SYMPOSIUM ................................................................................. 158
SUMMARY AND CONCLUSIONS ....................................................... 159

CHAPTER 5: DISCUSSION AND IMPLICATIONS ........................................ 162
RESEARCH STUDY: 2009-2010 ............................................................... 165
Common Problems in Rural Schools ....................................................... 165
REFLECTIONS ON POWER RELATIONSHIPS ......................................... 167
REFLECTIONS ON COMMUNITIES OF PRACTICE ................................... 169
REFLECTIONS ON TEACHER AND STUDENT ACHIEVEMENT ............... 171
LIMITATIONS OF THE STUDY ............................................................. 175
IMPLICATIONS FOR IMPLEMENTING PLACE-BASED SCIENCE EDUCATION .... 176

REFERENCES ..................................................................................... 181

APPENDICES .................................................................................... 198

APPENDIX A. PILOT QUESTIONNAIRE .................................................. 198
APPENDIX B. APPROVAL OF A STUDY INVOLVING HUMAN SUBJECTS ....... 200
APPENDIX C. CLASSROOM OBSERVATION PROTOCOL .......................... 209
APPENDIX D. OPEN-ENDED INTERVIEW QUESTIONS FOR TEACHERS ....... 213
APPENDIX E. OPEN-ENDED INTERVIEW QUESTIONS FOR COMMUNITY
MEMBERS/PARENTS ........................................................................... 214
APPENDIX F. INTERVIEW QUESTIONS FOR STUDENTS ............................... 215
APPENDIX G. SAMPLE LESSON PLAN .................................................... 216
APPENDIX H. 3RD AND 4TH GRADE STUDENT TEST SCORES .................... 245
LIST OF TABLES

Table 1. The National Test Result Average Score for Sixth Grade, 2007-2010 .......... 33

Table 2. Schedule and Timeline of Teacher Preparation Program for Place-Based Science Education, April 17 - October 25, 2010 ................................................................. 72

Table 3. Coding Chart ..................................................................................................... 81
LIST OF FIGURES

*Figure 1.* Foundational Elements of Thai PBE ................................................................. 60

*Figure 2.* Teacher, Observers and Students Studying Frog Behavior .............................. 128

*Figure 3.* Students Using Magnifying Glasses to Observe the Plants ............................ 139

*Figure 4.* Students Studying at Learning Stations in the Classroom ............................... 140

*Figure 5.* Students Learning about Different Kinds of Soil in the Community ............... 142

*Figure 6.* A Student Engaged in a “Water Powder” Filtration Experiment ..................... 143

*Figure 7.* Third Grade Students Studying the Mosquito Life Cycle .............................. 148

*Figure 8.* Students Experimenting to Find which Plants Absorbed the Oil the Best ........ 149

*Figure 9.* Students Testing Water in the Rice Fields and Drinking Water in the Village .......................... 150

*Figure 10.* Students Presenting their Work to the Head of the Village ....................... 151

*Figure 11.* Students at PW Elementary School Studying Weevils in Lanna Culture ... 152

*Figure 12.* Students Learning that Male Weevils Fight for Female Weevils ................ 152

*Figure 13.* Students Learn about Weevils from Local People in the Village ............... 153
CHAPTER 1: INTRODUCTION

Organization of the Dissertation

This dissertation has been organized into five chapters. In Chapter 1, the researcher defines the research problem, presents the research question, presents the pilot project that shaped the research, and describes the significance of the research problem. In Chapter 2, the researcher provides an in-depth description of the history of the education system in Thailand. The place-based education (PBE) concept is then presented followed by applications of PBE in various locations in the world where it has been administered in different situations. This is followed by the researcher’s propositions about the expected outcomes of PBE in the researcher’s Thailand study. In Chapter 3, the researcher presents her research design and a description of the participants and setting. She describes the study procedures, which stems from the pilot study in one rural school and its results. In Chapter 4, the researcher presents a description of the data gathered in the study of 5 schools, 7 teacher participants, 120 student participants, and 10 community member participants; as well as a narrative analysis of these findings. Finally in Chapter 5, the researcher presents a summary evaluation of her findings and recommendations for future research.

Background of the Problem

If students can make the connection between science knowledge and real life it is believed that they will be able to learn about science more efficiently and effectively (AAAS, 1990). To reiterate, this research project was designed to determine the effects of a professional development program in place-based science education on teacher and
student learning. In other words, could place-based education techniques enable teachers to help students make these connections in just such a manner? A study was designed to understand and evaluate this approach in Lampang Province, northern Thailand. The program involved the researcher working with elementary school teachers in five rural schools to develop a model place-based science curriculum to study teachers’ and students’ learning performance in place-based science education classrooms.

In Thailand, there are few examples directly referred to as place-based education but there are programs that are similar where in-service teachers connect local knowledge into the curriculum and lesson plans. For example, Bartlett and Jatiket (2003) reported that Manas Burapa, an elementary teacher from Wat Nong Moo School in the Nakhonsawan province (in the center of Thailand close to Bangkok), developed lesson plans by using rice fields as a classroom to teach about ecosystems. Although other teachers questioned whether students could pass the tests, Burapa proceeded with lessons anyway. The teacher believed that students learn from real experiences through hands-on learning in the local community. Rather than learning from a curriculum specified book, the students used the rice field as a classroom to teach about insect life cycles, the nitrogen cycle, and the difference between organic farming and farming with insecticides and chemical fertilizers.

During the learning processes, the students were able to talk about and come up with local stores of knowledge about the rice fields. The teacher was able to see that students learned by connecting scientific knowledge and local knowledge that made learning more meaningful and applicable to real life. Moreover, the rice field lessons helped the students connect with the local farming practices that are part of their
intergenerational lifelong learning. The teacher’s assessment of this project suggested:

(1) the successful involvement of parents and local community members in school activities (e.g. guest speakers, helping students analyze problems in the rice field, and sharing experiences; (2) students who learned how to plan projects, write, and record reports about the ecosystem; (3) improvement in student achievement on paper tests and participation in the activities; and (4) students who learned about ethical responsibility on how to care for the local environment. The teacher learned from an assessment by his students who said they enjoyed learning outside the classroom and learning more about local insects and ecosystems. Other students said they wanted to learn outside the classroom and hoped their teacher would teach this style forever because the activity made them interested in the subject. Although it was hot in the rice fields, the students enjoyed the freedom to learn more than in a classroom. Similar expressions were also expressed in this study. The researcher reported on these sentiments as well as reporting positive student academic outcomes resulting from the use of the natural environment as a classroom.

Most rural schools in Thailand have inadequate in-classroom resources to fulfill their teaching mandates, lagging far behind their urban school counterparts. On the other hand, they do have a rich inventory of rice fields and open spaces immediately adjacent to their schools that may be used as outdoor classroom space, if teachers and schools decided to use them for that purpose. In the classroom, the teaching and learning tools supplied are neither sufficient nor up-to-date, and they do not meet student needs. Scientific principles are presented hypothetically in isolation from culture – an approach that is beyond everyday students’ needs. The communities in rural school areas are
populated by farming families that practice traditional agriculture-based farming methods that have been passed down over generations. Because of this, local residents have little interest in learning and applying science unless they see it as applicable to their everyday practices. Rural elementary teachers are generally not well trained and not proficient in teaching science. For these reasons students in these areas are unable to learn science concepts effectively or to achieve impressive test scores in science.

Other challenges have arisen from these schooling deficiencies. When teachers neglect to adapt the curriculum to the community, students lose their connection to the community, and many move away from rural areas and go to the city to study or work and do not return (Klechaya & Chinn, 2009; Chinn et al., 2010); and in doing so all of that energy, effort, and time devoted to schooling is lost as well. While it is understood that some students might stay and others might leave their rural communities independent of the schooling they receive, this study assessed whether education played a role in students understanding, respecting, and caring for their community.

In a pilot study conducted by the researcher using place-based education techniques, primary school students investigated sources of water pollution in the community and how these sources as well as the use of insecticides in the rice fields could harm fish populations. Students learned how protecting water resources is important for families and future generations. This approach provided an opportunity for students to develop a sense of ownership and responsibility to the environment and local community. The researcher’s proposition was that even if students leave their community to go to higher education in urban areas, they may be more likely to return if
they are connected and attached to their community or they may support their community from afar with resources or advocacy.

According to the Office of Education Council (1999a; 2004), the student exodus out of rural areas to urban centers in part arose due to educators in the Thailand Ministry of Education who had been prepared in Western teaching techniques. Because of this they gave little thought to adapting local school curricula to local community cultures. Western teaching techniques with their focus on learning content and test taking can be characterized as primarily urban; students reflect the highly urbanized cultures of many Western nations. Western ideas have had a powerful influence on Thai education because many in modern Thai society believe that education can help Thais have a prosperous, materialistic life. This influence explains why so many in the Thai Ministry of Education have been trained in Western education approaches.

Western influence on Thai education not only influenced teaching techniques but also educational administrative techniques. Specifically, Thai educational practices and curricula for all urban and rural schools in the country were uniformly standardized and administered by the Ministry of Education in Bangkok in the 1990s (Office of Education Council, 1999b). This centralized control was subject to continuous change based on political changes in leadership. Unfortunately, it became apparent that this type of administration was not successful in rural areas because the National Curriculum was not relevant to the needs of the rural population. In fact, the centralized policy was so politically unpopular that in 1999, the National Education Act reversed the policy, decentralizing the education authority, and returning it back to the districts to develop
relevant education programs, provided they met the requirements of the overall national standards and policies.

According to Ampra and Thaithae (2001), when the local districts were given the management authority to implement in the basic education curriculum of 2001, the schools were able to create curriculum suitable for their locales. Almost instantaneously, school management became more responsive and efficient. However, in the rural areas, the schools still faced a lack of financial resources and professional staff. Because of the difficult economic situation in rural areas, instead of teaching the students to become good members of their communities, teachers continued to feel pressure to focus on teaching the students to pass national tests so that their students might continue on to study in more prestigious schools elsewhere. If successful, the local school would become well known academically, with increased numbers of students, which, in turn, would attract more money for the school and the teachers. At the time of this writing, however, while national tests focus on academic achievement, they do not assess the quality of the relationship between the school curriculum and the local community. In addition, the National Curriculum of 2001 has not included goals like the moral and ethical development of the student or their preparation as contributing members of local or national communities.

**Pilot Project in 2008**

In an effort to find ways to improve the teaching of science in rural Thai elementary schools, the researcher conducted a two-month pilot project from July – August 2008 in a small school in northern Thailand, the WTT Elementary School. The researcher first observed the existing teaching methods being used to teach science
courses and interviewed administrators, teachers and students. She found that 100% of the teachers strongly agreed that problems in science education were due to lack of school support for teacher development and training in science education. In addition, an overwhelming majority of teachers in the rural schools strongly agreed that the science education problems they were experiencing with their students were caused by student diversity (e.g. Hill tribe students spoke different languages from the majority of students), poor science lab facilities, and an ineffective curriculum that was not relevant to student experience or need. Sixty-six percent of the teachers also agreed that student learning was adversely affected by insufficient academic preparation. There was no agreement among teachers about whether problems were due to lack of science knowledge among the teachers.

Following this observation and analysis phase, the researcher then prepared a professional development program to prepare teachers to use a place-based curriculum developed by the researcher. The place-based science curriculum she developed connected closely to the community practices, environment, and knowledge. As a part of this curriculum, students went out into the community to study. For example, they learned from the farmers about the rice field environment and tested the water quality at various sites in the community. The researcher collected qualitative data that included: interviews of teachers, parents, and students; field notes; classroom observations; videos and photos of teaching in progress; and lesson evaluations. Pre and post surveys were used to assess teacher, student, and parent attitudes toward the place-based education curriculum implemented (See report at the link http://www.youtube.com/watch?v=wzH8vSBV540).
Lewthwaite (2007) asserted that, “Place-based education is rooted in place; that is, the organizing focus of the school is on the local socio-cultural, ecological setting” (p. 5). The researcher found place-based education activities in this pilot study encouraged students to care about their community, water resources, and the environment. A group of students from grades four to six undertook a science project—*The Testing Water Project*. A group went out to observe the water sources in the village and tested water samples from rice fields, streams, and irrigation canals. The researcher served as a model teacher while local teachers observed, explaining to the students how to use water-monitoring kits that were donated by the University of Hawaii. For the first time, students learned how to measure temperature, turbidity, nitrates, phosphates, biological oxygen demand, and bacteria in the water samples. They analyzed the data and demonstrated responsibility by reporting the results door-to-door to all people in the community. Visitors to the school noted that students were for the first time able to understand and show how and why it is important to protect the community’s water resources. Following the students’ report to the community, several community members asked the community leader why the water was unhealthy.

As part of the pilot project, the researcher invited parents to volunteer to improve the school environment through activities such as planting a new herb garden and painting the science lab and library. These volunteer activities helped to develop partnerships between the school and the local community. The researcher introduced and implemented a Sustainable Environment Project relevant to the school and community by teaching teachers and students the importance of a healthy environment and undertaking activities such as sorting recyclables and stopping the use of plastic bags and bottles in
the school. Every morning when the students arrived at school, it was part of their responsibility to take care of their environment. Students developed science projects that supported the environment such as reusing candles, recycling paper, and using waste liquid remaining after rice had been rinsed with water. One of these projects was further enhanced on the Buddhist religious day when students carried the recycled candles to the temple and everyone brought a flower from home to offer to the monks. Other projects led to the organization of a local procession in which some students carried posters to promote a sustainable environment in the local community and to develop a better relationship between the school and community.

Following some improvements of library and science facilities, it was decided that a Science Exhibition Day would be held where the school invited parents, local community members, teachers from other schools and the Director of the local education district. This was the first time that students from grades one to six presented their science projects to visitors. Science and culture activities were integrated as in normal daily life on that day, so the community would see that learning science was not alien to their lives and community. Science curriculum included local knowledge and traditions, and how they were used in everyday life. Also on that day, an agronomist came to school to train farmers on how to make bio-fertilizer from EM\textsuperscript{1} (Effective Microorganisms), a

\footnotesize{\textsuperscript{1} “EM\textsuperscript{®} is an acronym for Effective Microorganisms\textsuperscript{®}. It is a brand name referring to a line of microbial-based products using a technology developed by Japanese scientist Dr. Teruo Higa. EM\textsuperscript{1\textregistered} is a liquid bacterial product made of three groups of bacteria: Yeast, Photosynthetic Bacteria, and Lactic Acid Bacteria. EM\textsuperscript{1\textregistered} works together with beneficial microbes in the area to which it is added, creating a synergy among microorganisms and larger forms of life including insects and worms, pets and livestock, and people.” http://www.teraganix.com/Effective-Microorganisms-History-and-Availability-s/194.htm
mixture of bacteria that supports composting. This demonstration was important for the community because of the importance of reducing the use of chemical fertilizers.

During this pilot project, students reported that a monk in the village had dengue fever. Earlier a public health officer was seen visiting the school to observe how the school tried to protect students from mosquitoes. Based on the researcher’s observations, the officer explained how to prevent dengue fever but the teachers did not provide learning activities to help students understand about the difference between normal fever and dengue fever. Parents also did not understand how to prevent dengue fever; therefore, no one in the school community really understood how to address this problem. The researcher decided to talk to students and teachers, and together we developed and promoted a program on how to eradicate dengue-carrying mosquitoes in the school and the community. Students made the brochures and distributed them door-to-door. They showed how people could put EM into water buckets and waste water pipes to kill mosquito eggs. The students learned this from local tradition and science activities.

**Findings from the 2008 Pilot Project**

After the teachers gained an understanding of place-based learning from the curriculum developed, taught, and modeled in alignment with the community’s needs, the researcher interviewed the teachers and students. From these interviews, the researcher found that teachers and students had developed a positive attitude toward place-based learning in the schools. The teachers were able to develop their own effective curriculum based on real life. They understood how to engage students, but they still were not confident in teaching science. In a ten-question survey to assess student attitudes toward
the place-based learning activities, eighty students responded (see Appendix A). The researcher found that students successfully studied science from real life experiences using “hands-on” experiments. Science became more meaningful to students because science was related to their community. Students also said they would like to be more involved in science projects and would like to have more activity in the school and outside of the school. A majority of the students at WTT Elementary School responded “very much” to every question. Eighty five percent of the students very much liked the activities of Science Exhibition Day and 80% very much liked the learning activities about the environment. School activity days that were not connected to science such as Mother’s Day, Father’s Day, and Teacher’s Day were the least popular (65% liked it very much) because students were less involved and there was a lack of participation from the community.

It was clear that new approaches and methods using place-based teaching at WTT Elementary School had the potential for significantly improving student learning. When Science Exhibition Day was added, there was greater student involvement and participation with the community. Cooperative projects between the school and the community were also successful, particularly those related to science and the environment, including mosquitoes carrying dengue fever and the promotion of tree planting. The school and community relationships were stronger as indicated by increased participation and interest of parents than before the pilot research; and students confirmed this by expressing more interest in greater parental involvement in school activities.
From my observations, Buddhist philosophy was embedded in the local Thai culture in the sense that all the people in the community supported each other like a family as exemplified by calling each other sister/brother or auntie/uncle, even though they were unrelated. Accordingly, parents came to school to volunteer to help, teachers respected each other, and students respected their elders. In Buddhism, science and culture are not thought of as separate. For example, students pray in the morning at home, then recycle candles by bringing them to the temple. Through this act of preserving wax and saving energy, students care for the environment just as they protect other organisms that are part of life cycle in the rice fields. In the process, students develop strong moral and ethical reasoning while learning science.

At the end of the two-month project, the relationships between the school and community had improved and strengthened, as shown by many positive comments that were made on both sides. The immediate result was that many other schools in the same district became very interested in the results as evidenced by the comments below by some community members:

Question: "How do you think the community members got help and collaborated with school?"

Response by WTTCMI (a farmer):

"In the past few weeks the community has collaborated with many activities at the school. In the community we help each other more now but we rarely get any help from people outside our community and it was not always like this before. I feel so glad."
Question: "What do you think about the school now and is it important to have collaboration from inside and outside the school?"

Response by WTTPR1 (a parent):

"Our community now has a professional educator who came to help us. I am really glad and very proud. From now on our school of Baan Ton Tong village will not close down."

Response by WTTADM1, Principal, WTT Elementary School:

"We are very fortunate that our school has a chance to collaborate with Archan (teacher) Rose's research project to develop science teaching and curriculum. It has inspired and helped the community parents to collaborate and take care of our community and environment."

Question: How do you help the school now?

Response by WTTPR2, (winner of "Outstanding Farmer Award"):

"Yes, sometimes I cut the grass along the wall and some time I send my older son to help."

Question: What do you think about this project, its impact on community, students learning and their real-life experiences?

Response by WTTADM2, Principal, BWL School and Head of District Schools Association:

"I am really happy to have a chance to see the research project "Place-based Science Education." I am very impressed and greatly appreciate this project. I would like to thank Archan (Teacher) Rojjana (Rose) who has brought a very good new concept to our community in Lampang Province."
Despite the success of the pilot project it was obvious that teachers lacked science content knowledge needed to continue place-based education independently. They had limited time and were not able to work on lesson plans and continue to the next unit because there was no one to assist them at the school. The teachers also needed expanded time to learn and understand the standards of the national curriculum. Rather than teaching only from the book, the teachers needed to develop confidence as teachers by advancing their own learning of science. With greater awareness of science, they would have the potential to realize that science is everywhere. Then their attitude toward science teaching would improve.

The researcher planned the next professional development program based on findings and conclusions from the pilot study. In this second phase, the plan called for the teachers to analyze the national science curriculum together as a group. They would learn more about the place where the school was located—including study of the students’ culture, language, backgrounds, learning resources, environment, and local knowledge. Teachers would learn about social and real life in the local context, as well as about global knowledge from the news, television, and Internet. With these basic dimensions of professional development, the researcher predicted that teachers could create learning themes and integrate the community and culture into their science teaching lesson plans. For teachers to gain more experience and sustain their new curriculum efforts, the researcher also learned from the pilot that they needed to have peer study groups to work together and also share experience. They would also need to learn from and inform each other through casual observations in the classrooms. Finally, the researcher had recognized the importance of administrative support and educational
district support for what the teacher was doing. The researcher learned from the pilot that place-based education was not significantly different from or in conflict with the national curriculum. The two educational models—place-based and standards-based—could be compatible.

Finally the researcher reviewed what had been learned from the pilot project and used that new knowledge to organize this dissertation research study. Among the most important lessons learned was the realization by the researcher that there were a lot more unknown factors at play influencing the Thai educational system. For one thing, Thailand’s nationwide rapid transformation into a world economic power was changing the nation’s social structure by increasing wealth while simultaneously raising pressure to upgrade the nation’s human resource skills and ultimately its rural education system. Among other things, this increased the researcher’s awareness of the growing need for more effective science education, on the one hand, and for reinvigorating Thailand’s retreating traditional Buddhist culture on the other. For another, the researcher became more acutely aware in the country of the rapidly widening gap between the resources allocated by the central government to urban and rural schools. Urban schools, with their close proximity to the newly industrializing and urbanizing areas were taking the lion’s share of available financial and training resources leaving rural schools with undertrained teachers, underdeveloped facilities, and ineffective curriculum development. The researcher also became quite aware that the Ministry of Education’s emphasis on a one-size-fits-all curriculum approach in all schools emphasizing rote learning was not only ineffective in the rural schools but may have been accelerating further rural flight by families out of the agricultural regions into the cities.
For all of these reasons, the researcher decided upon a research question for this dissertation that was open enough to new educational approaches that it would enable a broad inquiry into what might be the most promising for student achievement, teacher development, and rural curriculum development in the current context of rapid industrialization, lower budgets, greater urbanization, pressure for culture change, and an ineffective, centralized and unstable national education policy. The researcher believed that place-based education as practiced in other parts of the world might be successfully modified and adapted to science curriculum development in Thailand’s rural schools and set on a course of inquiry to investigate the possibilities.

From the pilot research study, the researcher developed a model for place-based science education in Thailand. This model connected the local culture and Buddhism to the National Curriculum standards in science. Unlike science education in Western cultures, place-based science education in Thailand includes moral and ethical reasoning. Science education is not just about teaching knowledge, but is also about the learner’s own beliefs that come from the inside.

**Research Question**

Based upon the results from the pilot project in one school that demonstrated how PBE was an effective curriculum organizing principle, the following research question was developed: In the context of rural Thai elementary schools, how do teaching and student achievement change as a result of the teachers’ participation in a place-based science professional development program?
**Purpose of the Study**

This qualitative case study explored the application of place-based education at the local, rural level to determine its potential to reduce or eliminate the achievement gap between rural and urban areas, and to be replicated in all rural schools in Thailand. Specifically the study collected data regarding the following:

1. The ways in which preparing teachers with teaching strategies can help Thai rural students make the connection between science knowledge and their own lives in rural communities and improve learning outcomes.
2. The ways that Thai teacher and student attitudes toward place-based education changed.
3. The steps involved in developing and assessing the implementation of a model of place-based science curriculum for elementary school teachers in rural Thai areas.
4. The nature and scope of student learning and achievement in place-based science education classrooms.
5. The field-testing of a researcher-developed place-based science professional development program for rural teachers and a place-based science curriculum for schools in rural areas in Lampang Province.

The study’s outcome has theoretical and practical significance. It contributes to the development of theory about the optimum uses and applicability of place-based education techniques in teaching and learning about science. The study informs researchers about an approach to overcoming resource restrictions of rural schools. The study assesses improvement in teaching performance and job satisfaction when a
creative curriculum is developed. Finally, the study provides a set of in-depth case studies from which stakeholders—including policy makers, scientists, and educators—may gain rich insights about connecting academic knowledge to real life at the community level.

**Definition of Terms**

In order to clarify terms that have been used within the context of this study, the following operational definitions are provided:

1) **Bicultural** – Anyone who can successfully navigate between two cultures.
2) **Experiential learning** – This is learning that occurs through direct experience.
3) **Multicultural** – Communities with more than one group of people living together that include majority groups and minority groups speaking different languages.
4) **Place-based education (PBE)** – PBE is an educational approach using elements present in the local community, culture and immediate environment. It is hands-on direct learning, project-based, and real world based education. It is students and school staff helping communities with their own problems. It involves learning grounded in the history, culture, and ecology of the schoolyard, neighborhood, and community that students live in before learning about places further afield.
5) **Schooling for a Buddhist Way of Life** – Developing Thai youth as complete people who are capable of being good persons with good mental and physical health through *Tri-Sik-Kha* (three studies): Seen (morality), *Sa-Mah-ti* (concentration), and *Punya* (wisdom).
6) Situational Learning – This is an educational theory positing that learning takes place in the same context in which it is applied. This is learning that is situated within a specific context in a particular social and physical environment.

7) Social Constructivist Process – This is a qualitative research design approach where researchers assume that individuals seek deep subjective understanding of the real world experiences, places, objects and things in which they live and work. The research relies on the participants’ views of the situation that are developed through interaction and discussions with other persons.

8) Social Learning – This is an education theory that posits that people are influenced and learn from one another within a social context by observation and modeling the behavior of others.
CHAPTER TWO: LITERATURE REVIEW

This chapter is organized into three sections: In the first section, the researcher describes the context of Thai education including aspects such as industrialization, urbanization, geography, government and political structure, social structure, independence from colonization, spiritual influences, and educational system. In the second section, the researcher generally describes the origin and various meanings that have been given to place-based education in its history and development. In the third section, the researcher describes historic examples of how place-based education strategies have functioned in various countries in the world. Finally the researcher provides propositions about the expected outcomes of using place-based education approaches in Thailand.

The Context of Thai Education

Educators have reported about but not empirically studied whether place-based science approaches are effective in rural Thai elementary school education. To extend this knowledge base, the purpose of this study is to understand and evaluate the application of place-based science education localization and experiential learning techniques in a real world setting in Thailand.

Thailand’s educational system is going through a major transitional phase, the likes of which it has never seen in the long history of this ancient civilization. In the last several decades, Thailand’s economy has grown so fast that its political system, social infrastructure, and educational system have barely been able to keep up. Thailand today has one of the fastest growing economies in the world. In just a few decades it has become a world economic power, industrializing and urbanizing to such an extent that the
vast majority of its Gross Domestic Product (GDP) now comes from exports and foreign exchange (CIA, 2011; IMF, 2011). Thai people are very busy and productive. Its unemployment rate at 1% in 2010 has been among the lowest in the world (CIA), and its poverty rate is among the lowest in Asia. Per capita income has more than quadrupled in the past 4 decades (Jitsuchon & Richter, 2007). This is not the same Thailand of 50 years ago whose people mainly worked on the farm. Nor does it appear to be the same Thailand that will exist in the next 50 years. Presently, Thailand is a nation of approximately 67 million people (nearly twice as many people as reside in California), who are spread over a rich tropical agricultural territory about twice the size of the Oregon (CIA). This is a country made up of a multicultural, independent, industrious, spiritual people with a dominant language who have never been colonized (Malhotra, 2006). The reality is that Thailand’s current educational context is uncertain as a product of numerous forces that are vying to shape it. Major factors influencing the makeup of Thailand’s current educational system include its: economic (industrialization) structure, geographic (urbanization) structure, government (political) structure, social (anticolonial) structure, spiritual (Buddhist) structure, and educational structure.

**Economic (Industrialization) Structure**

Thailand’s educational structure has been being greatly influenced by its rapidly growing economy that has put pressure on educators to turn out a capable workforce. In 2010, Thailand’s GDP grew 7.8%—an expansion phenomenon that ranks it as one of the fastest growing economies in Asia and the world. In the same year, Thailand’s 37.25 million workers had an unemployment rate of 1.2%, giving it one of the lowest unemployment rates in the world (CIA, 2011). Also during the same year, Thailand
exported 1.6 million automobiles (an increase of 63% in just one year) making it the 13th largest producer of automobiles in the world (CIA). Two-thirds of Thailand’s GDP came from exports in 2010.

Thailand is presently regarded as a “newly industrialized country as of 2011” (IMF, 2011). This is a special category of what are considered by the International Monetary Fund (IMF) and others to be nations with economies that are more vigorous than those in the so-called developing world, but not yet possessing all the characteristics of a fully developed country (Bozyk, 2006; Guillen, 2003; Mankiw, 2007; Waugh, 2000). Thailand is also on many lists of emerging economies. The Center for Knowledge Societies (CKS) defined emerging economies as those, “regions of the world that are experiencing rapid informationalization (computerization)” under conditions of limited or partial industrialization (CKS, 2008).

Thailand is the number one exporter of rice in the world. It has the second largest economy in Southeast Asia, behind Indonesia. Forty nine percent of the population is employed in agriculture - a figure that has been going down since 1980, when it was 70%. This is a glimpse of Thai current national development; however, it goes only some of the way to characterize Thailand’s educational framework.

**Geographic (Urbanization) Structure**

Thailand is divided into 6 distinctive geographic regions based on natural features. There are 76 provinces in these geographic regions. Each province is divided into 877 districts. Thailand’s educational structure has been strongly influenced by its geographic patterns and urbanizing trends. There is a clear dichotomy between urban and rural education that will continue well into the future. An increasing number of people
are leaving rural areas to live in the cities and city suburbs, disconnecting them from rural culture that has played a dominant role in so much of Thailand’s past.

Thailand’s capital city and primary urbanized area is Bangkok that lies at the mouth of three large rivers. This is a densely populated city and suburban area of approximately 12 million people in a heavily urbanized megalopolis surrounding the Bay of Bangkok triangular area that is now the home of 20 million people (30% of the nation’s population). Thailand is the only land route connecting mainland Asia and Malaysia. Bangkok is the political, social, and economic center of Thailand. The city dominates by far all the other cities in the country in size, population density, economic activity, educational opportunity, transportation, industry, jobs, commerce, and services. All of Thailand’s cities have distinctive attributes that have been created from the unique blend of urban activities, industries and services they facilitate (Srikam, 2010). Bankok is also a major international tourist destination area that hosted over 10 million visitors in 2010.

**Government (Political) Structure**

Thailand’s government and political organization have significantly affected its educational structure as well. Thailand is the only Southeast Asian nation that has never been colonized. This political independence preserved the monarchy system as well the strong Buddhist culture (where much of its educational system traditionally resided). Thailand is currently politically organized as a constitutional monarchy. Since 1932 it has had 17 constitutions and charters and many government formats from military dictatorships to electoral democracies. It now has a prime minister, a directly elected bicameral legislature (with upper and lower houses) and an independent judiciary.
Although political crises and unrest have destabilized the government in recent years, with a continuation of coups, the basic structure of government has remained intact. The centralization of so much of Thailand’s vital government power, population, spiritual establishment, and business in the Bangkok region may be the most important reason why Thailand’s educational system has also been so strongly centralized.

**Social/Spiritual Structure**

Buddhist monks have strongly influenced much of the social organization of Thailand including its educational legacy perhaps since the time of Buddha 2,500 years ago. For hundreds of years temples were the centers of education and learning for the Thai people and monks were the teachers (Dhammapitaka, 1986). Although monasteries and monastery schools for the public were widespread, advanced education was only accessible to males who entered the Buddhist monastic system. Nevertheless, many of the everyday values of right and wrong, family social structure, and a way of life were practiced by Thai citizens in their home communities as a direct reflection of Buddhist principles passed on by the Monks over thousands of years. As secular and coeducational nationwide education replaced this kind of monastic male dominated education of the general population in the last century, Buddhism voluntarily assumed a supportive, yet influential role in providing societal guidance (Dhammapitaka).

Thailand is now a multicultural society of approximately 67 million people on its way to becoming more of a multicultural society with nearly 8% of the population who are migrants or expatriates from other countries (CIA, 2011). Thai is the official language of Thailand in education and government and it is closely related to Lao. English is now mandatory in the schools, but English fluency is reportedly not very high.
Many tribal languages are spoken in Thailand as well as Chinese and immigrant languages.

Thai culture shares similar values with many other Asian cultures including a high degree of respect for ancestors, gracious hospitality, generosity, maintenance of a social hierarchy, and respect for seniority. In recent decades, however, these fundamentals of Thai life have been changing. Under the influence of Western ways, schools, for example, no longer teach the principles of Dharma. While this has helped to create generations of Thai people who are, in general, better adapted to living in the modern world, there may also have been a loss of a moral support that has been fundamental to the sustainability of Thai culture (Dhammapitaka, 1986).

Perhaps sensing the impact upon the Thai soul of separating Buddhism from education, Drs. Susansuk and Rattanpan gained approval in 2003 from the Ministry of Education to undertake a project designed to include Buddhism in the primary and secondary school levels. The project has been simply known as “the Project”. Seventy-nine schools throughout the country participated in the program in which Buddhism was fit harmoniously into the national curriculum, so that all learning went forward with an emphasis on knowledge of Buddhism.

The Thai National Ministry of Education endorsed the concept that encouraged schools to apply Buddhism to organized systems of learning and teaching in schools. The goal of The National Education Act was for Thai youth to develop as complete people who are capable of being good persons with good health. This was also the original goal of Buddhism, which this project helped to define more sharply in terms of formal education. The development work of "School Buddhist Way of Life" has been
inspirational to Thai educational administrators at the national level. Buddhist philosophy is one of the pillars that may support the place-based science curriculum in Thailand. Students can learn science by connecting to scientific knowledge to the Buddhist philosophy.

The Educational Structure of Thailand

Thanks to a high degree of educational reform, Thailand is highly literate and has a well-organized educational system of preschools, kindergartens, primary, lower and upper secondary schools, vocational colleges, and universities (Ministry of Education (MOE), 2007). It has a significant private school system as well as a public school system. It is estimated that there are approximately 37,000 educational institutions serving 20 million students in Thailand (BIC, 2008). Education is compulsory for all children up to age 14 and free education is available for all up to age 17 (MOE). All appears to be going well on the surface, but in reality, there is strong evidence that this is not the case.

In contrast to Thailand’s high level of literacy, and despite a great amount of progress in education in the past decade, school curricula have been changing faster than teachers and students can cope, reflecting the rapid economic growth, globalization, urbanization, and political developments. Teaching currently relies heavily on rote learning and textbooks that may have unsatisfactory long term effects according to a number of educators who have warned against placing too great an emphasis on textbook learning (Fry, 2002; IEA, 2001). In addition, educational approaches of all kinds may well remain unstable given rapid societal and political changes that continuously place new challenges in peoples’ pathways under such influences (Fry).
In Thailand, one half the population is engaged in a slower paced, nature oriented, rural agricultural lifestyle, while the other half is engaged in a faster paced, urbanized, industrialized lifestyle. There is a striking contrast between completely different occupational, social, geographical and cultural contexts. This high level of divergence in lifestyle coupled with rapidly changing social and economic conditions may create a strong argument for avoiding one-size-fits-all educational approaches that work well in some situations, but not well enough in others. Liow (2004) issued a frank warning about this situation saying in effect that when educational curricula are considered irrelevant because lessons do not address issues of concern to students, or the converse. When such lessons address issues that are of no concern and make no connection with students, trouble typically ensues. And, it fact, consequences arising from just such a state of affairs have occurred on numerous occasions especially in the recent past two decades after wave after wave of critics and reformers have expressed their opinions.

Several other serious issues have manifested themselves in less than acceptable educational and learning outcomes in Thailand: imbalanced allocation of qualified teachers to urban and rural schools; inadequate teacher training; funding imbalances and disparities between urban and rural schools; the difficulty of counterbalancing the flight to urban area schools; neglect of Thai culture, traditions and community; school curriculum that does not support individual student learning; and learning mismatches between home and school.

**Imbalanced Allocation of Qualified Teachers to Urban and Rural Schools**

There has been a growing concern that there may be a great disparity in the distribution of qualified teachers between urban and rural schools, in part because of the
concentration of most of the political and industrial power and financial resources in Bankok (Fry, 2002; Kantabutra & Tang, 2007; Raudenbush, Kidchanapanish, & Kang, 1991). More qualified teachers are in the urban schools than in the rural schools. However this came about, this imbalance may be exacerbating the flight to urban school districts as people sense the disparities. Disparities also exist in teacher specializations, for example the number of teachers who are qualified to teach science.

Inadequate Teacher Training

Inadequate teacher training is a major concern among educational administrators in Thailand for several reasons. First, they are dismayed by the fact that teachers have a difficult time keeping students sufficiently motivated to learn their lessons, which is revealed by poor test scores (Bangkok Post, 2011; Ghosh, 2011; Lathapipat & Panpiemras, 2011). Second, there is widespread concern that the material being taught is irrelevant to a student’s lived experiences, as reflected in the lack of student enthusiasm for schoolwork and high dropout rates (Bhumirat, 1984; Ordonez, 2002). Third, employers have noted that students seemed poorly prepared for the workplace, despite having attended secondary schools (Gross, 2001). A fourth concern is the prevalence and amount of rote learning that teachers assign (Reuters, 2011, The Nation, 2010). Finally, there appears to be a limited palette of teaching methods that teachers employ. This requires supplementation (Hayes, 1994). Rural teachers are more in need of teacher training than urban teachers, but there seems to be less money available for rural teacher training (Foley, 2011).
Funding Imbalances and Disparities between Urban And Rural Schools

In addition to disparities in the allocation of good teachers to urban and rural schools, there is also talk of imbalances in financial resources for facilities, textbooks, teaching aids, and curricula (Kantabutra & Tang, 2007; United Nations, 2001). Rural schools apparently do not have the professional experience or resources to develop themselves without outside assistance.

Counterbalancing the Flight to Urban Area Schools

Parents and students are leaving their agricultural and rural lifestyles for urban alternatives for a variety of reasons. One of those reasons is the level of quality of the education that students receive and its value in preparing students for future jobs. Jobs in urban areas are more plentiful and in higher paying industrial businesses like automobile and computer manufacturing. Jobs in rural areas are less plentiful in part because educational experiences to better prepare students for future jobs in this sector of the economy are not available (De Jong, Richter, & Isarabhidhi, 1996). For the nation to deter students from leaving rural areas, more educational opportunities will need to be provided in rural areas that are relevant to rural employment opportunities (Goldstein, Prachuabphoh, & Goldstein, 1974).

Neglect of Thai Culture, Traditions and Community

In the push towards greater economic prosperity, Thai society has become more materialistic, secular, future oriented, internationally oriented and less concerned with past traditions, community, and culture especially in the highly urbanized areas (Samudavani, 1995). This follows the path of prosperity being experienced in other
nearby rapidly developing nations such as Japan, South Korea, Malaysia, and the Philippines. These changes have, in turn, motivated educational changes deemphasizing Thai culture and community.

**Non-Learner Centered Curriculum and Learning Mismatches**

In the national effort to provide compulsory universal education for all Thai children with its emphasis on high achievement in basic academic skills, there has been a standardization effort that has played down the individual differences that naturally exist between all people. Providing curriculum support for individual student learning has not occurred in the process, perhaps because it is difficult to fit into standardization procedures, and it is difficult to value (Ampra & Thaithae, 2001).

Because of the top-down and centralized educational system and curricula presently in place in Thailand, “one-size-fits-all” approaches to education have been predominant. This approach is characterized by the use of multi-cultural and multi-language textbooks, chalkboards, and teacher lectures that have been found to be disconnected from Thai culture, traditions, and local conditions and consequently believed to be irrelevant (Liow, 2004). In this framework, students do not have the chance to learn from real phenomenon in their own communities; they lack role models; they lack opportunities to connect or apply scientific knowledge to everyday life; they never have the opportunity to experiment, engage in trial and error, and develop their own creativity; and they never have a chance to communicate their ideas with their teachers and parents (Foley, 2011; Hopkins & Chaimuangdee, 2000; UNESCO, n.d.). The educational performance of rural area students is weak. The results are seen in in low standardized test scores, limited ability to read and write, low self-confidence, limited
creative expression and negative attitudes about learning and science (National Institute of Educational Testing Service (NIETS), 2009).

**Recent Historical Context of Thailand’s Education Policies**

The current system of formal education consists of four levels of education: one or two years of pre-school education; six years of compulsory primary education; six years of secondary education (three years at the lower secondary level and three years at the upper secondary level); and two or more years of higher education at the college level. This system has been largely fulfilled in urban areas where increasing numbers of people have migrated in recent decades. In the past few decades, national efforts have been directed to raising the overall educational standards of the nation to meet the development needs in technology and advanced agricultural methods. Efforts have resulted in the expansion of basic education in rural areas from six to nine years, including six years of primary education and three years of lower-secondary education.

In 1985, Thailand began evolving from an agriculturally based economy to an industrially based economy, which impacted the educational system (Rigg & Nattapoolwat, 2001). In the 1990s, Thailand experienced rapid economic growth and became a more industrialized nation, influenced by Western ideas and markets. Education became focused on producing a young generation of Thais prepared to work in many new industrial sectors. The curriculum stressed industrial skills more than traditional academic subject matter, cultural beliefs and social values. As a consequence, students became better prepared for industrial types of work and less prepared to apply their knowledge to better manage their everyday lives. Accompanying these changes were more and more Western ideas that began to influence Thai society. For example,
materialism became dominant in Thai society and Thai communities began to break down and lose their traditional strength.

**The First Decade of Education Reform in Thailand (1999-2008)**

After the crisis in 1997, the Thai government rewrote the constitution and among other things formed a new (Eighth) National Education Development Plan (1997-2001) that was designed to help prepare for technological and global changes by providing basic education for all people through secondary school, and the reform of teaching and educational administration. In 2000, as numerous education departments were consolidated and centralized into the Ministry of Education, all schools were required to pass education reforms to raise standards and conform to a standardized curriculum by 2005. As part of the reform, the National Institute of Educational Testing Service was established on September 3, 2005 (NIETS, 2009).

**The Second Decade of Education Reform (2009-2018)**

In the second decade of educational reform, reeling from intense criticism that the previous reforms were irrelevant for many and left the country worse off than they had been before, the focus was re-envisioned to be the quality of life-long learning for the Thai citizen which meant raising educational standards, extending opportunities, decentralizing education to all economic sectors, and providing new opportunities for place-based education. The first reform was not successful in learning, decentralization, and professional development of teachers. For example, the NIETS results have been disappointing. For the Ordinary National Education Test (ONET) (NIETS, 2009), which measures the student performance and whether the students could perform according to the objectives as set in the Basic Curriculum at the end of Prathom 6 (Grade 6),
Mathayom 3 (Grade 9) and Mathayom 6 (Grade 12), students scored under 50% in all areas except Health and Physical Education and Career and Technology. In addition, the science score was only 41.56% (see Table 1). These results included students in both rural and urban areas.

Table 1. *The National Test Result Average Score for Sixth Grade, 2007-2010 by NIETS*

<table>
<thead>
<tr>
<th>Subject</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thai language</td>
<td>36.50%</td>
<td>42.02%</td>
<td>38.58%</td>
<td>31.22%</td>
</tr>
<tr>
<td>Social studies, religion, and culture</td>
<td>-</td>
<td>-</td>
<td>33.90%</td>
<td>47.07%</td>
</tr>
<tr>
<td>English</td>
<td>38.66%</td>
<td>-</td>
<td>31.75%</td>
<td>20.99%</td>
</tr>
<tr>
<td>Mathematics</td>
<td>47.54%</td>
<td>43.76%</td>
<td>35.88%</td>
<td>34.85%</td>
</tr>
<tr>
<td>Science</td>
<td>49.57%</td>
<td>51.68%</td>
<td>38.67%</td>
<td>41.56%</td>
</tr>
<tr>
<td>HE/PE</td>
<td>-</td>
<td>-</td>
<td>64.76%</td>
<td>54.31%</td>
</tr>
<tr>
<td>Art</td>
<td>-</td>
<td>-</td>
<td>42.49%</td>
<td>41.10%</td>
</tr>
<tr>
<td>Career and Technology</td>
<td>-</td>
<td>-</td>
<td>51.69%</td>
<td>52.25%</td>
</tr>
</tbody>
</table>

In the second decade, according to the policy makers, Thai education needs to improve in teacher quality, the quality of the curriculum and learning, the development of moral and ethical character, and in connecting the national curriculum with the local communities (Office of the Basic Education Commission (OBEC), 2008).

**Thai National Curriculum**

The 2001 Curriculum for Basic Education was formulated at the national level. Since late 2006, developments in education were limited following the overthrow and
replacement of the elected government by the military. In 2007, a new constitution was passed and elections were held in December.

There have also been problems in rural areas because the curriculum was modeled to work mainly in urban areas. Rural communities have experienced difficulties because of the low level of ability of teachers and administrators. In response to this problem, the Ministry, through its Office of the Basic Education Commission (OBEC, 2008), revised the Curriculum 2001 and renamed it the Basic Education Core Curriculum 2008. This detailed document attempted to provide very clear guidance to administrators and teachers in rural areas on matters including curriculum standards, evaluation criteria, and time to be allotted for each subject in each grade. Schools were also allowed to adjust the curriculum in accord with their own priorities, student abilities, and backgrounds. In this way the new curriculum offered the opportunity for the application of place-based teaching techniques.

Initially, Thai education and curriculum standards were centralized in the Ministry of Education and were in use throughout Thailand. These policies were often subject to change based on the policies of the political leadership in Bangkok. This approach was not successful in rural areas where a National Curriculum was not relevant to local needs. Fortunately, in 2005, under the Thai Education Reform Act, the system was decentralized, and authority given to the districts to manage their own education systems. Under this new format, rural districts could develop relevant education programs provided they met the requirements of the overall national standard and policy.

When the districts were given management authority, local schools were then able to create curricula suitable for their localities. Local school management then became
more responsive and efficient. Despite this progress, rural schools still faced a lack of financial resources and professional staff. Rural teachers came under pressure to focus on teaching students to pass tests so that they could continue on to study in more prestigious schools elsewhere. This emphasis on improving test scores was based on the premise that if the local school established a reputation for producing a high number of students that got into prestigious schools, word would get around, enrollment would increase, and more money would be attracted for the school and the teachers. Unfortunately, the strategies backfired because teachers did not spend time developing themselves and the school curricula well enough to link general academic knowledge to the community. Among other things, focus on tests within the curriculum resulted in students having little or no sense of community upon graduation. Following graduation, many students moved to cities to study or work and did not return.

On the surface, Thai education planning and policy may appear good; however, the results have not been successful, in part because they have not integrated Thai culture, community and place into classroom learning. National tests focused on academic achievement at the expense of practical experience, cultural connection, integration and relationship between the school, the community, and activities undertaken for the moral and ethical development of the student as a good member of society. Teachers were trained in Western teaching techniques, a pattern applied to teachers across all districts. Little thought was given to adapting or applying the Western curriculum to the school and community at the local level.
Curriculum Options

Given all of the historic and educational context factors that have contributed to the present challenging state of educational affairs in Thailand, the researcher has posited that the curriculum approach that may hold the most promise in meeting the challenges that lie ahead may fall within the broad boundaries of an educational approach known as place-based learning – a concept similar to and associated with social and situated learning, problem-based learning, project-based learning, and community-based learning.

Place-Based Education

Placed-based learning is an educational technique using elements present in the community culture and immediate environment. Although some of the principles have been practiced for many years, the term place-based education began to be used in the 1990’s as an educational philosophy by the Orion Society, an educational non-profit based in Massachusetts, and by Professor David Sobel, project Director at Antioch University (Sobel, 2005).

Many other terms have been used to describe the concept of place-based education. Other expressions include social and situated learning, problem-based learning, project-based learning, community-based learning—as well as environmental education, sustainability-education, and experiential education. The approach of place-based education gets down to what is uniquely local (as distinguished from regional, national, or global)—namely, the environment, culture, economics, politics, art, and literature of a particular place. In this instance, “place” refers to the immediate neighborhood, community, or town—in other words, the smallest unit of social organization larger than the family. The term experiential used in the description is
intended to mean direct, hands-on, and learning-by-doing (as distinguished from abstractions and generalizations that are described in books) (Sobel, 2005).

**The Origin of Place-Based Education**

According to Woodhouse and Knapp (2000), place-based education originally developed as an extension of progressive education theory proposed by educational philosopher John Dewey more than 100 years ago. Dewey (1997) explained that school is connected to the community:

> I believe that the school is primarily a social institution. Education being a social process, the school is simply that form of community life in which all those agencies are concentrated that will be most effective in bringing the child to share in the inherited resources of the race, and to use his own powers for social ends. (pp. 77-88).

The connection of the community and real experience of a student’s life to the school were further described by Dewey (1997) to explain the relationship of the child to the school and society:

> We must conceive of [real community life experiences] in their social significance, as types of the processes by which society keeps itself going, as agencies for bringing home to the child some of primal necessities of community life, and as the way in which these have been met by the growing insight and ingenuity of men; in short, as instrumentalities through which the school itself shall be made a genuine form of active community life, instead of a place set apart in which to learn lessons. (p. 23)
Before the term “place-based education” existed, in the late 19th century Dewey (1997) advocated using the term “real world” to describe a form of student learning in the classroom. There was significant resistance to this idea because the teacher was thought to be the major influence of thought and knowledge in the classroom, the one who interpreted whatever took place in the real world. In response, Dewey pointed out that the process of student learning develops through interaction with actual phenomena instead through hearing or reading about phenomena (Smith, 2002). Smith asserted that “valuable knowledge for most children is knowledge that is directly related to their own social reality, knowledge that will allow them to engage in activities that are of service to and valued by those they love and respect” (p. 586). Place-based education has become known for creating learning opportunities by using place (where the school is located or where the students come from). These descriptions from progressive education support the researcher’s understanding that place-based education is the connection between abstract knowledge and specific places or communities.

**Connection of Environment, Culture, and Citizenship**

The philosopher David Sobel connected the importance of place to children’s nature study (Sobel, 1993; 1996). Sobel (2004) explained the importance of connecting place-based education to the local community:

Place-based education is the process of using the local community and environment as a starting point to teach concepts in language art, mathematics, social studies, science, and other subjects across the curriculum. Emphasizing hands-on, real world learning experiences, this approach to education increases academic achievement, helps students develop stronger ties to their community,
enhances students’ appreciation for the natural world, and creates a heightened commitment to serving as active, contributing citizens. (p. 7).

In place-based education, student learning is also connected to the community, culture, natural resources, history, and geology of place. Other place-based educators have expanded Sobel’s conception of place-based education, connecting it to the local community and environment. According to Woodhouse and Knapp (2000), place-based education (PBE) is based on the concept that “education should prepare people to live and work to sustain the cultural and ecological integrity of the places they inhabit” (p. 4). Place-based education has been described by Woodhouse and Knapp as an outdoor activity, community-oriented schooling, ecological education, and bioregional education. Smith (2002) indicated that placed-based education involved cultural study, nature study, real world problem solving, internship and entrepreneurial opportunities, and induction into community processes. Loveland, Woodhouse, and Knapp asserted, “place-based learning and civic engagement have emerged over the past decade as the rich ecotone of environmental education, conservation, and community development” (The Center for Place-based Learning and Community Engagement, 2008, p. 3).

Place-based learning has roots in the environmental education movement in the United States forty years ago. Later, the integration with learning standards expanded beyond the natural environment to include the "cultural, social, and economic conditions of place" (The Center for Place-based Learning and Community Engagement, 2008, p. 3). Because people have a strong attachment to their communities, place-based learning promotes ecological and cultural literacy, conservation, and community stewardship.
Loveland (2003) further explained the connection that place-based education has to environment, culture, academic achievement, and citizenship:

Place-based education is learning that is rooted in what is local -- the unique history, environment, culture, economy, literature, and art of a particular place. The community provides the context for learning, student work focuses on community needs and interests, and community members serve as resources and partners in every aspect of teaching and learning. Together we have discovered that this local focus has the power to engage students academically, pairing real-world relevance with intellectual rigor, while promoting genuine citizenship and preparing people to respect and live well in any community they choose. Place-based learning helps schools and communities get better together (p. 1).

As Stern (2006) reiterated, “Place-based education is an educational philosophy that derives its curriculum from the locale” (p. 139).

Themes of Place-based Education

Smith (2002) divided the concept of place-based education into five thematic patterns. These thematic patterns, discussed below, include cultural studies, nature studies, real world problem solving, internships and entrepreneurial opportunities, and induction into the community process.

Cultural studies. According to this approach, students are encouraged to investigate the historical and cultural traits of the life of people in their local community. Moreover, students have a chance to present their works and share their experience with community members.
Nature studies. This approach uses the local natural phenomena of a particular place as a context for learning. According to Smith (2002), place-based education in the form of nature studies uses the students’ “inborn curiosity about the physical world” to provoke student interest (p. 588). The Environmental Middle School in Portland, Oregon, is an example where natural phenomena are the center of the school policy. Two days of school a week are reserved for work in the community or in the field. After adopting this learning approach for the school curriculum, the school reported a high level of student performance in comparison to students in other Portland schools.

Real world problem-solving. The “real world” problem solving approach to place-based education provides students with engaging opportunities to learn about the school and community issues in which they are interested. Based on these issues, the students are encouraged to identify local problems, select one to focus on as a class, research the topic, identify a potential solution, and play an active role in addressing the problem. This approach arguably enhances students’ sense of place, as they enact their role as a member of the community.

Internships and entrepreneurial opportunities. This approach provides students with a chance to think about local vocational options—entrepreneurial and employment options in their own, rural communities. They are encouraged to find and create their own economic opportunities within the community, rather than leave the place to seek jobs somewhere else. Smith (2002) pointed out:

… in addition to helping young people learn about the local culture, natural phenomena, and problems, a place-based education approach that links school learning to locally available occupational opportunities, provides young people
with the confidence and initiative they need both to remain in their communities and to be of service to their families and neighbors. (p. 591)

**Induction into the community processes.** This approach is perhaps the most comprehensive form of place-based education. According to Smith (2002), it aims to turn the school and students into “genuine intellectual resources” that exercise the responsibility needed both to represent and to address community needs in government and business. (p. 591). This approach trains students to be active participants in the community, asserting that they are as entitled to do so as adults. They can express their concerns and ideas, and exercise their knowledge of community issues. This approach is based on the notion that the best learning takes place when people are involved in real-world processes while addressing real-world challenges. Smith reported that one example of this approach occurred in Oregon. In this process, the students had a chance to share their needs from the viewpoints of children and to play active roles as community members. These roles included using global positioning technology to map salmon and bird habitats.

As examples of place-based education take varied themes as described above, it is common for rural schools to adopt more than one theme in their communities. In some rural areas in Thailand, culture and nature studies might be the main focus of the school curriculum; whereas in other areas, all five themes of place-based education might be applied. The nature of place-based education, therefore, varies appropriately from place to place. It is very important that when applying place-based education to the school curriculum, it should support and fit well with the students’ and the community’s needs.
**Sense of Place in Rural and Urban Areas**

A sense of place exists in both rural and urban areas. According to Apo (2006), a sense of place means:

It can be as large as a country or as small as a coffee shop. Sense of place is about the feeling that emanates from a place as a combination of the physical environment and the social construct of people activity (or absence of) that produces the feeling of a place. (p. 8)

Kaupu (2006) further explained:

Sense of place is the knowledge of who you are, where you come from and those treasures that have been passed from generation to generation to be used in such a way to enhance all that you do to honor the past, function in the present and set a solid foundation for the future. (p. 9)

Jayanandhan (2009) asserted that students in both rural and urban locations can develop a sense of place. Place-based education in rural areas is:

. . . rooted in (and sometimes synonymous with) environmental education. It emphasizes the role of place in education as something to develop connections between students and their surrounding environment. Field trips, interactions with community members, and strong connections between curriculum and the surrounding world help ground learners in communities and in a relationship with the land. (pp. 104-105)

As discussed by Jayanandham, in urban Black communities, critical pedagogy of place (Gruenwald, 2003) is important for connecting “not only to ecology and community life but also to social struggle and resistance” (p. 105).
According to The Center for Place-based Learning and Community Engagement (2008), in the early 1970s U.S. educators developed a place-based curriculum by focusing on awareness and human relationships with the natural environment. This curriculum was called “environmental education” in the school system but was not part of the standardized curriculum. Since that time place-based education has emerged from “environmental education” to include the social, cultural, and economic aspects of place that are necessary for learning about environmental stewardship. In a review of “Place-based Education in a Global Age: Local Diversity” (Gruenewald & Smith, 2008), Hayes-Conroy (2008) stated that place-based education “requires a focus on what lies beyond the bounds of any one community or locale—that is, on the relationships between places” (p. 1). Students “must feel the connections between their education in school and their lives beyond if they are to be motivated and inspired to continue learning” (Hayes-Conroy, p. 2). Place-based education is about where people live, but it is also important to consider all students’ perception of place, multiple viewpoints representing differences in socio-economic background, gender, or ethnicity. Place-based education has the capacity to promote social learning, in part arising from student diversity, as well as environmental learning.

The place-based education approaches outlined above are offered as examples of ways in which such an educational approach may be effective. In this study, the researcher explores ways that place-based education can be used in a science-education context as well as ways it may help rural schools develop an effective curriculum for the local communities and eliminate the gap between learning opportunities within urban and rural schools. In doing so, the researcher explores ways rural schools may be assisted in
meeting national curriculum standards and traditional Buddhist spiritual/cultural morality and ethics.

**Examples of Place-Based Education Around the World**

**United States.** Loveland (2003) presented information on the academic success achieved by using place-based education in five different states including: Alaska, Oregon, Nebraska, Colorado and California. In Alaska, place-based education techniques were used in a program known as the Alaska Rural Systematic Initiative (AKRSI) in the teaching of mathematics and science connecting indigenous knowledge, culture, and the local environment to the formal education system. The program was initiated with students in the Russian Mission School who before the program had the lowest test scores of all 12-16 year old students in its district, and had one third of students not attending school. The curriculum included unique activities for each season of the year. Students were sent out into subsistence camps where they learned about fishing, medicinal plants, hunting, and the beaver habitat, helping to make science more meaningful and connected to their lives. At the same time, the students also learned concepts that connected to Western scientific knowledge and technology. Among other things, students learned how to use digital cameras and laptop computers to create Web pages. Ultimately, academic performance rose 24.3% and the number of dropouts decreased because the curriculum offered students the opportunity to learn something related to their life and their community. When the students became more interested in school, then their academic achievement improved. However, project directors indicated more research was needed to track continued student academic performance, extending to higher education.
In Tillamook, Oregon at Tillamook Junior High School—a national service learning leadership school—teachers designed a place-based education program linked closely with academics. In one project, students worked with the Oregon Department of Forestry to survey the status of cutting areas and help calculate how many trees and stumps remained after logging. Students entered their measurements and calculations into an Oregon Department of Forestry mapping and data program where they were found to be virtually identical as the measurements determined by professional surveyors. Although this kind of project was time consuming and may have conflicted with time needed for other classes, not only did the students learn how to apply science and math skills, but they also learned a considerable amount about working collaboratively while taking great pride in participating a community project.

In Colorado, K-8 students at Guffey Community Charter School have learned general principles of science by practicing “real science” alongside a “real physicist” in a local, “real scientific research” program. Monitoring the stars two afternoons a week in a Denver Museum of Nature & Science program called "All Sky," they learned how to monitor the movement of meteorites and fireballs with a sky watch camera; analyze, compile and code data; and transmit the information back to the museum for further processing and analysis, making science relevant for the students by getting them involved in hands-on data collection and analysis with an actual working scientist (instead of a non-technically oriented general science teacher).

In Nebraska, an entrepreneurship class at Boone Central High School in Albion engaged in redesigning, renovating and running a local movie theater. Students were involved in a comprehensive program that included site visitation, financial analysis, site
planning, renovation fund-raising, physical renovation, marketing and operating the theater completely by themselves. This use of place-based learning has taken education to a new and highly practical level for the students.

Snively and Williams (2008) asserted that they achieved more meaningful results working with Alaska Native students when place-based learning techniques were used. Prior to the introduction of such techniques, Kawagley (1999) noted that native Yupiaq children were expected to learn humanities and sciences in what to them was a foreign language. Under place-based learning, careful attention has been paid to the nature of the Yupiaq people and their culture.

Yager (2003) noted that integrating place-based education into the school curricula is more interesting and practical for students, enabling them to learn through actual experience of real phenomena that they cannot achieve through textbooks or classroom lectures.

Chinn (2006) reported on a professional development program in which a group of non-Hawaiian teachers was brought together with ethnic Hawaiian teachers and students in a five-day full immersion academic and cultural program to sensitize particularly the non-Hawaiian teachers to the outlooks and traditions of the Hawaiian environment and Hawaiian culture. The experience allowed non-Hawaiian teachers to understand Hawaiian views of culture and prepare lesson plans and activities to help students receive outside knowledge and at the same time keep their own identity. Chinn also described a place-based educational experience in which high school students paddled canoes out to reef flats with ethnic Hawaiian scientists and ecologists to learn how to use GPS, quadrants, and water-test kits. Students combined traditional practices
with removal of invasive seaweed and environmental monitoring and experienced the value of “doing” hands-on science.

Barnhardt (2006) suggested that curriculum should integrate the best Western knowledge and local culture to preserve local environment and traditions. Zehr (2007) reported a demonstration of this with a Navajo Immersion School that has been successful in meeting student-achievement goals and making the connection between the school, the community, and real life by integrating Navajo language and culture into its curriculum. Other schools in the district that were not following this curriculum were not successful because the content was separated from the community and did not make sense to the students.

In a place-based education project in Arizona, Semken and Freeman (2008) investigated students’ place attachment (bonding with a place through direct experience) and place meaning (emotionally attaching to place). Significant changes were found in both place attachments and place meanings in the experimental group, thus indicating the effectiveness of place-based education programs in helping participants connect with their local community. Semken and Brandt (2010) also asserted that place-based education can help groups such as the Yavapai and Apache Native Americans, Hispanics, other ethnic groups and the U.S. Government who have been experiencing generational spiritual, emotional, and values conflicts over the use of Arizona desert lands to better understand the positions of the others.

United Kingdom. Harrison (2010) asserted that when place-based education is located in a particular place, students learn about the place by being involved in sustaining the place they are living in. For example in the Carnegie rural charter schools,
place-responsiveness was learned through outdoor activities and holistic outdoor learning. According to Harrison, place-based education increased “learner appreciation for the close at hand, to develop their own critical awareness of their locality and to take part sustainably in the life of their home place” (Harrison, p. 2). In the U.K. students use the internet to connect outside knowledge with their own place.

**Canada.** In Canada, place-based education has been applied to different subjects (e.g. mathematics, art) and grade levels, while including the indigenous people by using cultural themes. Within each province and territory, the school principal and teachers in each school have a significant role in implementing the education curriculum in the classroom. Place-based education takes place in the formal school context as well as in community organizations outside of formal schooling, including zoos, museums, youth and other groups (Canadian Environmental Grantmaker’s Network, 2006). Although each province has goals or language focus, there is not a coordinated approach.

Place-based education emphasizes the connection of students to the local community, including the culture, history, economy, and the natural and human-made environments. Policy makers in Canada support and pay attention to place-based education by giving education program grants. In the formal education system, school boards are responsible for the budget in the schools. Each school has its own curriculum that fits into the place and school setting. The school principal and teachers have a decentralized role in implementing the education curriculum in the classroom. The government supports teacher training (Conference Board of Canada, 2009).

Inwood (2008) studied teachers in a school where place-based education was applied in art classes to study sustainability using local materials from the environment
surrounding the school. Students thus received a more holistic art education in which the entire practice of producing art was presented and learned.

Some have contended that even though the Canadian educational system is decentralized, most curricula are top-down driven with learning content that is irrelevant to indigenous people. Aylward (2007) asserted that there are distinct divisions between life and school in indigenous rural communities. Rather than focusing on differences, rural educators and students can benefit from an educational policy that focuses more on bottom up community issues, allowing for the tensions and conflicts to be negotiated and for meaningful learning to take place.

Similarly, O’Conner (2010) examined experiential and place-based educational programs for First Nations students in the Yukon Territory and the Cree Nation reserve in northern Alberta. Through action research, the researcher explored factors involved in engagement and improved educational outcomes for indigenous students. Specific themes were identified at both sites, including: the importance of partnerships within the community, alternative forms of evaluation, engagement of students through field studies, use of indigenous knowledge and culture in the curriculum, and attention to sustainability issues. Rather than focusing on Western knowledge, O’Conner found that teachers are more engaged when they can become more generative in their teaching and learning by relating to local values and systems of knowledge. For example, O’Conner explained that an important aspect of experiential learning and indigenous thought is interconnectedness and relational learning. Rather than top down lessons that fragment subject matter, helping learners organize information holistically and globally is very important in curriculum design. Further, rather than focusing on top down, standardized
tests, O’Conner used broader multi-faceted forms of assessment such as portfolios, journals, personal narratives, and peer evaluations allowing students to provide meaning and a context for learning.

In another study, Lewthwaite (2007) used the critical lens of the Kaupapa Maori Theory to study the role of the principal in the transformation of a northern Canadian aboriginal school from a *school in the community* to a *community-based school*. The researcher found that the school’s administration was very supportive of the school science curriculum that was connected to local community aspirations and in which cultural artifacts were displayed throughout the school. These artifacts, for example, included cultural value statements, elder photos and biographies, and local displays of community history.

Finally, place-based education may be seen as a chronotope—the connection of indigenous people to a place through time (van Eijck & Roth, 2010). In this place-based education study, indigenous participants were engaged in a dialogue with scientific voices about a coastal region of British Columbia, Canada, known as Tod Inlet Marine Park where there was a strong indigenous attachment that was much different from that of the European settlers. Unlike the Europeans, the connection of indigenous people to the land was established through elders.

**Ecuador.** Schroder (2006) described a study in Ecuador that brought together local and external knowledge systems by exploring the interactions of three concepts: native indigenous science, inter-culturality (ways that Western and local scientists interact and integrate these discussions into our classrooms) and place-conscious
education. Place-based education was seen as a way to defend communities against economic, cultural and other types of encroachment by the larger society and the world.

**Malawi.** Glasson, Frykholm, Mhango, and Phiri (2006) worked with Malawian teachers to document teacher learning and the development of a place-based science curriculum using inquiry-oriented teaching strategies. The curriculum was designed to connect indigenous knowledge with science learning. Prior to the study, place-based education was not part of the national curriculum and science-teaching strategies were primarily lecture based. Later, the Glasson, Mhango, Phiri, and Lanier (2010) further investigated local funds of knowledge related to indigenous farming. Third space theory (Bhabha, 1994)—the negotiated realm of overlap of first space (local knowledge) and second space (global science knowledge)—was used to help learners create a new synthesis of understandings. Indigenous knowledge was used to develop a pilot agricultural curriculum that used mobile phone technology to help connect a local farmer with a classroom teacher to assist students in growing an organic garden (Glasson, 2010). This research did not document student achievement on standardized assessment measures.

**Asia-Pacific (Australia, Samoa, Taiwan).** In Australia, Bartholomaeus (2006) asserted that place-based education was important in rural school settings where education is becoming increasingly important to local businesses and farms who are struggling to prosper. In these cases local heritage plays an important role in integrating education with community support and economic survival.

Rae and Pearse (2004) asserted that there is value of place-based education in urban settings where in the age of on-line learning and electronic media, place-based
education may be an especially important complement as an ecologically holistic, outdoors activity where students learn about sustainability and develop a sense of responsibility and ownership in sync with the ethos or spirit of the local rural or urban community they live in.

Davis and Stocker (2006) illustrated how case studies of the adoption and restoration of beaches by government working with school children in local coastal communities in Australia were an example of how place-based education was effective in teaching sustainability and stewardship.

Tavana (1994) confirmed the high failure rate of Samoan high school students, and attempted to identify the barriers to success as well as Samoan core values to increase the students’ rate of success. Barriers were identified connected with Western Samoa’s education system and curriculum that has a Western bias that is not relevant to everyday life in Samoan society. Tavana proposed a curriculum that integrated local knowledge, culture, and a sense of place. Among other things it was suggested that students go to college and bring back technology to preserve indigenous knowledge in local communities by interviewing elders, church leaders, and business leaders to preserve their identity and Samoan knowledge.

Wen, Kao, and Tsai (2010) asserted that educational reform in Taiwan using place-based education should focus on the quality of citizen life emphasizing that “native awareness and a global perspective, includes a love for one’s homeland, patriotism, a global perspective (both culturally and ecologically)” (p. 1). They then pushed forward with a plan and studied the results of their case study. Among their findings were that their place-based education approach enabled students to become emotionally place-
dependent giving students a greater incentive to learn about their environment, gain community support, and fulfill expectations for their education.

Chinn et al. (2010) reported the results of working with a team of rural Taiwanese professors, tribal elders, and teachers, who developed place-based lessons that integrated science and culture for both mainstream Han Chinese and indigenous students. The researchers discovered that students learned best from teachers working in association with community elders by actively practicing local arts, listening to local music, and reading local accounts.

**Place-based Education in Thailand**

Suwannarat (2002) presented a case study concerning students who learned about an environmental problem from a rural local rubber plantation community in southern Thailand. A serious problem arose because local workers did not understand the danger that acidic processing chemicals posed. When a number of people burned themselves by stepping on the rubber barefoot a teacher saw a learning opportunity by bringing the situation into the classroom. After studying the problem and learning about acid-based chemicals, the students helped their community understand the problem and remedies. Ritchie (2007) showed how place-based education might be an enduring and powerful way for students to understand the culture and ecology of Thailand through the use of field trips to local forests and rivers with community volunteers enabling both an understanding of place, along with history, culture, biohabitat and seasonal changes. Crites (2007) described insights about the connections between humans and the environment that is derived from spiritual beliefs.
Klechaya and Glasson (2011) investigated how Thai and U.S. science educators in an urban Thailand school used place-based education to teach science lessons about ecological sustainability and culture while fulfilling national curriculum standards. Primary school students conducted experiments growing locally available plants in enclosed jars to observe evaporation and condensation, measuring the amount of water in plants, and observing transpiration while working in groups under the guidance of the teachers and the participation of the local parents and community guest speakers. Class discussion topics included growing rice, minimizing wasted lunch, the water cycle, and conserving water at home reusing wastewater for growing plants. Students presented their findings through Internet video with a U.S. science educator collaborating on this project.

Evaluation of the results of this Thai project in place-based science education demonstrated that inquiry science teaching and project-based learning could be successfully integrated, modeled and implemented through a professional development program. Classroom teachers generally underestimated what the children could accomplish as non-readers. Children enjoyed learning science through inquiry. The teachers were impressed by the children’s questions and thinking. Similarly, the parents were impressed with the accomplishments of their children.

**Connection to Learning Theory and Approaches**

Place-based education is connected to social, situated and community-based learning theories. Social learning theorists have posited that people learn by observing others (Merriam & Caffarella, 1991). Similarly situated-learning theorists contend that teachers can use the real situations to understand real life, linking literacy and language, social studies, mathematics and science to a model of learning connecting home and
school culture; and by extension this theory also can connect local, Western, school and outside-of-school knowledge (this can also be described as a student’s “funds of knowledge” (Gonzalez, Andrade, Civil & Moll, 2001).

In both urban and rural societies, students learn within zones of proximal development (ZPD) (Vygotsky, 1962). This term refers to the contextualized learning space in a classroom where dialogue among teachers and students take place. Situated learning together with place-based education may help student learning be more meaningful. ZPD applies not only to learning by students but also to the interactions between people in society and the community. The value of local funds of knowledge is found in and applies to everyday life. In contrast, school and classroom-based, generalized, decontextualized, Western and formal knowledge is usually found in books.

**Applying Place-Based Education in Thailand**

From the literature review, place-based education has been developed and implemented mostly in Western countries and especially in the U.K., Canada, Australia, and the U.S. (Harrison, 2010; Inwood, 2008; Sobel, 2004, 2005; Woodhouse & Knapp, 2000). In the pilot study, the researcher applied place-based education as an alternative Western educational concept to solve problems in rural schools in Thailand. The researcher developed the concept by adapting it to the needs of primary schools in rural Thailand. By working with the teachers, students, and the community, the researcher became aware of how place-based education could make learning more effective by looking carefully at the structure of the place, school, community, and National Curriculum. What emerged was the researcher’s insight that the missing part of place-based education as a Western concept of situated learning in rural Thailand was the local
concept of a community culture steeped in Buddhist philosophy (Klechaya & Chinn, 2009).

The Thailand National Curriculum, the Buddhist philosophy of education, and Situated Learning Theory are foundational principles in understanding the application of place-based education (Indigenous/local knowledge vs. Global knowledge) teaching techniques in rural Thai primary schools (see Figure 1). These foundational elements form the basis of study propositions that are critical elements in case study research (Yin, 2009).

An example of how Buddhism pervades national conduct and local community culture may be seen in the use of the “wai,” which originated in and is an important part of Buddhist practice (Kingdom-of-Thailand.com, 2011). The wai is a gesture in which the palms are placed together as if to pray and held at chest level or higher as a sign of respect. All Thais, Buddhist or not, use the wai in greeting and as a sign of gratitude, acceptance and respect. The wai is also a way of expressing and promoting harmony. Indeed, it is part of the very basis of Thai culture and the functioning of civil society. A foreigner who masters the proper use of the wai greatly enhances the way she/he is received by and viewed by Thai people.

Following this insight and coupling it with observations and interactions with teachers and students in the professional development program in the pilot study, the researcher developed a model of place-based education that was adaptable to rural schools in Thailand. The researcher reasoned that all Thais live in a society in which the Buddhist philosophy and moral tenets underlie the moral and social structure of the nation, whether or not Thais embrace Buddhism as a religion. Indigenous and local
knowledge exist harmoniously within this cultural structure/context and actually have grown out of it. Accordingly, global or Western knowledge is not accepted in Thailand if not related to wai, the basic culture of the people of the Thai community. That being said, Buddhism can help facilitate the connection between global knowledge and Thai culture by acting as a lens through which non-indigenous knowledge is viewed as a bridge over which global knowledge can be integrated into the Thai environment. This external knowledge encounters local and traditional knowledge with which it must ultimately harmonize in order to find acceptance. Given the Thai context, it is expected that a place-based, situational learning educational program that allows for integrated cooperation between the local teaching staff, national curriculum administrators, students and community may be harmoniously accepted. And if this can occur, then the national curriculum, the Buddhist philosophy of education, and situated learning can operate together to support the effectiveness of place-based education as a teaching/educational technique, and as the basis of elementary and secondary education.

In the pilot research project in rural Northern Thailand conducted by this researcher in 2008, the students studied ecological systems in their home rice fields. The school invited an agricultural officer to give explanations and demonstrations on how to use organic fertilizer. Further discussion in the classroom focused on describing and understanding the science of food chain dynamics in animals and humans and how it ultimately leads to impacts upon families and students. At the same time, the school sponsored a Buddhist day in which one of the five precepts of Buddhism (not harming living beings) was inserted into the lesson (Robinson, 2009). The important role religion has played in this biological process was also included in class discussions.
This kind of discussion has been made more relevant today because it has become quite apparent that as recent as 20 years ago farmers as well as the rest of Thai society believed and respected religion far more than they do today, following its tenets closely (Puntarigvivat, 1998; Rigg, & Nattapoolwat, 2001). In those days skin problems among farming families caused by the overuse of chemicals such as seen today did not exist. Perhaps farmers then were more tolerant of insects and other animals and understood the various roles the entire ecosystem played in providing and sustaining human food sources; and consistent with that they tended their rice crops less intensively than at present especially during the rainy season, avoiding the unnecessary elimination of animals and others insects and thereby maintaining a balance in the ecosystem (Kautsky, Ronnback, Tedengren, & Troell, 2000; Puntarigvivat).

Synthesizing all of these factors led the researcher to the conclusion that the local Thai environment, which is rich in physical, human, and spiritual resources, is the key foundational element and proper stage upon which fundamental educational experiences could be generated to produce healthy, curious, intelligent and morally sturdy generations of young people by the steady, resourceful guidance of patient, local, skillful, and spiritual educators, leaders and parents. It is perhaps not coincidental that this would also be the very same rich agricultural lands that are also seeded, nurtured, and made to produce our food so bountifully by the same wise, knowledgeable, and responsible farming caretakers who are entrusted with developing our most valued resources.

And so through these insights grew a new model of place-based education in Thailand, developed by the researcher through her pilot study and her experiences as a teacher and administrator in Thailand. This model builds upon the strong foundation of
indigenous local knowledge and the enrichment through global knowledge, the principles of situated learning, Buddhist philosophy, the National Curriculum as illustrated in Figure 1. This model applies in the northern region of Thailand that dominated by Buddhist culture. However, if this model is applied in the south of Thailand, Islamic philosophy will be more appropriate.

Figure 1. Foundational Elements of Thai PBE

As an example of how the model would be applied, relevant and interesting science projects would be devised by specially trained PBE teachers that used the natural outdoor world as a classroom rich in natural and human resources to engage and be explored by primary school students in learning adventures of an endless variety that would engage local farmers, parents, leaders, and spiritual mentors readily available in
the community. They in turn would share their knowledge and wisdom about what they do, have done, think and have thought about for many years about the land and people upon it, engaging projects and all the systems and activities that operate and have operated over, around and through the land and its people for many years.

The model involves PBE teachers who train under a professional development program that includes situated learning, Buddhist philosophy, and connections to the National Curriculum. Following this professional development, teachers will be able to help students be life-long learners while making meaningful connections between the schools and community. The knowledge gained by the researcher in investigating place-based education in five elementary schools in rural Thailand will be used to guide teachers in how to perform better through their professional development program, how students may achieve a higher level of science learning, and how the Thai national curriculum may successfully connect to the local funds of knowledge in the community.

The researcher may also learn factors that prevent teachers from being successful, students from learning in science, and community members from providing their needed support. It is expected that situational learning and place-based education, developed in this way will result in better teacher development, more effective teaching, more effective learning, higher science student test scores as a result of more relevant learning, better communication between the schools and their communities, lessening of importance of the school resource gaps between urban and rural schools because of more participation and support by the communities for local education, and better integration of rural schools with national curriculum objectives.
Suggested Role of Place-based Education in Thailand and the U.S.: Focus on Thailand

Educators in both the United States and Thailand use place-based education to facilitate science learning and eliminate the mismatch between scientific knowledge and local knowledge, real world and community-based learning. Science educators in both nations also try to enhance students’ morality through place-based education. In the United States, emphasis is placed on developing the relationship between students and the place where they live by connecting the real world experience with the scientific knowledge and practicing the critical skills through learning activity. Many place-based education programs in United States like AKRSI, address not only academic performance, but also student engagement as good community citizens by emphasizing sense of place and membership. Similarly, in Thailand, this approach encourages students to appreciate their deeply rooted culture and to develop their cultural identity. In both countries, not only does science education connect scientific knowledge to local traditional beliefs but students also learn to acknowledge their roles and responsibilities to care about their culture and environment.

In Thailand, this study does not explore whether place-based science education may be a valued science-teaching approach for urban schools or schools that have strong financial, material and human resources. Rather, its focus is the PBE model in rural Thai schools, and explores ways it may successfully bridge the gap between urban and rural student learning and eventually be the preferred approach for science teaching in rural schools in Thailand or beyond.
Place-based science education in the United States and Thailand differ in one important respect: organizational support. The primary purpose of place-based education in the United States and Thailand is to improve the achievement of individual students as well as the quality of life in rural communities. According to Wanich (2006), “Place-based education in the United States plays an important role in terms of education development. As such, most educators and educational theorists would take its mission seriously” (p. 18-19). In the United States many national and nonprofit organizations support science-community approaches such as: Rural Entrepreneurship through Action Learning (REAL) Enterprises, a North Carolina-based project, that is currently running programs in 30 states; and the Rural School and Community Trust that has reported various successful projects in more than 700 schools in 33 states (Annenberg Rural Challenge, 1999). The Rural School and Community Trust works with many place-based programs such as the Alaska Rural Systemic Initiative (AKRSI), and Community-Based School (CO-SEED) that were created by 11 communities in northern New England, and the GLOBE Program: Connecting with Local Communities and involving students in conducting science research projects at the local level.

Thailand has not had the supporting policies or organizations to implement place-based education in rural areas. According to the National Education Act of 1999, the main purpose of the education development of the country is to contribute to the solution of economic problems and financial crisis facing the country including the lack of human resources and lack of strong local communities. Support for science education in Thailand comes only from the Institute for the Promotion of Teaching Science and Technology (IPST). IPST is an agency under the direction of the Ministry of Education.
that sponsors schooling consistent with some of the principles of science education. In
this context, place-based education has not played an important role in science education
development or overall Thai education strategies. Recently, the National Curriculum Act
of 2009 allowed for decentralization of the curriculum, allowing local communities to
innovate their own curricula. However, with insufficient research and financial support,
the role and importance of place-based approaches in the Thai education system have not
yet gained the attention of the policy makers and there is still no organizational support
for place-based science education in Thailand.

Summary

The literature discussed above supports the basis of this research project: that
place-based learning can be a valuable tool for enhancing student learning and science-
teaching techniques and that it can also serve to improve school-community relationships.
Observations made in a pilot study by the researcher as a teacher in Thailand suggested
the potential value of place-based education in the Thai context. This preliminary work
permitted the collection and organization of data on this subject.

Place-based education may enable students in rural Thailand schools to become
good citizens, with a sense of identity, self-responsibility, ethics and moral values, as
well as becoming good members of a global community with respect for other people and
cultures. To promote a sense of place, their education can be designed to provide
practical knowledge related to everyday life in their community that supports individual
learning and individual success. The three pillars connecting place-based education in
Thailand (i.e. National Curriculum, Buddhism, and Situated Learning) may be able to
support rural schools and encourage them to build curricula relevant to local needs while
being assured they may be able to achieve the National Curriculum standards. Using this approach, Thai people may be able to restore the link to Thai culture and sense of community. Achieving a balance in the Thai education plan may involve taking a closer look at the causes and effects of social problems, for example the loss of cultural connections to Thai heritage through rapid economic development in recent years.

Place-based education focuses on the merging of students’ everyday life with local community heritage, culture, knowledge, language, natural resources, environment, religion, experiences, and opportunity. These aspects of place-based education can provide a foundation for study in the elementary school curriculum. When students can understand the nature of science, their attitude towards science can improve, and they can become willing to apply science knowledge to real life. Place-based education can help science curricula to be more relevant to students and the community in which they live.
CHAPTER 3: METHODOLOGY

This research focused on addressing the question: What is the effect of a professional development program in place-based science education on teacher and student learning. In this chapter, the qualitative research design, research methodology, background variables, methods of observation and methods of analysis that have been used in this study are described.

Qualitative Research Design

According to Creswell (2007), qualitative research and mixed methods are most appropriate to use as research methods when there is a need to explore a problem or issue. This researcher believes that it is the best tool available to explore and understand the rich and deep meaning people and groups attribute to human problems based on published research studies. This methodology has greatest relevance for exploring the type of questions posed in this research study (Creswell, 2007; 2009; Denzin & Lincoln, 2000; Fontana & Frey, 2000; Gelo, Braakmann & Benetka, 2008).

Specifically, this research study focuses on a number of small schools in Lampang Province in rural, northern Thailand, that have not been studied before except in the researcher’s pilot study, and about which little information exists in scholarly literature. In addition, because so little documentation exists about this specific subject matter, exploratory investigation is the best way to approach this inquiry. Data come in part, from interviews gathering the voices of village and community leaders, school teachers, village and district-level education leaders, and students. In addition, professional histories of school curricula were gathered and reviewed. Field notes were written based on participant observation of classroom teaching and student learning.
conducted by this researcher in Thailand. Data collected on student learning included observations of students during classroom instruction and artifacts produced by the students. Although mixed methods were not central to this qualitative study, standardized test scores were collected and evaluated in the context of overall student achievement. From these data sources, themes have been identified describing place-based science curricula that participants have found to be the most promising for student achievement, professional teacher development, and rural school curricula.

Denzin and Lincoln (2000) defined qualitative research as a situated activity overseen by an objective observer who captures what is happening in field notes, interviews, conversation, photographs, recordings, and self-memos. Although qualitative research appears to be well matched to the study of place based education models, some may inevitably criticize the approach for being subjective and lacking the scientific discipline and authenticity of quantitative methods (Horsburgh, 2003). The counter to this criticism is that properly conducted qualitative research provides a rigorous framework that is unique in its ability to access information that is highly complex within a unique context of factors and about which little, if anything, is understood. This is information that only emerges after meticulous attention to detail, description by an educated and capable observer, and interpretation using a flexible framework managed by an open-minded analyst.

Glaser and Strauss (1967) asserted that developing categories using the constant comparative method is a way of evolving a theory. Accordingly, the researcher used the following six steps for developing new knowledge through constant comparative
— as described by Bogdan and Biklen (1998, pp. 66-68) and Glaser (1978)— in the observation collection process:

1. Collect observations and conduct open-ended interviews;
2. Look for key issues that will become categories of focus;
3. Make observations that provide many elements of the categories of focus;
4. Document and write about the categories, then describe and account for all things within the observations and interview responses while continuing to search for new ideas;
5. Continue to work with observations and interview responses to present the emerging themes to discover relationships of categories; and
6. Connect the relationships of categories through sampling, then coding and finally writing to analyze the foci of the core categorized.

**Case Study Research Method**

The case study research method is an inquiry approach in which the researcher explores a program, event, activity, or process performed by an individual or group in one or more locations (Creswell 2009). Schramm (as cited in Yin, 2009) described a case study as an approach that is most heavily focused on understanding decision-making and specifically the why, how, and outcome of decisions that have been made. Yin further clarified the conditions in which the case study approach was appropriate:

1) When the boundaries between the phenomena are not clearly evident; and
2) When there are propositions to guide data collection and analysis (p. 18).

Qualitative case studies vary in size and intent. This particular study is focused on what is described by Stake (1995) as a *multiple instrumental case study* where a single
issue or concern is studied in multiples cases. In this case study, place-based science education in rural Thai elementary schools was the singular concern. There are also various approaches in analyzing data. This particular research was an embedded analysis of a specific aspect of a case as described by Yin (as cited in Creswell, 2007).

What is structured as a research design includes a social constructivist process where the researcher interviews a sample population in a specific work setting, analyzing the complexity of this subjective data through an inductive procedure building from specific experiences to general themes. The researcher then interprets the meaning of the essence of human experiences about a phenomenon in its context (Creswell, 2009).

**Data Collection Site**

Open-ended observation and open-ended interviewing of the selected participants in Lampang Province in rural, northern Thailand took place first hand by the researcher because observation of individuals in their own social settings offered valuable insights into their motivations (Creswell, 2005).

**Sampling and Selection of Participants**

Sampling involves selecting individuals to study who have something in common that can be studied by a researcher (Creswell, 2005). In this study, the researcher used a “purposeful sampling technique” where the particular settings, persons, and events were intentionally chosen in order to get information that is not available from other sources (Maxwell, 1996). The researcher recruited 7 elementary school teachers from 5 different schools and villages in Lampang Province, 120 elementary school children from the same 5 schools and 10 mixed gender community members from the same five communities as volunteers using the following selection criteria:
1. Rural schools in Lampang Province in northern Thailand;
2. Elementary school teachers and students in grades 1 through grade 6;
3. Diversity of grade levels in elementary school from grade 1 to grade 6;
4. Diversity of ages of teachers, students and community members;
5. Diversity of gender in teachers, students and community members;
6. Diversity of occupations of community members; and
7. Diversity of education of teachers and community members.

Through open-ended and semi-structured interview techniques, these participants talked about their experiences using both traditional and place-based education techniques and their respective connections between science knowledge and real life.

Other data sources in the study included a pilot study and researcher’s field notes of observations made about the participants during the interviews.

The researcher selected small schools (< 500 students) in the same educational administrative district with their voluntary cooperation. The researcher selected a sample from the following groups of participants:

1. 7 volunteer teachers (1 male and 6 females) from different schools and villages in Lampang Province. Teachers who taught Grade 1-6 from the following 5 schools: WTT Elementary School, PW element Elementary School, BHP Elementary School, PCW Elementary School and, PNT Elementary School.
2. 120 students participated in Grade 1-6 from 5 schools.
3. 10 mixed gender community members (2 from each school, all over 30 years old, and residents in the villages where the schools were located) who
volunteered and were purposely sampled from a larger group to participate in the study.

**Teacher Professional Development Program**

The research program described in this study was developed further and refined based on the results of a two-month pilot project conducted by the researcher in 2008. In the first month of this pilot project, teachers participated in a training program on weekends in which lessons were modeled and lesson plans were developed. At the end of the development program, teachers had written lessons integrating science with health, nutrition, and social studies and worked to convert a library into a science laboratory. They practiced using place-based science lesson plans and shared experiences. In the second month, the researcher also observed classroom instruction and interviewed teachers. The researcher found that the teachers needed more time to develop their confidence in teaching different science subject areas.

In 2009, the researcher visited the five schools to interview administrators, observe instruction, interview teachers to learn about their attitudes and knowledge about teaching science. This information, along with the experience from the pilot study, was used to develop the 2010 Teacher Professional Development Program.

The 2010 Teacher Professional Development Program trained teachers Monday through Friday for two months. In this training, teachers analyzed the National Curriculum to make connections with science in the local community. The teachers worked together to write lesson plans for the whole semester and provided peer feedback for writing lesson plans. After the training and writing lesson plans, the teachers taught lessons in the schools for three months. Using a coaching model, the researcher observed
and provided feedback. Table 2 shows the teacher training schedule and timeline that was followed:

Table 2. Schedule and Timeline of Teacher Preparation Program for Place-based Science Education, 2008 Pilot Program through April 17 - October 25, 2010

<table>
<thead>
<tr>
<th>Date</th>
<th>Program</th>
<th>Key speaker</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>June-July 2008</td>
<td>Pilot research program, obtain consent forms and study the impact of place-based science curriculum in one school</td>
<td>WTT Elem School</td>
<td></td>
</tr>
<tr>
<td>June-July 2009</td>
<td>Develop teacher training program for elementary science by using place-based education</td>
<td>Researcher RK/administration team</td>
<td>15 teachers from 7 schools</td>
</tr>
<tr>
<td>April-May 2010</td>
<td>Training Program: Develop place-based science program for small elementary schools in Lampang Province Thailand. Obtain consent forms Pretest -Attitude -Knowledge -Practice</td>
<td>IPST -The Office of Basic Education officers from the Ministry of Education -Drs. P.S. &amp; P.O. from IPST -Dr. P. SWU -Dr. C. and others</td>
<td>15 teachers from 7 schools</td>
</tr>
<tr>
<td>April-May 2010</td>
<td>-Introduce community Learning resources -Parents and school activities -Place-based learning (Place-based education) -Curriculum for student diversity -Multiple assessments -Standard of science and nature of science -Effective science lesson plan</td>
<td>-Village headman and team -Dr. P. and team from IPST -The Office of Basic Education officers from the Ministry of Education -Dr. P. SWU -Dr. C. and others</td>
<td>15 teachers from 7 schools</td>
</tr>
</tbody>
</table>
Table 2, continued

<table>
<thead>
<tr>
<th>Date</th>
<th>Program</th>
<th>Key speaker</th>
<th>Participants</th>
</tr>
</thead>
<tbody>
<tr>
<td>April-May 2010</td>
<td>- Science teaching techniques</td>
<td></td>
<td>15 teachers from 7 schools</td>
</tr>
<tr>
<td></td>
<td>- Developing science lesson plan</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Post Test</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Attitude</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- Knowledge</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>- Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td>May 2010</td>
<td>- Peer feedback on lesson plan</td>
<td></td>
<td>15 teachers from 7 schools</td>
</tr>
<tr>
<td></td>
<td>- Present place-based learning lesson</td>
<td></td>
<td></td>
</tr>
<tr>
<td>June-July 2010</td>
<td>- Pre-test student attitudes</td>
<td>Guests from Education District</td>
<td>Students and 15 teachers from 7 schools</td>
</tr>
<tr>
<td></td>
<td>Teaching by using place-based education</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Observation: Visit schools and classrooms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>August 2010</td>
<td>Science Project Week</td>
<td>Teachers, Students</td>
<td>Public</td>
</tr>
<tr>
<td></td>
<td>Science camp and science teaching symposium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September 2010</td>
<td>Follow-up</td>
<td></td>
<td></td>
</tr>
<tr>
<td>October 2010</td>
<td>Final collection of data from teachers, students</td>
<td></td>
<td>15 teachers from 7 schools</td>
</tr>
<tr>
<td>March 2011</td>
<td>Analysis of the data</td>
<td>Researcher RK</td>
<td></td>
</tr>
</tbody>
</table>

**Interview Questions**

These interview questions were used to explore the connection between the place-based science education program with teacher and student learning.

1. The following open-ended interview question was asked of teachers during the course of the research: **What teaching strategies and assessments of place-based science curricula are the most promising from the teacher’s point of view for student achievement, professional teacher development and rural school**
curricula development in Thailand?

2. The following open-ended interview question was asked of students during the course of the research: *What courses and specific classes of place-based science curricula are the most promising from the student’s point of view for engagement, learning and achievement in Thailand?*

3. The following open-ended interview question was asked of community leaders during the course of the research: *What are the benefits and drawbacks of place-based science curricula from the community’s point of view?*

**Informed Consent**

Each participant selected to participate in the study received an email and regular postal service delivery with a copy of University of Hawaii official informed consent letter for all participants (Appendix B). The letter introduced the researcher to the participant as well as listed the title, purpose, nature and benefit to society of the study, and the general body of knowledge on the subject. The letter stated the study’s expectations of the participant, the expected time needed for participation. There was a statement in the letter stating that participation was voluntary and withdrawal was possible at any time. The letter assured each participant of the confidentiality of the research process and informed them of when the research results were published. The informed consent letter provided the mailing address, cell phone number, email address, and the name of a person to contact if the selected participant had any questions. The IRB Application and informed consent forms are shown in Appendix B.
Confidentiality and Security

The identity of the participants, schools and the data acquired from the study remained confidential. As a precaution, linkages between the participants’ names and the data undergo encryption masking using alphabetic letter designations. Any hardcopy responses from the participants will remain in a locked safe box for at least three years and all electronic responses will undergo encryption for data security. After three years, all electronic and hardcopy responses will be erased and disposed of.

Participants were interviewed separately in their own facilities so that no one other than the researcher and participant knew of their participation.

All participants were assigned pseudonyms and code numbers to protect their identity. They were identified for the purpose of the reporting by functional characteristics that make each participant have a unique identity, for example type of teaching specialty, years of teaching experience, grade level, number of children the parent has, years of parenting experience, and community role.

Withdrawal Procedure

Prior to selection, all interviewed candidates were told in their pre-selection interviews that although their participation throughout the entire interview process would be greatly appreciated, they could withdraw at any time without consequence. All information collected up until the time of their withdrawal was forfeited and not used. It is for this reason that the researcher selected two more alternates than needed whose information was used in case of withdrawal from other members. However, during this research program, no participants withdrew from the study.
Investigative Process

In-depth interviews and direct observations were conducted before and after teachers who received professional development implemented a place-based science curriculum in selected schools. There were both individual and group interviews.

According to Trochim and Donnelly (2006):

In interviews it is assumed that there is a questioner and one or more interviewees. The purpose of the interview is to probe the ideas of the interviewees about the phenomenon of interest (Qualitative Data, para 2).

Rubin and Rubin (1995) explained that qualitative interviewing is a way of learning about teaching in different places to learn about participants local cultural views, their problems and solutions, and how their practices are similar to and different from others. The interview is a process of finding out what participants think about place based education and science education. The interview questions depend on what the interviewer wants to know. The result is an understanding of what points of view are held about place-based education by the participants. As the interviewer, the researcher sought to be a good conversationalist as well as a good listener. All interviews were recorded and later transcribed. The data were collected on digital video recordings and in written notes.

After classroom observation or visiting the school, the researcher conducted interviews as a group discussion. The researcher included parents and other community members in the interviews and asked many questions of the teachers, principal, and students.

Trochim (2006) asserted the following about direct observations:

. . . the observer does not actively query of the respondent. [Direct observation] can include everything from field research where one lives in another context or
culture for a period of time to photographs events and things that illustrate some aspect of the phenomenon (Qualitative Data, para 3).

The researcher recorded the data from observation in written notes, video recordings, photographs, and through pictures, or drawings. She also collected work done by students or teachers if volunteered.

**Observation Protocol**

The researcher developed a classroom observation protocol from a science education teaching development program from the Institute for the Promotion of Teaching Science and Technology (IPST) (see Appendix C). This protocol was designed to learn about the lesson objectives, activities, student collaboration, and how the knowledge connected to the community.

**Individual Interviews**

The researcher interviewed participants face-to-face, one-on-one at the school, school office, or community office of the participant so that the researcher would be able to obtain information about the setting where the participant performed the work. Open-ended questions were asked of the participants allowing freedom of response without interviewer bias in a low-key, low-pressure setting where they felt comfortable.

It was anticipated that the researcher would discover that participants responded much more meaningfully when asked direct, pointed, and repeated questions about their experiences and how they formulated strategies to resolve challenges. It was also anticipated that this technique was important because at the time of the interviews it was obvious to the researcher that participants did not feel confident expressing their ideas, thoughts and actions. Their lack of confidence may have caused them to give initial
tentative responses that required a patient, probing type of interviewing technique to get at the real meaning behind their responses.

**Video Interviews**

Digital video-recorded interviews, pre-approved by the participants, were conducted to create a clear documentary record that could easily be analyzed over time.

**Documents, Field Notes, and Self-Memos**

The researcher relied on the analysis of documents as part of the observation set; these included class notes, student assignments, student evaluations, teacher lesson plans, curriculum plans, and curriculum evaluations. These data were collected to investigate possible connections between these documents and other elements of the observation set that were expressed in different ways.

Field notes enabled the researcher to record the ideas and reflections of the researcher that emerged while collecting data. According to Bogdan and Biklen (1998), field notes can be invaluable resources, because recording what the researcher experiences, sees, and thinks can help to focus the observation collection. For example, in this study, the researcher created a chart demonstrating similarities and differences between participants.

Similar to field notes, the researcher used self-memos to record descriptions, summaries, and feelings about the issues that emerged in this study. These memos function to connect personal reflections with research strategies and techniques (Maxwell, 1996). Recording observations in self-memos was useful in the sense that frequently when being presented with participant experiences, the researcher understood
how they fit into the broader picture, especially in the beginning of the interviews. It was determined only afterwards while reviewing notes that patterns began to emerge.

**Method of Observational Analysis**

The researcher designed open-ended interview questions for the 21 teacher participants in the training program (see Appendix D). The researcher designed open-ended interview questions to be asked of community member/parents to learn about their views of place-based education during the intervention (see Appendix E). Student surveys captured the views of students about science education and place-based science learning before and after the place-based science curriculum was implemented (see Appendix F).

**Data Analysis**

The researcher trained the teachers to teach science by using the place-based science education approach. The teachers then taught the students and the researcher noted patterns about what was observed and responded to by the participants who experienced the actual process of placed-based instruction. These findings were compared to existing notions about place-based education that were formulated elsewhere.

Qualitative analysis methodology provided guidance to the researcher to begin analyzing the data by sorting and categorizing through a process of open coding. As Trochim (2010) asserted:

*Coding* is a process for both categorizing qualitative data and for describing the implications and details of these categories. Initially one does *open coding*, considering the data in minute detail while developing some initial categories.
Later, one moves to more selective coding where one systematically codes with respect to a core concept (para 6).

For this study, analytic categories and relationships were drawn between the data from interviews and observations to answer the central research question. The qualitative data collected from each data source were analyzed separately and then the results were merged to look for additional confirmatory or contradictory results. Table 3 illustrates how the data were coded and consolidated into categories. The categories related back to the research question: In the context of rural Thai elementary schools, how do teaching and student achievement change as a result of the teachers’ participation in a place-based science professional development program? These may provide some insights into findings and the application of place-based education in the Thai context.
Table 3. *Coding Chart*

<table>
<thead>
<tr>
<th>Categories</th>
<th>Data</th>
<th>Codes</th>
<th>Findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Teachers’ views of science education before and after implementing</td>
<td>1.1 Initial Teacher Interviews</td>
<td>Science teaching (ST)</td>
<td>• Initially, teachers did not like science but after the project the teachers were more engaged.</td>
</tr>
<tr>
<td>place-based science education.</td>
<td>1.2 Final Teacher Interviews</td>
<td>Science Content (SC)</td>
<td>• In the beginning, teachers did not understand science content, but later the teachers learned how to research so they would understand more.</td>
</tr>
<tr>
<td></td>
<td>2.1 Lesson Plans</td>
<td>Student Learning (SL)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.2 Teaching observations</td>
<td>Community Involvement in Classroom (CI)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 Teacher Reflections on Lessons</td>
<td>Teacher Professional Development (TPD)</td>
<td></td>
</tr>
<tr>
<td>2. Teaching strategies and assessments used in the place-based science</td>
<td>2.1 Lesson Plans</td>
<td>Peer Observation (PO)</td>
<td>The students connected the scientific knowledge with everyday life.</td>
</tr>
<tr>
<td>education classroom.</td>
<td>2.2 Teaching observations</td>
<td>Inquiry-based (IB)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2.3 Teacher Reflections on Lessons</td>
<td>Outdoor Activities (OA)</td>
<td>Students in the 4th grade scored significantly higher on standardized science tests.</td>
</tr>
<tr>
<td></td>
<td>3.1 Student Interviews</td>
<td>Project Assessments (PA)</td>
<td>The students were able to design experiments and projects.</td>
</tr>
<tr>
<td>3. Students’ views about place-based science education.</td>
<td>3.1 Student Interviews</td>
<td>Knowledge Assessments (KA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.1 Standardized Science Pre-test</td>
<td>Self-Assessments (SA)</td>
<td></td>
</tr>
<tr>
<td>4. Student achievement in the place-based science education classroom.</td>
<td>4.2 Standardized Science Post-test</td>
<td>Test Scores Before (TSB)</td>
<td>Parents showed good cooperation and attitudes toward school activities and classroom learning.</td>
</tr>
<tr>
<td></td>
<td>4.3 Science Experiments</td>
<td>Test Scores After (TSA)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.4 Science Projects</td>
<td>Community Connections (CC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.5 Classroom Assessments</td>
<td>Critical Thinking (CT)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.1 Parent interviews</td>
<td>Ecological Connections (EC)</td>
<td></td>
</tr>
<tr>
<td>5. Impact of the PBE on community views toward education and school.</td>
<td>5.2 Principal interviews</td>
<td>Connections of Community (CC)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5.1 Parent interviews</td>
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<td>5.1 Parent interviews</td>
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Methodological Considerations

Methodological issues are part of all serious study efforts. In qualitative research, researchers must pay close attention to credibility in relationship to the observations and interviews. Accordingly, the researcher also must identify potential problems with credibility in relation to research design, the data set, and the method of data analysis. The principal way the researcher accomplishes this objective is by following an open-ended interview protocol as identical as possible for each similar category of participant. The researcher conducted all the interviews. In this protocol, the interviewer asked a set of questions that reflected the intent of the principal research question and that did not disclose the interviewer’s personal or theoretical biases, relying on several verification techniques to insure that the interviewee confirmed the accuracy of recorded responses to interviewer questions.

Validity and reliability concepts are seen differently in qualitative research than in quantitative research (Trochim & Donnelly, 2006). Guba and Lincoln (2005) asserted that notions of validity and reliability in quantitative research do not work in qualitative research. The authors offered a different set of standards for judging the soundness of qualitative research. The traditional criteria for judging quantitative research include internal validity (e.g., does the research actually measure what it is intended to measure), external validity (To what extent can research results be generalized?), reliability (Is research consistent and reliable in similar settings?) and objectivity (Can bias be restricted or eliminated?). More appropriate criteria for judging perception in qualitative studies are: credibility, transferability, dependability, and confirmability (Guba & Lincoln), as described below.
Credibility

This criterion concerns the believability of what is observed by the participant. Since the participant’s perspective is what will be dissected, the ultimate judge is the participant (Creswell, 2007). The greatest risk associated with this research is the potentially biasing effect that the researcher may have about participants in the interview process where information is given to the researcher. The researcher adopted an attitude of inquiry to bracket personal opinions or biases as much as possible. She also established the procedure where preconceived interview questions are reviewed and edited by two external outside reviewers. In addition, to avoid researcher bias, outside observers and peer observers were involved in the analysis and reflections on classroom teaching. She set up an interpretive post-interview procedure that regards all participant responses as equally important and that gives an outlet for the researcher’s experiences and opinions to be expressed along the same plane of importance. Audio recordings and a self-notation system also form a record to review potential sources of interviewer bias by the researcher.

Thick and rich description shows that the researcher’s findings are credible by helping the reader make sense of the connections with the data from the participants in this study. According to Carlson (2010), this approach is taken, “to provide very detailed descriptions of settings, participants, data collection, and analysis procedures as a way of making their accounts more credible” (p. 1104).

Triangulation is one of the primary research strategies of insuring research credibility. Key (1997) defined triangulation as a process of analyzing data from multiple sources. This research uses the method of triangulation, which involves the convergence
of data from multiple data collection sources such as interviews, observations, and surveys from participants.

**Transferability**

Transferability, a parallel concept to generalizability, is the relative degree to which qualitative results or outcomes can be applied to other contexts or settings. The better the job that the researcher does in thoroughly describing the context, the more transferable will be the results. The participant is the best person to make the transferability judgment since this is the person who has determined its credibility.

**Replication**

This is also a judgment call by the participant. The extent to which results can be repeated or replicated depends upon the extent to which the context conditions can be replicated. Replication may not be possible with qualitative research because that is not its purpose. Nevertheless, the research is responsible for describing conditions as accurately as possible to maximize understanding and to guide future research.

**Confirmability**

This is a concept about how well other researchers are able to confirm or corroborate the results. There are a number of ways to determine this including: checking and rechecking the data, having another researcher repeat the research procedures, seeking out contradictions, and having a data audit to check for bias and distortions.

Member checking is when the researcher gives participants a chance to approve particular aspects of the interpretation of the data. It is important because according to
Curtin and Fossey, (2007), member checking is a “way of finding out whether the data analysis is congruent with the participants’ experiences” (p. 92). In this process, the classroom observations and interviews were video recorded, the researcher wrote down field notes during observations; and the researcher asked teachers questions during interviews. After the data were collected and analyzed, the participants had an opportunity to examine the findings. It was very important to write all the script and narrative in Thai language before sending it back to the participant to check. After the participant examination, the data and findings were translated back into English.

Findings were confirmed in the current case study through comparison of findings across all of the different sources of documentation: video recordings, personal notations, transcriptions and categorizations—an approach sometimes described as triangulation (Morse, 1994). To confirm data collected, the researcher consistently asked the participants further questions to elaborate on the original information they furnished.

**Background of the Researcher**

The researcher is Thai, speaks the language fluently and is completely conversant with the culture both of the nation in which the research was conducted and with that specific geographical area. The researcher studied in Thai schools and graduated from a Thai university. She was an elementary teacher, head of teacher professional development department in a Thai school, the school’s academic consultant, school and administration auditor, and a key speaker for teacher training sessions. As such, she understands the Thai educational system well. The researcher also performed a number of functions during this project including being a professional trainer in place-based education for teachers and administrators; a resource person for education district
officers, community members, administrators, teachers, and students in place-based science education; an observer in the class room and school activities; and a model teacher for the teachers who participated in this program.

**Expected Study Outcomes**

Since place-based science education is such a new approach to Thailand, the researcher had very limited expected study outcomes about the content of the responses given such very limited published information.

The very reason the researcher selected the qualitative research case study approach was because so little was known about countrywide experiences. It is hoped that this study will furnish in part an answer to the question of whether place-based science education could be implemented successfully in Thailand’s cultural context within its nationwide educational structure.

**Limitations of the Study**

The scope of the study was limited to the 5 schools 8 teachers, 150 students and 5 program sites. Generalizations of the study findings was not possible or warranted; still, transferability of key findings to similar Thai rural elementary schools is likely.

**Summary**

In this chapter, the case study approach and specific methods to be used to collect and analyze data were described. A series of qualitative interviews and observations were conducted with students, schoolteachers, parents, district-level education leaders, and village/community leaders, who were chosen through a purposive sampling technique. The researcher documented her observations from these interviews, described the analysis of these interviews, as well as the suggested categories and themes that have
been developed in Chapter 4. In addition, school documents were reviewed and observations were conducted at school and classroom sites. Field notes and self-memos captured the richness of the data gathered. In the following chapter, the results of the study are presented.
CHAPTER 4: RESULTS

The results will answer the primary research question: In the context of rural Thai elementary schools, how do teaching and student achievement change as a result of the teachers’ participation in a place-based science professional development program?

To assess the status of elementary science teaching before the professional development program in place-based science education was implemented, interviews of five school principals were conducted to understand the background of the schools they were in charge of and the context and issues involved with teaching science and student learning in their schools. Interviews with seven teachers in five elementary schools provided detailed information on the professional background, education, interests, and attitudes towards science teaching before the training. The teachers also described their needs and the issues related to their participation in the professional development program and the teaching of science. Initial classroom observations of teaching and student learning before the professional development program also provided data to better understand issues involved with teaching science in the rural schools.

The content of the professional development program is described in Chapter 4, along with the background of each teacher participant, and the teachers’ interview reflections on the training program both before and after the program’s completion. To better understand teacher learning in the context of the place-based science professional development program, the researcher collected and evaluated data on the following: 1) how the teachers worked together; 2) how community resources could be included in the implementation of the place-based science lesson plans and school curriculum; 3) how the
teachers organized their lesson plans; 4) how teaching was conducted in the classroom; and 5) how classrooms were suited to the science teaching and learning activities. Peer observations and interviews with teachers were also conducted after teaching the place-based science lessons.

Students were observed during place-based science instruction to better understand how they applied science skills in the activities. The students were interviewed after the lessons to better understand how their learning, attitudes toward science, and how the place-based science instruction was different from previous lessons. Standardized test scores were conducted for a select group of students in the 3rd grade, and again after they participated in place-based science instruction for a semester in the 4th grade.

Parents and select community members were interviewed to assess their perceptions of how teaching and student learning changed as a result of the place-based science education professional development program. A detailed discussion is presented about the changes that occurred in the teacher lesson planning, classroom teaching, student learning, and community involvement.

**School and Teacher Profiles**

School profiles of each of the five elementary school case studies are reported to convey the context of the community, schools, and teachers before implementing the professional development program. The school profiles were constructed from interviews with the principals as well as from independent observations made by the researcher. Profiles of the seven participant teachers follow the profiles of the five participant schools below.
School Profile: WTT Elementary School 2007

WTT-ADMIN1, New Principal
Lampang District

Teachers (#): 9  Male: 1  Female: 8
Students (#): 108  Staff: 1  Volunteers: 1
Grade levels (e.g. K-6): K-6

During the first pilot study visit in 2007, the researcher noted that the physical plant of WTT Elementary School needed improvement. The school consisted of two old and obsolete one-story buildings. Both the buildings and playground were not well maintained. There was no learning center, nor were there any plans to establish one in the future. The knowledge boards were not attractive, and they had not been regularly updated. The plants in the school gardens did not have identifying nametags or labels and thus were inadequate as teaching and learning tools, contrary to the practice in other schools. The playground facilities were old, not safe, and were not conducive to student learning. The library was out of date and substandard. The number and variety of books was inadequate and unsuitable for student learning. There were no computers and other modern technology in the library such as slide projectors, cd players, televisions or digital e-readers. The room space was not well lit. Seats were too small for the children and the tables were too large.

The classrooms were generally very small. There were an inadequate number of chairs and desks, and many were broken or worn out. The student restrooms were not properly equipped, and there were not enough of them for a school with 100 students. The computer lab was small with five out-of-date computers and only one television available. The language lab consisted of two radio/stereos for playing CDs. The science
The lab had little equipment available and no means of fixing broken equipment. There were not enough school supplies or sports equipment for students.

The canteen had an insufficient number of tables and chairs with many that were worn out, broken, and needing replacement. Students bussed their own plates after eating, first scraping left over food off of the plates into containers to become compost and trash into other containers, then washing their plates and placing them in clean stacks. The space was also used for meetings. Trees, shrubs, grass, rice fields and an irrigation canal made up the environment outside and surrounding the school. There was easy access to a local road; however, there was no public transportation available. Students walked or biked to school. Sometimes, the school hired drivers with pick-up trucks to transport students to events going on in the community.

There was not enough teaching and support staff available. For example, when some teachers had a meeting at the district education office, there was nobody available to teach 5th and 6th grade classes. There were also no substitute or stand-by teachers available when normal teachers were on leave or attending seminars. The teachers in this school were generally passive. For example, when the teacher witnessed a student with a problem, nothing would be done to remedy the situation.

WTT Elementary School 2009

In 2009, after the pilot study in 2008 and intervention with the teachers, the researcher wanted to see if the teachers could continue to implement place-based science education by themselves. From observations after the pilot study, the general attractiveness and maintenance of the school environment including buildings, playground, garden, knowledge boards, and library were much improved. The plants in
the garden had identification labels, thus becoming useful a teaching tool; and the library was stocked with more books, catalogued using the Dewey decimal system, barcoded. The space was clearly more suited for student learning, in fact so much so that it received the outstanding local schools library award in 2009.

The researcher noted some other improvements as well. The student restrooms were cleaner although more facilities were still needed for a school with 189 students. The language lab was changed to a science lab. Students were more active and a lot of hands-on learning was taking place in the classrooms. The canteen was newly remodeled, cleaner, and there were enough new tables and chairs to accommodate the students, thus much improved as a place for meeting and learning. The playground facilities had been repaired and were conducive to play and learning.

Nonetheless, more improvements were still needed. For example, the computer lab still needed more computers and there were still an insufficient number of teachers in the school. As before, most of the villagers in the community surrounding the school were manual workers and farmers earning an average income of $100/month. In addition, most of the people predominantly shared the spiritual philosophy of Buddhism.

**Teacher Profile: WTT-T1**

WTT-T1 was a female teacher who was born in the Lampang District. Her education and experience background included: a B.A. in Mathematics; attendance at in-service training seminars on the topics of “Student Learning Assessments” and “Thai Language” that were held between 2008 and 2010 and were conducted by curriculum specialists from Division 1 of the Thai Education District; teaching at the WTT
elementary school for eight years where she had been assigned to teach every subject offered in grade levels 1 and 2; and serving as school secretary.

**Teacher Profile: WTT-T2**

WTT-T2 was a female teacher in the Lampang District. Her education and experience background included: a B.A. in Elementary Education; attendance at in-service training seminars on the topics of “Academic Coordinator and Curriculum Training”, “Drug Awareness”, “School Assurance Quality Training,” and the “Thai Democratic Monarchy Seminar” that were conducted by curriculum specialists from Division 1 of the Thai Education District; teaching at the WTT elementary school for 30 years where she had been assigned to teach every subject offered in grade level 6; serving as an academic coordinator for the school; and skills in handicrafts.

**School Profile: PCW Elementary School**

PCW-ADMIN 1, Principal
Lampang District

Teachers (#): 17  Male: 5  Female: 12
Students (#): 147  Staff: 1  Volunteers: 2
Grade levels (e.g. K-6): K- 8

At the time of the researcher’s interview with the Principal of the PCW Elementary School in 2010, the school consisted of 11 classrooms housed in 4 one and two-story buildings. The school physical plant needed improvement. Most notably, there was no playground for all the students in the K-6 grade levels. There was no learning center and no plans for a learning center in the future. There were unattractive, out-of-
date knowledge boards. There was no meeting room, although one was under construction.

The plants had no identification labels. There were not enough plants to use as teaching tools for teachers and learning tools for students. The plants that were there were poorly maintained. The garden was adequate compared to other schools. The school landscape was dysfunctional and underutilized. The library was small and did not have enough space for the school’s 147 students. The library was out of date and substandard in that the number and variety of books was inadequate and unsuitable for student learning. There were no computers and other modern technology such as slide projectors, cd players, televisions or digital readers. The room was not well lit; and seating was unsuitable.

The classrooms were generally very small. There were an inadequate number of chairs and desks in them, and many were broken or worn out. There were not enough school supplies and sports equipment for the students. The computer lab did not have enough computers for students to use, and the few that were available were obsolete. The sound system in the language lab was dysfunctional.

There was only a small inventory of science equipment in the science lab and the equipment was not available for student use. The teachers had to borrow equipment from another school from time to time. There was also no time to maintain the science lab and keep it organized because there was only one science teacher at the school who was just too busy because she had to teach every level and many subjects.

Overall, the school was trying to make improvements on its own without help from the government. Most parents in the community were traditional farmers and
manual workers who earned an average monthly income of $32. In addition, most of the people predominantly shared the spiritual philosophy of Buddhism.

**Teacher Profile: PCW-T1**

PCW-T1 was a female teacher in the Lampang District. Her education and experience background included: a B.A. in Elementary Education; attendance at in-service training seminars on the topics of “Teaching English” and “Distance Training in Science” conducted by curriculum specialists from Division 1 of the Thai Education District between 2008 and 2010; teaching at the PCW elementary school for 30 years; serving as “Head of School Relations with the Community,” and skills in handicrafts and Thai sweet cooking.

**School Profile: PW Elementary School**

PW-ADMIN1, Principal
Lampang District
Teachers (#): 9 Male: 1 Female: 8
Students (#): 73 Staff: 1 Volunteers: 1
Grade levels (e.g. K-6): K-6

At the time of the researcher’s interview with the Principal of the PW Elementary School in 2010, the entire school was housed in two very small one-story buildings. The school physical plant was in great need of improvement. Most notably, the garden was not adequate or well maintained, although there were pots between the two buildings for growing vegetables. The knowledge boards were not attractive and the boards were not updated regularly. The playground facilities were old, unsafe, and
were not conducive to student learning. The student restrooms were substandard and there were not enough restrooms for the number of students in the school.

Other problems were evident. There was no school library so the teachers prepared their own books for the students and borrowed everything else they needed from the public library. Students read the books that their teacher brought to class for them. The classrooms were generally very small with not enough desks and chairs. The furniture that was there was worn out and in some cases broken. There were 10 out-of-date computers and only one television available in the computer lab. There were not enough school supplies or sports equipment for the students.

Despite science being taught in the school, the science lab was unused. The lab had some equipment that could have been used as teaching and learning tools, but much of the equipment was old or in disrepair and there was no teacher trained in science in the school. Students had broken some of the equipment because they did not know how to use it and apparently had insufficient guidance.

The school was located outside the village. It was easy for students to access the local roadway; however, as no public transportation was available, students walked to school. Most parents in the community were traditional farmers and manual workers who earned an average monthly income of $100-$300/month. In addition, most villagers predominantly shared the spiritual philosophy of Buddhism.

**Teacher Profile: PW-T1**

PW-T1 was a female teacher in the Lampang district. Her education and experience background included: B.A. Elementary Education, teaching science, social studies, art, vocational and technology in grades 4-6 for 31 years; she attended in-service
training seminars on the topics of “Teacher and Educator Quality Training”) and “Outdoor Science Learning” conducted by curriculum specialists from Division 1 of the Thai Education District between 2008 and 2010; serving as financial and document officer for the school; and computer skills.

**School Profile: BHP Elementary School**

BHP-ADMIN1, Principal  
Lampang District  
Teachers (#): 8  Male: 1  Female: 7  
Students (#): 60  Staff: 1  Volunteers:-  
Grade levels (e.g. K-6): K-6  
School buildings (#): 5  
Classrooms (#): 14

At the time of the researcher’s interview with the Principal of the BHP Elementary School in 2010, the school consisted of 14 classrooms housed in five, one-story buildings. The school’s physical plant needed improvement. The playground was not well maintained and the playground facilities were old, unsafe, and were not conducive to student learning although there was a very big soccer field. The plants in the school gardens did not have identifying nametags and thus were inadequate as teaching tools and learning opportunities as compared with other schools.

There was no learning center and there were no plans for one in the future. The building and knowledge boards were not attractive and the boards were not updated regularly. The books in the library were inadequate and not suitable for student learning. The library was clean but not well lit and its seating was unsuited to the age and interests of the students. There were no computers and other modern technology
such as slide projectors, cd players, televisions or digital e-readers. They were either not enough classrooms or the ones that were there were generally too small for the number of students in the school. There were not enough desks and chairs. Some were worn out or broken; most were in need of being replaced. There were not enough school supplies and sports equipment for the students.

The computer lab was small with six out-of-date computers and only one television available. The language lab was seldom used and the sound system was broken. The science lab had equipment available that had never been used. There was not enough support staff available at the school so substitute or stand-by teachers were not available when permanent teachers were on leave or attending a seminar. The school was closed many times when the researcher arrived. The teachers at the school were generally passive.

There was one Buddhist temple and a study center in the community where the school was located. In addition to the predominant Thai population, the community also included a small minority group (the Taileu) who spoke a different language. There was easy access to a local roadway. There was no public transportation available so students walked and bicycled to school. Sometimes the school hired pick-up trucks to transport students to special events. Most parents in the community were traditional farmers who sold produce in the village and manual workers who earned an average monthly income of $220. In addition, most of the villagers predominantly shared the spiritual philosophy of Buddhism.
Teacher Profile: BHP-T1

BHP-T1 was a female teacher, born in the Lampang District. Her experience included: a B.A. in Elementary Education; attendance at in-service training/seminars “Mathematical Learning on Educational TV” (IVST) and “Teaching English” (College of Education, Lampang) between 2008 and 2010; teaching at the BHP elementary school for 23 years; serving as a health education specialist responsible for first aid; and skills in typing, handicraft, and arranging floral displays.

Teacher Profile: BHP-T2

BHP-T2 was a female teacher, born in the Chaengrai. Her experience included: a B.A. in Agriculture; attendance at in-service training/seminars “Buddhist School Project” (Education District) and the “Mathematical Learning on Educational TV” (IPST) between 2008 and 2010; teaching at the BHP elementary school for 27 years, teaching every subject in grade 4.

School Profile: PNT Elementary School

PNT-ADMIN1, Principal
Lampang District 5200 Tel: 540-325891

Teachers (#): 8 Male: 2 Female: 6
Students (#): 61 Staff: 1 Volunteers: 1
Grade levels (e.g. K-6): K-6

At the time of the researcher’s interview with the Principal of the PNT Elementary School in 2010, the school consisted of eight classrooms housed in three, one-story buildings. The researcher found this school to be in better condition than other schools she visited. The playground was well maintained and the school resources were
used very effectively. For example, the parents built an activities stage with recycled wood from the school. The garden plants had identification labels so they were being used as a teaching tool for teachers and a learning tool for the students as done satisfactorily in other schools.

The library was well maintained and had enough books that were suitable for student learning, however there were no computers and other modern technology such as slide projectors, cd players, televisions or digital e-readers. The classrooms appeared more like a home than a classroom although they were generally very small, with enough desks and chairs despite some being worn out and broken.

The computer lab had eight computers; three were up to date and five were out of date. Only one television was available. The sound system needed fixing and equipment was not available in the language lab. There were not enough tables and chairs in the canteen as some were worn out, and some were broken and needing replacement. The canteen was also used as a place for meetings and classroom learning when a larger space was required. There was easy access to local roads, although there was no public transportation available so students walked and bicycled to school. Sometimes, the school hired pick-up trucks to transport students to special events.

Most parents in the community were traditional farmers and manual workers who earned an average monthly income of $100. In addition, most of the villagers predominantly shared the spiritual philosophy of Buddhism. The community also consisted of the Taileu—a small minority group that spoke a different language from Thai.
Teacher Profile: PNT-T1

PNT-T1 was a male teacher born in the Lampang District. His education and experience background included: a B.A. in Social Studies; attendance at in-service training seminars on the topics of “Social Studies and Thai Culture” (District Council) and “School Safety” (District Office) between 2008 and 2010; and teaching every subject in grade 3 at the PNT elementary school for 28 years.

Interviews Before Training in 2010

The interviews recounted below took place after the 2008 pilot project on place-based education science teaching but before the teachers had received the professional-development training that was part of the 2010 project phase. Accordingly, they may be considered "initial" or preliminary in nature, offering an understanding of each teacher-interviewee's experience with science teaching and place-based education prior to the 2010 training. The researcher conducted the first two interviews with teachers WTT-T1 and WTT-T2 who were originally involved in the pilot study. Therefore, it should be said that these two teachers had some limited prior experience with place-based education and the researcher was interested in finding out about their understanding before the 2010 professional development program. The remaining five teachers interviewed—PCW-T1, PW-T1, BHP-T1, BHP-T2, PNT-T1—had no prior experience with place-based education.

WTT-T1 Interview

Interview Question 1: After participating in the 2008 pilot research project, were you able to continue teaching by using place-based science education?
WTT-T1 - In 2008, I was teaching about computers and worked as a school clerk. I did not have a chance to teach science. My experience in place-based education was very interesting for me because I could see that the students were happy to learn and interested in the subject and activities that they are doing in science.

**Interview Question 2: How do you feel about your science teaching?**

WTT-T1 - This semester (2010) I taught science, mathematics, and every subject for grades one and two. My background is actually in mathematics. For science, I can teach by using my base of knowledge from when I was in high school. I can teach if I have a chance to review all the information and have examples but I’m still not confident in the subject details and my teaching approach. When I teach the science content for grades one and two, I feel that I mix up the content between the grades.

**Interview Question 3: What do you think about place-based science education?**

WTT-T1 - In 2008 I didn’t pay enough attention to place-based education because I didn’t have a chance to teach science. But I have experience from training and some basic information about place-based education.

**Interview Question 4: How much do you understand about place-based education in classrooms?**

WTT-T1 - I have knowledge and understanding of place-based education but I don’t have any experience yet. That is why I’m not clear.
WTT-T2 Interview

Interview Question 1: After participating in the 2008 pilot research project, were you able to continue teaching by using place-based science education?

WTT-T2 - I tried two or three classes but not every class because I’m not really sure and clear on how to continue with place-based education. At the same time, I have to teach every subject and it takes a lot of time to prepare.

Interview Question 2: What happened to the students when taught using place-based education compared to a normal class?

WTT-T2 - The students took a lot of effort to learn and they had a lot of fun with the activities; but they took a lot of time. Sometimes we couldn’t move from a place-based class to a regular class because it took a lot of time to finish up. For example, in science class we did place-based education. After science class we did math class and it took time to transition to math class after active learning in science class.

Interview Question 3: How do you feel about your science teaching?

WTT-T2 - After the training in 2008, I tried to teach using place-based education but I can apply it only to science subjects. This is because I don’t have confidence. I tried to apply place-based education to only the class I know about from the training. I can’t do my best yet and I need some more time for training.

Interview Question 4: What do you think about place-based science education?

WTT-T2 - In 2008, when I tried to teach by using place-based education, it affected student learning and behavior. For example, the students learned communication skills. I feel the students learn from hands-on learning more
than direct teaching in class. One more thing I found out from using place-based
science education is that students lack the science skills because I did not allow
them the chance to develop the skills.

*Interview Question 5: How much do you understand about place-based education in
classrooms?*

WTT-T2 - Place-based education is about bringing the place and everyday life
experience to apply to classroom learning. It was very difficult from the
beginning to start because I didn’t have any experience doing this before, but it
was worth it to start to do it. I also apply PBE to other subjects I teach such as
social studies class.

**PCW-T1 Interview**

*Interview Question 1: Normally, what subject do you like to teach the most?*

PCW-T1 – My background in is English language study. I have to teach science
but I have no idea about science at all.

*Interview Question 2: What do you do to solve your problem in teaching science?*

PCW-T1 - The students watched distance-learning television. I knew their
problem but I couldn’t help them. I wanted to improve my science and
experimental skills. I also wanted to help by asking questions but I didn’t know
how to do it.

*Interview Question 3: What do you think about place-based science education?*

PCW-T1 - I don’t know anything about place-based science education but I
would like to learn if I have a chance to train. I want to participate so I can learn
about how to teach science. I want to do my best.
Interview Question 4: Do you like science?

PCW-T1 - I don’t like science but I have to teach. I want to know more about science and how to teach it. That is my problem.

Interview Question 5: Do you have any lesson plans in science?

PCW-T1 – No I don’t.

PW-T1 Interview

Interview Question 1: Have you ever heard about place-based education before?

I heard about it but I’m not sure it is the same thing. Place-based education from what I know is about using the “funds of knowledge” in the community to teach in the schools.

Interview Question 2: Have you ever had experiences using local knowledge in classroom? If so, what subject?

I teach in Career and Technical Education. We bring the student to visit the people in the village to learn how they make clay bricks. We also visited the farms (but not often).

Interview Question 3: Does this relate directly to classroom learning or not?

Honestly, when the students go and see it and we discuss about it in class, it is not directly related to the classroom learning. But I want students to have extra activities and experience. Hopefully, students can get ideas about developing their own science or social study project. I’m still struggling and don’t know how to manage this experience.
**Interview Question 4:** *How do you feel about your science teaching?*

I like science teaching but my background is not in science. Many times I would like to learn how to teach science that I hope would help me develop my teaching style. I go and study by myself. I never had a chance to go to a seminar or training program that would really help me with science teaching. I have the responsibility to take care of the science lab, but honestly I don’t know how to use all the science equipment. (The teacher showed the researcher a telescope and microscopes from the lab that were broken and that she didn’t not touch because she did not know the name or what the equipment was used for. The teacher showed the researcher a test tube but she didn’t know what a test tube stand was used for).

**Interview Question 5:** *How are the students doing with science in your class?*

When I teach science, I teach by following the book. Most of the time, the students learn from distance-learning television (this school is in the television distance learning King’s project). This project is helping the schools that don’t have enough teachers to teach in the rural schools. Students learn at the same time that teachers teach on television. I also learn about science on television at the same time as the students. The students need more attention, reinforcement, and feedback in the classroom. Sometimes I tutor the students on test taking. I know this is not a good way for the students to learn (on television) but it is better than learning from me because I’m not confident in science. I wish that I could learn science skills so my students can improve. The students do not talk
much in my class and they don’t know about science skills at all because I don’t have a chance to teach them.

**BHP-T1 Interview**

*Interview Question 1: Can you tell me about your experience of teaching science?*

BHP-T1 - My background is social studies. I teach very well and am very confident in social studies. I am also good in handcrafts and my students get A awards every year from that. For three years, when we had a decrease in the number of students in class I had four students in grade 1. Two students had hyperactive learning problems. I never taught science and the students learned from distance-learning television. I haven’t focused on science because my students don’t read and write. They are a little bit slow. Since we don’t have a lot of students in my school, we don’t have problems. I came to school at 9 am sometimes and sometimes I went home early. I’m really focusing on reading and writing more than teaching any skill.

*Interview Question 2: How are your students doing on your science examinations?*

BHP-T1 - Not good, very low. Not only do they not know science, but they also can’t read and write.

*Interview Question 3: What do you think about place-based science education?*

BHP-T1 - I don’t know anything about it all because honestly I don’t like science very much.

*Interview Question 4: Are you interested in teacher training in science?*

BHP-T1 - I still don’t know how it is going to help and I hope this training will be interesting and I can learn more about teaching science. To me, I think it will
be very difficult because I don’t have a science background and I don’t know how to teach it well. I don’t know how it will work for me but I will try.

**BHP-T2 Interview**

*Interview Question 1: What do you think about your science teaching?*

BHP-T2 - My background is in agriculture. Despite that, I can still apply the basics of science in my classroom when I teach science. I will feel more confidence when I know more about science skills and science projects.

*Interview Question 2: Have you ever taught students science by using experiments in class?*

BHP-T2 - Most of the experiments are learned through distant learning on the television. I never prepared an experiment for class.

*Interview Question 3: Why is that?*

BHP-T2 - I feel no confidence in organizing (the experiments) by myself. On the other hand, when my students follow the experiments on distance-learning television, I am able to assist them. If I knew more, I might be able to assist students more in science learning.

*Interview Question 4: What do you think about how your students are doing in science?*

BHP-T2 - Parents really expect that students can learn a lot from the schools because the parents don’t know about education at all. These parents are from minority groups and the students have ability for learning and are smart, however, we don’t support their learning very well. My students are average for rural students but not outstanding.
Interview Question 5: Did you ever know about place-based education at all?

BHP-T2 - No, I didn’t know, but from my basis of knowledge, I think place-based education is about attracting the community members to come and teach in the school. For example, sometimes we invite the speakers who are experts in minority dancing to come and teach the students to dance.

Interview Question 6: What do you think about yourself if you have a chance to train in science teaching?

BHP-T2 - I’m interested in science training very much but I didn’t have a chance to go and participate in science training. Most of the training about science is not related to what I want to know and does not help improve teaching skills. I want to know about science content, lesson planning, the standards of science learning, and how to assess student learning. I am really interested in science projects.

Interview Question 7: Why are you interested in science projects?

BHP-T2 - I believe science projects can help students improve learning skills in science.

PNT-T1 Interview

Interview Question 1: Normally, what subject do you like to teach the most?

PNT-T1 - Social studies, but I like teaching science too. However, I lack science-teaching experience.

Interview Question 2: What do you do to solve this problem in teaching science?

PNT-T1 - For the first ten years of teaching, I had to teach science from the book. In 2005, they had distance learning from television. I was happy because
the students could learn science from television. Even though I sit in the class with the students and they are learning from the television I try to assist the students as much as I can. However, I’m still not confident helping the students with the explanation. If the administrator asks me to do extra work, I don’t have time to pay attention to the students. The television does not relate to students’ lives. Some minority students do not understand the language, and I don’t have time to stop everything and explain it to them.

*Interview Question 3: What is the cause or trouble with your science teaching?*

PNT-T1 - I have problems with my health.

*Interview Question 4: What do you want to know about science teaching?*

PNT-T1 - I want to know about science content, science skills, science teaching methods, how to use science tools, how to do science procedures and experiments, and how to teach science projects.

*Interview Question 5: Have you ever had experience using place-based science education in teaching?*

PNT-T1 – No, I haven’t.

**Classroom Observations of Teachers and Students Before Training**

The researcher observed the classrooms to see what science teaching was like before receiving training in place-based science education. She also observed student learning and noted problems in teaching. The researcher kept a checklist to record school materials used such as lesson plans, books, classroom activities, student worksheets, and products.
WTT-T1 Observation

Teacher WTT-T1 had 12 students in the same classroom in two different grade levels - 5 in grade 1 and 7 in grade 2. Despite the disparity in grades, the teacher had very good relationships, interactions, and class control with these students. When the teachers taught, the students in class sat down at the table and learned from the book instead of participating in hands-on learning. The teacher organized the seating in class so that grade one was on one side of the classroom and grade two was on the other side. This was important because the instruction was not integrated between the two grades. The teacher did not have a science lesson plan, nor did she have an assessment and evaluation system, nor did she have any school materials such as worksheets or books to use in hands-on activities, nor any supplemental books. This teacher had not been observed before.

WTT-T2 Observation

There were 24 students in this 6th grade classroom. There was evidence of hands-on learning in technology and careers but not in science. The teacher mostly lectured, but there was still some time for hands-on learning. There was evidence of student activities such as constructing worksheets as well as some student projects. The students greeted the visiting researcher (recognizing her from the previous pilot study).

PCW-T1 Observation

The classroom environment was clean and nice. The students looked healthy and happy. There was evidence of hands-on learning in career and technology but not science (worksheets, graphing, materials, science lesson plans or science curriculum).
PW-T1 Observation

There were twelve students in the class. The classroom did not appear safe during this observation because there was a hole in the roof. The teacher explained that students in the other classroom disturbed their class during their classroom sessions because of the lack of a wall dividing the classes. There was no evidence of activities or hands-on learning in the notebooks or in the empty classroom that lacked books, pictures, or materials to support student learning. When the researcher was observing, the students lacked confidence in verbally expressing themselves. Even when the teacher asked the students questions, the students were too shy and lacked confidence to respond to the teacher’s questions, she did not look healthy.

BHP-T1 Observation

There were only four students in this classroom. There was lot of evidence of hands-on learning in social studies and career/technical education. There was no evidence of activities in mathematics or science. There was no evidence of science in the 3rd grade notebooks and there were no lesson plans or student records observed. There was only homework in Thai language writing and math basics on the teacher’s desk. The teacher strongly emphasized and encouraged the students to answer and participate with the students on the distance-learning class on television instead. The students were occasionally aggressive and shouted at one another. Some of the students showed evidence of having ADD (attention deficit disorder) by not paying attention or by their lack of interest in learning.
BHP-T2 Observation

The classroom environment had lot of evidence of student work including some evidence of student learning in math and science. There was evidence of lesson plans and student performance records. During the distance-learning class on television, the teacher assisted and involved the students in activities. In general, the teacher was very good at supporting students with their learning activities and explaining information.

PNT-T1 Observation

This classroom was very untidy and lacked learning support material. When students spoke with each other, they used their local minority language. When they spoke in the Thai language, they had a different accent. There were only five students in the class and no evidence of activities or hands-on learning. There was a daily live television broadcast available for learning. The researcher observed that the students just listened and wrote down what the television teacher said while not appearing happy or communicating with each other. While the students on television were involved in activities, the students in the class were only watching and were not engaged in the same activities. When the television teacher asked questions, the students in the PNT-T1 classroom did not respond. The PNT-T1 classroom teacher would also not respond and just sat around not involved.

Teacher Participation and Reflections about Training Activities

After studying the problems in teaching science education in 2009, the researcher found that teachers had no background, training, knowledge, or experience in teaching science, no lesson plans, and no knowledge in how to teach science activities. The
training program was designed to provide not only a basic background in place-based education but also instruction and practice in science-teaching techniques. For example, they were presented with optional methods in relating and integrating the science curriculum content: to the communities the schools were located in; to the resources found around the schools; and to the Thai National Curriculum and standards. It was also very important to help the teachers to understand the fundamentals of science and how place-based education relates to the natural environment, and to Buddhism. The professional-development program also trained teachers in conducting authentic assessments (e.g. making student evaluations that are indicators of learning such as creating and scoring tests, appraising behavior using worksheets, and scrutinizing student projects) and involved them in practice, participation, networking, helping each other, sharing, reflection, and being part of a community of learning.

All seven of the teachers participated in the program and all attended its activities 100% of the time, with the exception of one teacher who was briefly absent to attend a funeral. The training took place during the semester break. After the semester begin, the teachers met after school on Monday, Wednesday, and Friday and all day Saturday. The sessions lasted from 4:30 pm to 6 pm on the school days, and 9 am to 4 pm on Saturdays. During the classroom peer observations, substitute teachers were provided. The teachers returned home each night and traveled a few miles by car, local transportation, or motorcycle to the sessions. The teachers often carpooled. The teachers were provided materials from the program and they also shared their own materials.
The teachers were fully engaged during the training activities and all kept a learning log in which they wrote about what they learned from the training each day and questions they had. For example, after listening to a presentation on place-based education and connecting to local communities, one teacher (PHB-T2) was glad to learn about how to engage with parents and to draw out opinions about community needs. Another teacher (PHB-T1) said she learned that place-based education was meaningful for student learning if she organized the content and managed the activities by allowing for community participation. Yet another teacher (PW-T1) said that science skills cannot be learned in one day after listening about how to teach science skills and experiments. Instead, she said that science skills such as observing, wondering, and experimenting would need to be practiced all the time by her students. Teacher PCW-T1 said that the technique of station learning was very helpful and she would like to use this technique in her classroom. She also said that the guest speaker who made a presentation about experimental skills was very knowledgeable.

Teacher PCT-T1 said that he never got a chance to organize his authentic assessments and that he began doing so and reported test scores only after seeing a guest speaker's presentation on education assessment and presentation of data to the Education District. He realized that assessment of student behavior was important and that every subject he taught needed to reach the national standards of learning for that subject. He also asked for guidelines to be able to report assessments.

After learning about how classroom activities should reach every learner, teacher WTT-T2 said that she began to appreciate that students in the classroom had different
interests and that this was the key reason she needed to learn how to organize and support different learning activities.

When the teachers collaborated as a group they came up with good ideas such as how to share teaching activities, how to integrate community resources into the lesson plans, and ideas for class management. The teachers saw how such collaboration might help the students in their own classrooms. The teachers became less afraid to present their work and share feedback with each other. The researcher observed that the teachers were getting along very well and were sharing and learning from each other. They began working as a group addressing challenges present within the same grade level despite being in different schools. They worked at the school level in formulating a school curriculum that met the Thai National Curriculum Standards, and simultaneously they worked together at different schools within the same grade level on sharing ideas about creating lesson plans that met National Standards. After the teachers wrote trial lesson plans, they got feedback from each other, the Education District, and the guest speakers (ten guest speakers were funded by the researcher). They shared food and became friends in the socializing sessions that accompanied the training.

**Place-based Education Applications after Training**

The teachers wrote place-based science classroom lesson plans that integrated community resources and the Thai National Science Curriculum. The plans included the school background, community context and the students' academic, cultural, and economic background (e.g. whether the student was from a Hill Tribe or other minority group). Included in the lesson plans were the learning content, science skills, and
student assessment techniques for each standard and learning activity (see appendix G for an example of a place-based science education lesson plan).

In contrast to the place-based education lesson plans, the traditional lesson plans provided by the Education District included the content and activities but did not include student assessments, the integration of the Thai National Curriculum, nor understandable instructions by teachers on how to write them. After designing the place-based lessons as a learning exercise, the teachers designed classroom evaluation forms to assess student science learning, and then they evaluated what everyone had come up with. Students also participated in self-assessment surveys.

**Classroom Teaching and Student Learning Using Place-based Education**

The teachers had to get to know the students’ learning styles, interests, demographics, and test scores when the semester started by gradually making changes in their lesson plans and approaches to teaching. After the teachers taught four classes, they allowed the researcher and other outsiders to observe their teaching. Each teacher volunteered to be observed. In the observation procedure: (1) the observer respected the class by wearing formal clothes; (2) employing the strategy of *kullayanamittra* (true friendship)—a technique in not trying to hurt people by showing support while telling the truth; and (3) completing the observation form. The teachers being observed: (1) prepared a copy of their lesson plans and a sample of classroom materials for the observer; (2) prepared the classroom space where the observer could observe without disturbing the learning activities; (3) provided information about classes and student activities before teaching; and (4) taught the place-based science lesson.
Before the class started, the observers met with the teacher for 10 minutes to learn about what would happen in the lesson and about problems that the teacher wanted to focus on and wanted help with. In the next 10 minutes the teacher prepared to teach the class. During the formal observation period, the observers did not interrupt or ask questions or participate in any of the activities. The teachers took notes to complete the observation form. After the lesson, the observers: (1) let the teachers describe how they felt about their teaching; (2) shared the positive aspects of teaching that they observed; (3) shared information or suggestions without being intimidating; (4) discussed and shared strategies with teachers about what they learned; and (5) submitted the observation form to the teacher so they could reflect later on their teaching. Each teacher was observed two times as reported below:

Observations of Classroom Teaching After Training

An example of the teacher observation process is described in this section. Each teacher was observed two times: once in the beginning of the semester and a second time after one month. The teachers’ peers, outside observers, and the researcher conducted the observation. The example portrayed below is of a fourth grade teacher. This single example is followed by a summary of the observations of the other six teachers in the sample.

Overview of BHP-T2 Lesson Observation 1

The teacher and student greeted each other at the start of classes in the beginning of the semester. The teacher reviewed the content presented in the student’s previous class and coordinated it with the activity of the day to enable a smooth transition for the student. The content of this class was about local plants. The teacher collected sample
leaves from plants in the community. Seven students were divided into three groups. Students were given a sample of a leaf and were asked to identify the local name and the Thai name. The teacher then provided the scientific name from the encyclopedia. Students were asked to draw the leaf and note differences in color, shape, and where the leaf came from. When the students tried to identify the leaves and find the name, the teacher asked if they knew the local use of the leaves. For example, guava leaves are made into tea that can be used for stomach pain. From this lesson, the teacher wanted the students to identify the plant by examining its leaf structure with a microscope.

**BHP-T2 Lesson 1: Peer Observations (summary of 2 observers)**

**Activities of teaching.** The teacher greeted the students and handed out the different samples of plant leaves. The students worked together as a team and tried to identify the differences in the leaves. The teacher guided the students to appreciate the subtle distinctions. The teacher and students interacted and learned from each other. For example, the students shared stories of different plant uses in the home. The teacher also expanded their knowledge by giving the students an assignment to go and collect the name and use of a local plant that they found at home. Time was well managed for the assignment and the teaching effort fulfilled the purpose of learning in this class.

**Teaching techniques, visual aids, assessment procedures and motivation tactics.** The teacher often gave positive reinforcement with comments such as, “Very good. That is the correct answer. Excellent.” The material used in class related to the learning content. On the other hand, it was not clear how the teacher assessed student learning. The teacher helped to support student learning by asking questions and challenging students with a competition between student teams. The teacher integrated
social studies into the challenge by offering a story about the use of Pandan leaves for decorating and making offerings to the monks. She also expanded the students understanding by advising them that Pandan leaves both smelled pleasing and camouflaged the unpleasant odors of fish or pork.

**Integration (moral/ethical, funds of knowledge, other subjects).** The teacher integrated moral and ethical principles together into the class proceedings very smoothly encouraging the students to work as a team and repeatedly reminding the students to cooperate. The teacher asked questions about how the students could protect the trees in the community that produce the leaves, asking what would happen if the leaves were threatened with extinction? Students responded by offering that each household would have to do what they could to protect the leaves. One peer observed that one or two plants could usually be described in books. Surprisingly the students learned 10 leaves in each group and then 30 leaves by combining the groups. This was a very good, interesting and efficient teaching technique.

**Something impressive.** The teaching and learning atmosphere was very good. The teacher’s personality was very kind and calm, never yelling at the students despite their occasional expressions of frustration. The teacher patiently listened to the students giving them a chance to explain and express themselves. The teacher prepared everything before class and was very well organized.

**Positive suggestion.** The students were enthusiastic to learn so the teacher might have taken the students outside the classroom where they could have actually seen the Pandan leaves growing naturally rather than just learning about them in class.
BHP-T2 Lesson 1: Outsider Observations

The outside observer (Education District Officer) talked about how placed-based education activities were a good example of hands-on learning and how the students had the opportunity of learning more effectively by using different tools. The students took advantage of these new techniques, for example, by learning new leaf identities from each other. This is an example of using funds of knowledge where one student knows about a leaf and shares this knowledge with others. The teacher helped to make connections between scientific knowledge and the students’ observations and knowledge of the leaves. For example, the teacher discussed how plants could be identified by the structure of the leaves. The students observed that some leaves had hair and had differences in color and smell related to leaf identification. The students drew pictures of the different structures of the leaves and used all their senses to identify the leaves.

The outside observer also noted that the purpose of learning in this class was to teach the students to identify the leaves, however what was interesting to the observer was that the students learned more than what was set out as the purpose of the class. The lesson presented a valuable time for learning for the students. The hands-on teaching techniques and visual aids helped the students learn from each other and construct the knowledge of leaves by themselves. For example, the students compared the structure of the leaf veins to grass, tree leaves, and weeds to categorize and identify the plants as monocots or dicots. The students also tore the leaves apart to identify the plants.

The teacher used a number of different methods of making assessments. Initially the students were asked to present and evaluate their own work and give verbal feedback
to their peers. The teacher then evaluated student feelings about lessons by noting their responses to “smiley faces”. The teacher also assessed students’ learning with worksheets. When the students presented in class and asked each other questions, the students’ explanations were not complete. The observer thought the teacher should provide more immediate feedback to the students. In the end, the observer noticed that the teacher did a good job of controlling time. Also noted was that the students respected each other. The observer noted that lesson integrating the consciousness of preservation along with the responsibility of taking care of local plants went above and beyond what is required by the National Curriculum and the traditional classroom lesson.

The lesson involved bringing local plants into the classroom—a technique that proved more effective than learning from the book. The students were very happy to learn by using real examples and they were excited to present their own work to their peers. They pushed and challenged each other’s limits of knowledge about plants. During the entire process, the teacher guided and always supported the students. The outside observer was surprised to see how the teacher organized the classroom and how much the students learned. Instead of learning about leaves in the classroom, the teacher demonstrated that learning could be as effective or more effective by learning outside the classroom. The students learned a lot in a period of just 50 minutes. As remarkable as this was as compared with other traditional methods, the teacher knew to be careful about presenting too much information at one time. In the end, the outside observer was very impressed.
BHP-T2 Lesson 1: Teacher Reflection

The teacher said she was excited that there were so many kinds of local plants that she would like to introduce to her students. Unfortunately, there was not enough time. She was excited and nervous about teaching because in 27 years she had never been held accountable for her efforts by being observed. Perhaps because the students cooperated more than normal with the visitors in the room, she was very interested in hearing the opinions of the visitors about what they observed. The teacher said she was very happy to be observed by everyone and she wanted to know if her teaching was acceptable and if they would provide her with feedback on her teaching style.

BHP-T2 Lesson 1: Researcher’s Observations and Reflections

Before the day of observation, the teacher had time to discuss the lesson with the researcher. The researcher gave suggestions on how to organize the activities and gave support on how to teach the class. The researcher also explained about how to use the observation form and reviewed the protocol with the teacher and observers before the observation. This helped the teacher feel more confident about teaching a place-based science lesson. On the day of the observation, the teacher prepared the lesson plan, assembled the classroom materials, readied the assessment plan, and then shared the plan with the observers. The researcher noticed that the teacher was excited at the beginning of class in what was her first class observation. The peer observers were also excited. The observers used the Buddhist way of kullayanamitra to help people understand and support each other.

When the class began, all the observers sat down in the back of the classroom in a space organized by the teacher. During the classroom activities, the observers were
able to stand behind and look at the students’ work but were careful not to interfere with instruction. When greeting the students, the students respected the adults by standing up and forming the *wai* expression (putting the hands palm to palm together in the middle of the chest and then bowing). The *wai* expression is a part of the Thai culture where students paid respect to the teacher and welcomed guests to the classroom. They bowed first to the teacher and then to the guests. Everyone sat down and the teacher asked how everyone was doing.

After reviewing the activities of the previous class, the teacher introduced the activities of what they were going to learn and do in class that day. The teacher then started the lesson with a song in which the students played a game about working in a peer group. The teacher next discussed collecting plants in the community. She provided structure to the lesson by first explaining how to use the worksheet, then she showed the students the leaf samples in the basket. Following that the teacher requested that students work with their peers and started the process by pairing a high ability student with a low ability student. The teacher then gave the students ten minutes to identify the leaves and three minutes to explain to the rest of the class what they found.

When the students began to identify the leaves, they could recognize the shape of the leaf even if they didn’t know the name of the plants they grew on. The teacher then explained that the leaves came from plants in the community and she asked the students if they ever noticed them. Since most of the students may not have paid attention to the plants or have known their names, the teacher encouraged the students to look for them after class. This is the way the teacher encouraged integrating local knowledge with the school science curriculum. During the student presentations, the class discussed their
worksheets, passed leaves around, and identified the leaves. With the teacher’s support, the students’ presentations were followed with a question and answer session to help each other with the leaf identification. After observing the leaves, the teacher asked the students to look up the scientific name in the encyclopedia.

The researcher observed that the students talked together in their own minority language. For example, when they identified a leaf, they first spoke in their minority language, then their local language dialect, and then in the official Thai language. They then identified the leaves in the English scientific language. When they spoke to the teacher in the classroom, they spoke in official Thai language. It was very interesting that the students spoke in four languages at the same time (minority, local dialect, Thai and English).

The researcher noticed that when the teacher asked the students to observe the leaves, she tried to encourage the students but she didn’t guide the students in how to observe the leaves scientifically. For example, the students didn’t notice the many shades of green in the leaves. The teacher didn’t talk about the detail needed with scientific observations. In general, however, the teacher encouraged and challenged the students, spoke very clearly, and was kind and friendly.

When assessing student learning, the teacher helped the students construct their knowledge and come up with their own unique understanding of what they learned. She did this by guiding questions and giving responses to student answers. If the student response was not clear, the teacher asked open questions that the students could answer. When the student answers were totally wrong, the teacher directed the question to a student who did know the answer. The teacher also assessed students with worksheets
and she worked with helping students be more organized. She integrated the lesson in the Buddhist way of helping the students to be kind with each other and sharing materials in class. When a student answered the teacher’s question correctly, the other students clapped their hands providing mutual support.

In the meeting of the observers after the lesson, the teacher was asked to assess her own teaching. The teacher said from the beginning she felt a little bit nervous, because she worried that the students would not cooperate. However, as the lesson progressed, she felt more comfortable because the students were happy and excited to learn. She said she tried to use active learning techniques, and she found out that sometimes the students were confused about the plants because the same plants sometimes have many different names. The plants are called one name in the community while being called another name in the market. Because they had different names, the teacher said she had to explain whether the plants were the same or different. The teacher was not sure what to do about some students who had problems in learning, did not participate fully, and spoke very little. She wanted to know strategies to help.

The peer observers complimented the teacher by saying that she did a very good job and the students had very good manners. They also said that she used fun activities in class. One of the peer observers expressed that she didn’t know what to write down. The researcher encouraged the observer to write down anything that came to mind because the teacher could reflect on the comments later. The teacher said this was the first time she used what she learned from the training program, and she was very happy because the students were enthusiastic and did not waste any time.
The outsider from the Education District evaluated how the teacher organized the class and whether place-based education met the standards of the Thai National Curriculum. At first, his attitude was somewhat skeptical and hesitant as this was the first time he observed a place-based science class; however, he noted that even though the teacher was not trained in science, she looked and acted like a professional. In the end, the outsider observer was very pleased with the teacher’s performance.

Overall, the observers of the teacher gained valuable experience. This was important to understand because the next time the teacher observer would become a teacher being observed. Therefore, this process helped the teachers think about their own teaching techniques, lesson plans, and how to organize the classroom.

**Overview of BHP-T2 Lesson 2**

After teacher BHP-T2 taught her first lesson she then became an observer of two other teachers. One month later, she was observed teaching a second lesson on domestic animals. This class was the third, five-hour lesson on wild and domestic animals. In this class, the students were studying the behavior of domestic animals.

The observers met early in the day before the classroom observation. The teacher took the observers and her students to a frog farm shown in Figure 2 to study about animal behavior at a student’s house in the village. Seven students rode their bicycles along a small, windy road in the village to get to the farm. The teacher rode a motorbike and the observers traveled in a small car. The trip took about 10 minutes. The students were informed that the parents would be the teachers that day. The Thai students wore their local dress instead of their school uniforms. The students’ mother and grandparents greeted the members of our class when we arrived. This typical Thai
house had a family living quarters situated on the upper level and a domestic animal living quarters situated below.

Figure 2. Teacher, observers, and students studying frog behavior

The animals included chickens, two dogs, and several cats. At the back of the house were two concrete barrels filled with water where about 400 frogs were living. The family made ceramic crafts in the house. A neighbor came to visit the guests while the class was in session. All the parents and children knew each other very well because they were all neighbors. The children sat on the floor and the adults sat in the chairs according to Thai custom.
The class began with the mother introducing herself and explaining why she wanted to have a frog farm. The mother said she knew the children very well but they never had a chance to see the frogs. The teacher also explained the purpose of learning in this class and explained that they would learn more about domestic animals from the mother. A long time ago when they wanted to eat frogs they would catch them in the rice fields. Recently the populations had declined and were unsafe to eat because of the use of chemical fertilizers and insecticides being used there. The mother also stopped doing the rice farming in the village.

The animals should be protected according to the Buddhist way, so instead of depending upon wild frogs that had been poisoned by the chemical fertilizers and insecticides in the rice fields, they wanted to raise the frogs in a clean environment to sell for food in the village. The government furnished domestic frogs so they ordered 100 frogs to begin their enterprise experiment. Although the frogs ate a lot—about four times per day—and the mother had to buy frog food to feed the frogs, business was good and the mother was now raising 400 frogs. The students learned how the mother fed and cared for the frogs including how she changed the water. They also learned about the noises the frogs made. The children were able to observe the frogs but were not able to put their hands over the barrel where they were being kept as this might tempt the frogs to jump out. The students from the class who lived in the house explained how she fed the frogs bread and how the frogs jumped after the bread as soon as they saw it.

During this time, the teacher reminded the students to complete a paper about what they observed and take notes about the color and the behavior of the frogs they found interesting. The students wondered which frogs were male and which were
female and why there were color differences. They also wondered why the frogs liked to hide under the pipes and whether the frogs were happy.

**BHP-T2 Lesson 2: Peer Observations (summary of 2 peer observations)**

Activities of teaching: Both peers commented that the students were excited to learn about a topic from everyday life that was interesting and meaningful to them. This class made a good connection between student life and science knowledge and proceeded very smoothly.

**Teaching techniques and visual aids (assessment, motivation).** The parents were very kind and willing to help. It was interesting that the parents were invited to be the teacher. The teacher and the mother, who was the guest speaker, all cooperated together very well. The teacher added scientific knowledge, and the parent explained her experience with frogs. This was a great activity for students to learn about real phenomena. The researcher observed that the students were enthusiastic, asked many questions and took notes during the class. This approach improved their observation skills and stimulated their curiosity about what they saw. The students dramatically improved their observation skills in just two months. One peer observer wondered how the teacher would assess student learning and what the report or homework would be. Each lesson plan identified a science standard of learning and science skills. During the peer observation, the teachers were expected to assess learning according to these standards.

**Integration (moral/ethical, funds of knowledge, other subjects).** The teacher integrated the local knowledge about frogs with classroom science. This helped to make learning more meaningful to the students. When the mother explained from her
experience, she raised important points about the economics of raising frogs in a business context. She also discussed the situation of decreasing frog populations due to chemicals in the environment and how it would be harmful to humans if they ate the frogs. They also learned that just harvesting wild frogs from the rice fields without knowing anything about their health and welfare risked endangering the sustainability of their populations. Therefore, raising the frogs through careful management made economic as well as ecological sense. The peer observers thought that the teacher was making an interesting point about preserving food resources for the community

**Something impressive.** The students were very well behaved and the parents were also very cooperative. Everything in the class was well organized and ran smoothly. The students were enthusiastic and improved in their ability to ask questions. At the end of the class, the teacher gave the students the opportunity to say “thank you” to their families and give appreciation speeches.

**Positive suggestion.** The peers very much appreciated the chance to observe the class and they wanted to bring this type of learning into their classes. They had no specific suggestions but were very positive.

**BHP-T2 Lesson 2: Outsider Observations**

The outside observer was a science education professor who worked for the University of Bangkok. She also worked for the Institution for Promotion of Teaching Science and Technology that was responsible for the Thai national science curriculum standards. The observer said that the activities in this classroom were related to the National Curriculum and demonstrated that learning could be expanded for students outside the classroom.
In her introduction, teacher BHP-T2 never forgot to make the connection between the purpose of learning and activity for the day. The content of learning was about the effect that environment had on the behavior of animals. This lesson provided an example of how readily the frog responded to the offering of food – in jumping up to get it. This was an example where learning by observing real life was superior to book learning. The observer thought it was interesting that parents gave the students a chance to ask questions, observe, and feed the frogs.

The students were participants in the learning process. For example, they were asking question that helped frame the activities. The time management for the lesson was very good because the activities were well-organized and the students had time to go to lunch and get back to school for another class. This activity provided learning outside the classroom, the students were well behaved, and the students were motivated to ask interesting questions such as: what enables frogs to jump so high?; would frogs stay hidden if no food was offered to entice them out?; why did the frog move away from the their shadows?; was the frog scared when they were hiding?; why did the frogs come out if their food bucket was kicked?; and did the frogs know that people will bring food for them? When the students came up with ideas or wondered about the frog behavior, the teacher always complimented and supported them.

The observer thought that it was interesting how students made connections with direct experience in learning about animal behavior. The observer was impressed that the teacher talked about the five precepts of Buddhism that related to not killing or torturing the animals and the current belief that animals have feelings just as human beings do and need love and care.
The outside observer noted that the teacher was patient, kind, and focused on student learning, fairness, and equality for all students. The teacher respected students when they asked questions or made comments. Finally, the observer was impressed that the students could understand animal behavior by learning from real experience. The science lab doesn’t always have to be in the classroom. It can be in a home or somewhere in the community as long as the teacher knows how to connect local knowledge with learning activities.

**BHP-T2 Lesson 2: Teacher Reflections**

The teacher thought that time management would be a problem but she was pleasantly relieved when she spoke with the guest speaker - the mother of one of the students - to plan their activities together. They simply made a mutual effort to cooperate so that time was managed very well. The teacher learned from the observers that it was difficult for students to write down observations in their notebook while in the field. The teacher should have made hardback folders available to help the students write better. The teacher appreciated the comments of the observers about showing respect and appreciation to the guest speaker. The teacher had a chance to share her experience and story to the observer about how to organize the classroom and get the parents involved in the lesson. She had to go to the village and find parents who could contribute. The parents didn’t know the content but they had an opportunity to share their experiences and connect with the students’ learning process. If the teacher had not planned her lessons and activities with the parents, student learning would not have been as successful.
The teacher very much appreciated everyone observing her and helping to support her to be more confident with her teaching. This was a great opportunity for learning how to teach science and she felt that place-based education helped her make successful student learning possible. She was very impressed with the way students were able to learn. The depth of student thought and understanding far surpassed what she had experienced in the traditional classroom where the students usually had very short answers that they had very little conviction about. She learned that the situation was quite different in place-based education where student learning was more substantial because there was a thinking process in which students learned how to construct knowledge by themselves and were more responsible. She also learned that parents paid more attention to their students/children such as when she asked the students to talk with their parents about different uses of lemon grass. As the teacher became more experienced with place-based education, attitudes toward the school and the classroom were changed greatly. Both the students and the parents become more involved. In one case, a parent who knew a great deal about lemon grass gave a talk on the plants, its uses, and its preparation in typical local cooking and local medication uses. In the end, the teacher made a book of stories from the community about student projects that integrated local language and Thai language.

**BHP-T2: Researcher Observations and Reflections**

The researcher spoke with the teacher after her first observation and found out that the teacher had been unsuccessful in her first attempt at having a parent into her class as a guest speaker. This experience was not successful because the content of the talk was not related to the teacher’s expectations because the teacher had never
formulated a specific plan through discussion with the parent beforehand. In her second observation, the teacher went into the community a week ahead of time and had a detailed discussion with the parents to better relate their experiences to what the students studied in the class. The researcher asked the teacher about how she compared place-based education with traditional teaching. The teacher responded by saying she actually had to work and prepare harder using place-based education.

The students also helped their teacher a lot by providing information about their resources. The students gave examples of what they wanted to learn about. When they suggested animals such as dogs, cats, pigs, chickens, or ducks some of the students showed interest, but many did not. On the other hand, when someone mentioned frogs, most of the students got very excited. The student who suggested frogs also knew where to go to find a frog farm and shared information with the teacher to help the teacher to plan the lesson. The students were enthusiastic in helping the teacher contact the parents and they made an appointment for the teacher to meet the frog farmer who also happened to be a parent. With such a spirited response by the students, the teacher could easily see that the students were very inspired and wanted to work on the project.

The teacher could see another difference between place-based and traditional style class learning. In the traditional class, the students were bored and while some finished the work, others did not. The students were frequently unhappy because the teacher expected them to do a lot of homework studying the contents of books and answering questions about what they read. It didn’t help the situation at all to discover that when the students didn’t understand and asked their parents for help, their parents
couldn’t help because they didn’t understand the contents in the book that came from outside the experience of those in the community.

Not only were the students spirited about learning using the place-based approach but their sense of responsibility to themselves and their friends increased when they did so. The teacher mentioned that she although she was working harder on the place-based teaching approach than on the traditional class approach, it was worth it because the learning spirit of the students was infectious and would lead to a lot easier and perhaps accelerated learning in the future.

The researcher asked the teacher about how the parents responded to place-based education. The teacher replied that some parents were shy but they were willing to provide a lot of information and help in any way they could. Most of the parents never had a spoken in front of a class to share their experiences before, but they looked forward to participating. The parents were also very interested in how their children were doing in class and wanted to see firsthand what the new approach might be developing into.

From the researcher’s analysis of peer observations of other teachers as well as direct interviews with teachers about their own experiences, she could see that the teachers were very interested in how to organize the classroom because they asked a lot of questions about it. The teachers were excited and they liked how the students gave appreciation speeches and showed respect by sitting on the floor. This again was an example of demonstrating the *wai* expression in Buddhist culture. When the parents spoke to all the children, they referred to their child as son or daughter rather than describing them by name. The students in turn, referred to their parents as auntie, uncle,
or grandmother. The teacher also asked the students questions about raising frogs. Some students had experience with frogs and were very outgoing, so they excitedly answered the questions.

The outsider was fascinated about student learning using the place-based approach but she was concerned from the beginning with how the teacher would connect students’ learning experiences with scientific knowledge. Later, the observer could see that the teacher did very well in accomplishing just that. For example, the parents explained based on their personal observations that the real frogs behaved differently from scientific explanations. The parents thought that the frogs were responding to humans but the observer noted that scientifically the frogs responded to the knocking stimuli. The outside observer said that learning was meaningful and she gave lots of compliments to the teacher. It was obvious that the teacher was happy and made more confident by the experience she was having.

The outside observer was concerned about the safety of the children outside the classroom. The teacher responded by saying she had approval from the school principal and was in possession of signed consent forms from their parents. This class was a very good example of place-based science education. Sometimes you don’t need a science lab to learn science when science can be learned in the natural environment outdoors.

**Summary of Other Classroom Observations**

The six other teachers taught a variety of place-based education lessons. BHP-T1, for example, taught a third grade lesson about the use of everyday materials in daily life such as plastic, iron, and ceramics. The students discussed which materials might be used for a particular reason, for example which material would be best to drink water out
of. The teacher had difficulty in making scientific knowledge connections with the everyday use of these materials. In the second lesson, the teacher taught a lesson on plants. This lesson was better planned. The teacher let the students go out and collect a plant they liked in the school. The students had a chance to express themselves by drawing the structure of the plants. The students had to identify the plant and explain why they liked the plant.

Another third grade teacher (PNT-T1) also taught his first place-base education lesson on materials. This lesson was similar to a traditional lesson in that he stood in front of the classroom and talked about different materials. He gave only one example of connecting the content to the community. In the second lesson shown in Figure 3, he took the students outside to collect plants. The students used magnifying glasses to observe the plants. The students identified the plants by the local name and noticed that the leaves of some plants closed when they were touched. The students also studied the structure of plants that floated in the water. This was a big improvement in engaging children as the students were very excited. The teacher was also very pleased with his success.
A fourth grade teacher (PW-TI) taught a lesson about photosynthesis. From the beginning, the teacher was very nervous and she repeated the information several times. However, she was very kind to the students and showed them great care and concern. She took the children outside around the school garden and the students noticed that some plants were wilting and the leaves were turning yellow. The teacher asked the students why this happened. In the classroom, she had the students do an experiment by covering a plant with a black plastic bag and leaving the others exposed to sun. The students observed the wilting of the plant and the teacher connected their observations about this to photosynthesis. The second lesson was on the structure of the rocks and
sand. In Figure 4 the students can be seen studying at learning stations in the classroom that were organized by rocks, soil, mud, and surface soil that was found in the community.

Figure 4. Students studying at learning stations in the classroom

At each station, the students had about five minutes to observe or perform a simple experiment and then they rotated to another station. This class was challenging, the students were excited about learning and the teacher was more confident.
The next teacher (WTT-T1) was a second grade mathematics teacher who was teaching science. She introduced the concept of nutrition in her first lesson, asking the students to identify what they ate that day. The students brought their lunch of fried rice and soup into the classroom, and then identified which nutrition groups the foods belonged to. The students also described what they had for breakfast. Unfortunately, some of the children did not have breakfast so the teacher asked them what they had for dinner. From the researcher’s observations, this was an effective place-based science lesson for connecting to students’ lives because the students will understand and value how food is very important to their health. Students can understand which food they eat from the local community is nutritious and connected to the five nutrition groups. In this class were Hill Tribe students so communication was sometimes very difficult. When the students couldn’t write down what their food was, they were asked to draw a picture.

In the second lesson, the students learned about different kinds of soil found in the community. The students were asked to collect soil from home and different places in their neighborhoods. In the classroom shown in Figure 5, the students were asked to identify where the soil came from such as from a rice field or from under a tree. The students also used a funnel and paper to find out which soil was the muddiest and best for using in the rice fields. The lesson was very useful as the students used simple tools to conduct science experiments that connected with ongoing activities and concerns in the local community. Both teachers and students enjoyed the classes very much—despite the fact that they were challenging,
The next teacher (WTT-T2) was very well organized, worked as an academic coordinator at the school in 2008, had experience teaching, and had a lot of responsibility in the Education District. Despite all of this, she was still not confident with the process of place-based science education. After the professional development training in 2009-2010, she felt more confident as she learned more about using local materials to be incorporated into her lesson plans. In her first lesson on nutrition, the students researched and collected information on family meals three months back. They researched the ingredients of various sauces, including fish sauce, soy sauce, and oyster sauce. They checked to see how much sugar, vinegar, MSG, and other chemicals were in the sauce. The students found out that cheap sauces were made of water, salt, and food coloring all of which had little nutritional value. They also speculated about whether these ingredients affected the health of family members. For example, the grandmother of one of the students had experienced problems with aching bones and problems with her eyes since she was 30 years old. The student’s mother had the same problem. Another student’s parent had stomach problems. The students suspected these problems might be related to nutrition. In the second lesson, teacher WTT-T2 designed
activities where students experimented with a “water powder”—a suspension of a non-soluble astringent powder in water used locally to freshen the skin. In this experiment shown in Figure 6, they permitted the powder to settle to the bottom of the solution and filtered it out. They gained an understanding of what suspension is through this exercise and the teacher gained confidence in teaching science by using materials from everyday life.

*Figure 6. A student engaged in a “water powder” filtration experiment*

PCW-T1—the last 4th grade teacher—had an English background and enjoyed teaching English more than science. Her students did not have good science backgrounds as science was not taught in earlier grades at their school. This teacher was the only teacher in school to participate in the professional development program. In the first lesson, the students identified local plants and studied the structure of plants and how they grew. However, the teacher was not confident and couldn’t explain the science in depth to the students. Nevertheless, the teacher used plants and materials from the local environment. The students were very interested in the activities. They reported
the local names, Thai names, and English names of the plants and explained very well about the structure and detail of the plants. Even though the teacher lacked the ability to connect with scientific knowledge, she tried very hard to support student learning. She also learned a lot from her peers on how to arrange the classroom.

Lesson 2 also went very well. The students learned about plant photosynthesis through an experiment in which they put a leaf in a beaker of water and then boiled the water. The teacher identified the green color that came out as chlorophyll. She asked the students how chlorophyll might be used. They came up with their own examples, such as using the color from the leaf as a natural food color. Chromatography paper was then used to separate the green colored water into pigments of different color. The teacher worked hard in this class to learn more about the science behind the lesson. She thought it was interesting that the scientific words were in English. It was probably because of this that she became more confident integrating science with English and supporting the students’ learning. She learned more about how students think and that many students like to do experiments and feel like they are scientists. PCW-T1 said that her students’ favorite class was now science, rather than English.

From these observations, it is clear that most of the seven teachers had similar problems in the first lesson they taught. They were not yet confident in the connection between place and science education, they lacked experience teaching science, and the scientific content in their lessons was not organized and presented in enough depth. The teachers worried that they would teach the wrong scientific content. To address this problem, the researcher, after the observation, provided the teachers with pertinent books, websites, and a handbook she created for the teachers to review. Unfortunately,
there were not enough resources at each school, and it was a very slow process to
download information from the Internet using their old computers.

In the second lesson, the teachers were more confident and they did a better job
of connecting their teaching activities with the community. The students were more
excited and enthusiastic about learning. The teachers developed their own network in
which they shared ideas, learned together, and told stories. When their students had
problems, they offered suggestions to help each other out. Originally, some teachers
never knew each other as they were from different villages. In this project, however,
they became closer to each other. The Education District officer was very surprised in
how closely the teachers collaborated.

**Teacher Interviews After Implementing Place-Based Science Education**

The seven focus group teachers were interviewed at the end of the semester after
implementing place-based science education. The teachers really liked how the
professional development program was organized. They were proud of the way it
changed their science teaching. Two of the teachers, BHP-T1 and PW-T1, had planned
to retire early but they now wanted to teach one more year to prove they could do very
well teaching science. One of the teachers, BHP-T1, conducted classroom research and
wrote a report on developing a place-based science education lesson plan. This plan was
presented to the Education District. BHP-T1 was designated a science professional
teacher at the elementary level and received a promotion and salary increase.

Before the training, teacher WWT-T1 was aware of experiments in the textbook, but she
did not know how to organize the experiments or find lab materials. After the training,
she learned how to bring everyday life into the classroom to conduct the experiments,
making her students in grades 1 and 2 very excited. The students recycled bottles and everyone brought soil from home to use in the experiments in school. The students in teacher WWT-T1’s class learned a lot and understood the science concepts. This helped the teacher understand and learn together with the students. Luckily, teacher WTT-T1 was able to prepare a lesson because she knew a little more than the students.

Teacher BHP-T2 felt that the networking with peers and working as a team to improve teaching helped her to develop more confidence. If the government did this, everyone might be a better teacher providing better support for student learning. Teacher BHP-T2 no longer felt that her peers were the enemy; instead, they were like a family that supported and respected each other. She did not think that she had to walk alone since she knew that everyone had the responsibility of teaching the children.

Teacher BHP-T1 worked in the school with the Taileu minority population of students who speak a different language. The Taileu parents worked very hard every day in agricultural trading as a minority group living with the majority. They had high expectations for the schools and did not think that they had time to care for or teach their children. When the teacher asked for cooperation and took time to come talk with them in the village, they began to understand the importance of their involvement in their children’s education. One family had allowed the students to use their own home as a classroom.

Teacher BHP-T2 emphasized the importance of listening to the people in the village and communicating what they were teaching. The teachers and parents communicated more than ever before because of place-based education.
Teacher PCW-T1 initially thought that science was very difficult to teach. After the place-based education project however, she understood more about science, thinking that it was a lot simpler than she thought. She realized that science is not particularly Western and understands that everything in science is connected to everyday life and culture such as the soil and things found in the kitchen. When she teaches science, she now tries to think about how what happens in the village can come into the classroom.

**Student Work Samples**

Between lessons 1 and 2, the quality of the student work improved greatly as they became confident and enthusiastic about learning. From the feedback for the peer observers and the researcher, the students were able to verbally talk about science and think critically about the topics and experiments. The student work discussed below shows what the students understood and learned from place-based science education classes.

Students were conducting science projects in most every class. In PCW Elementary School, the students collected local plants and conducted research to find the local names, Thai names, and scientific names. In BHP Elementary School, the 3rd grade students were studying the life cycle of the mosquito. They collected samples of larvae as seen in Figure 7 and drew the larvae every day until they became adult mosquitoes. Although these students could not read or write, they were able to learn to observe and record their observations by carefully drawing pictures. The students were able to explain the life cycle of the mosquito, and they knew when the insect should be destroyed to keep them from reproducing.
Figure 7. Third grade students studying the mosquito life cycle
In BHP Elementary School, the students were involved in a project to learn how to use local dried weeds and grass to absorb cooking oil from the canteen. Disposing the used cooking oil was a problem for the environment. The students shown in Figure 8 collected the oil, and then experimented to determine which plants absorbed the oil the best. In this project, the students were using science skills such as measuring and analyzing results.

*Figure 8.* Students experimenting to find which plants absorbed the oil the best

In another project in BHP Elementary School shown in Figure 9, students tested the water in the rice fields and drinking water in the village. Using water test kits, they found out that the water turned yellow because of iron and some samples had bacteria in
the water. The students noticed that the water was sometimes clear and sometimes it was not.

*Figure 9.* Students testing water in the rice fields and drinking water in the village

In Figure 10 the students are shown presenting their work to the head of the village. The village head tried to warn the people to boil the water before drinking, but nobody cared until the students presented their research.
In Figures 11 to 13 the students are shown at PW Elementary School studying the weevil, a slow-moving insect that is important in the Lanna culture. The students learned to identify whether the weevil was a male or female. They learned that the weevils ate coconut palms and that local people eat the larvae. The weevil was also raised in the village for fighting. Through their investigations, the students found out that the female deposits a chemical to attract the male. If two males are present, then they will fight. The weevils are now difficult to find. The students became experts in understanding the science of the weevil and the importance to the local culture. They presented their research in a symposium for their school and community.
Figure 11. Students at PW Elementary School studying weevils in Lanna culture

Figure 12. Students learning that male weevils fight for female weevils
Figure 13. Students learn about weevils from local people in the village

Student Interviews After Place-based Science Education

The researcher talked with the students during and after the project. The students sometimes spoke their own language and sometimes they were asked to explain using the Thai language. At the beginning of the project, the students didn’t talk very much and were passive and quiet. As the project progressed, the researcher began to see a difference in every school. The students were eager to talk and asked many questions as they became more involved in place-based education activities.

In BHP Elementary School, a 4th grader was asked how he felt about learning science through a television teacher as compared with when the in-class teacher teaches a lesson. The student replied that he sometimes understands the experiments on television and other times he does not. Usually the in-class teacher does not have time to do the experiment. When the in-class teacher teaches science, it is more fun. The
student feels like a scientist. If he fails the experiment or doesn’t understand, the teacher gives him a chance to do it again. There is more time to learn. This student enjoyed going out to interview people in the village. He was very excited when he was referred to as “doctor” as he wants to become a doctor in the future. This 4th grade student said when the teacher is teaching only from the book, it is very boring and he doesn’t want to do the homework. When he reads, he doesn’t understand from the book. When they do experiments as a group in class, this student understands more. He knows more than when learning from a book and feels he learns faster. Before, he would feel embarrassed when he presented because what he said was not true. Now when the student presents, he cannot lie because he understands what he is presenting.

In WTT Elementary school, a 6th grade student participated in activities every week outside of school. This student liked science projects but they take a long time to finish. Science projects, however, made the student think because he has to figure out what project to do. He talks to the teacher, parents, and looks at books in the library. This is a lot of work. Sometimes the students disagree and this helps them learn how to solve problems. When asked what happens if they can’t agree on the project, the student said they talk to the teacher and vote.

At PW Elementary School, a 4th grade student was asked what the students learned from their science projects. The student now knows how to do a science project and has become an expert on weevils. The student is confident and knows more than anyone in the PW Elementary School and other schools. In the science project on weevils, they students learned how to make a plan and follow it. Now this student knows how to organize and this skill is applied to soccer. In soccer, this student
organizes the team and is systematic in the game. He learned to be the boss and his friend followed him. They learned how to listen and respect others. Later, the student followed his friend. Working together they finish faster such as when they learned about the weevil by observing it through a magnifying glass. They learned to see the differences between males and females. The students were very interested in the weevil project and liked to learn about the weevil life cycle and why it is important to their culture.

**Evaluation of Student’s Standardized Test Scores**

To provide further evidence of student learning within the context of the qualitative data collected, the researcher collected evaluation data on the students’ final semester science examinations. The final semester science examinations were standardized tests that were based on the Thai National Curriculum standards and were distributed by the Education District. Students’ final semester science examination scores that were administered at the end of the second semester of the 3rd grade after receiving traditional instruction are reported below. Final semester science examination scores were reported for the same population of students at the end of the first semester of the 4th grade after receiving place-based science instruction (see Appendix H). Using a t-test, students scored significantly higher on the 4th grade final semester examination (after receiving place-based science instruction over one semester) when compared to the final semester science examination scores in the 3rd grade (67.84 average score in grade 3; 83.94 average score in grade 4, p value< 0.05, n = 50). The 4th grade student scores were compared with the same students as 3rd graders the previous year. The place-based science instruction consisted of approximately forty lessons. Only data from the students
transitioning from 3\textsuperscript{rd} to 4\textsuperscript{th} grade in the project are reported because this was the only grade where the sample sizes were large enough to test for statistical significance. In addition, the reported data came only from schools that used standardized tests in both 3\textsuperscript{rd} and 4\textsuperscript{th} grades.

**Interviews with Parents and Community Involvement**

The researcher found in direct personal interviews that the parents of the children who were engaged in the place-based education project very much appreciated having a chance to be part of school curriculum and their children’s education. They never had a chance to present information about their own experiences or knowledge in the community before. In the past, the parents did not feel that they were a part of school and thought that school was only the work of the student, teacher, and principal. Parents may have only attended school events such as a father’s day or a mother’s day. In spite of that, most parents wanted to know what students were doing in school, learning from the experience, and how they could help. The parents thought that the National Curriculum was much more complicated today as compared with when they were children in school. Parents do not have any access to learning these days, even in the first or second grade, and they also don’t know anything about the kind of science taught in schools.

In this placed-based education project, the parents had a chance to talk with teachers who explained what the children were learning and what was being taught in class. The parents thought that their children learned a lot of content and the science lessons looked professional. Another parent was a member of the local town council. He wanted to see money spent to support local education and support children in their own community. He expressed that this was important to preserve their local culture and
language. This parent wanted the students to continue local traditions and value local heritage. According to the parents, through modernization, school teaching has lost its local connections. Local students often go to the cities and do not come back. Children are difficult to control and do not respect their elders. This project gave this parent hope for the generation currently in this school. Place-based education integrated the content of the curriculum with everyday local life, thus providing hope that students will be valuable members of community.

In another interview, a monk saw children as coming to the temple only when the school sent them to visit one or two times per year. The students never came to pray in religious way. The monk was glad that the school invited him to come to teach about Dharma that teaches children how to be good people and not to hurt others. Students can learn in the temple and school how to live the right way and be good members of the community. Being responsible community members is an important part of taking care of the environment.

Another parent commented that place-based education had changed student learning at home. Before, students would not do homework and they were not enthusiastic about school. After place-based education was activated in the school, the parent noticed that the students were preparing and spending time learning at home. The students were now glad they had homework. Before, the parents didn’t know what teacher did. Now students interview parents and other family members, such as their grandmothers. The students now call on neighbors to help with the curriculum, such as to identify an animal or to talk about conservation. Before this, parents did not think the local students could compete with students in the city. However, this parent saw
something change after place-based education was started. Students were more
enthusiastic, more secure, and assumed more responsibility. The parent hoped the
teacher continued the program because they wanted their children to go to a good school
and get a good job.

Symposium

A symposium was organized in the Education District for teachers and students to
present their work on place-based science education. Approximately 150 teachers, 300
students, principals, parents from each school, and Education District officials attended
the symposium. Sixteen teachers from project, including all seven focus group teachers,
presented their work in posters sessions and PowerPoint presentations. Students involved
in the project presented their projects in poster sessions. The researcher also presented to
the audience the goals and results of the project.

The symposium provided an opportunity for teachers who did not participate in
the project to network and learn about their colleagues’ experiences with teaching place-
based science education. The participating teachers who presented were very enthusiastic
and shared their understandings of teaching science that connected to the local
community funds of knowledge. The teachers shared their lesson plans, books, student
testing results, and activities. The students presented the results of their investigations on
topics such as weevils, plants, frogs, soil types, and nutrition at their posters. On the
stage, cultural dances were performed along with science games.

The symposium provided evidence that the teachers’ attitudes towards teaching
science improved dramatically. As result of the project, teachers’ professionalism and
understandings of how to teach science by connecting to the local community were
greatly improved. The student presentations were evidence that students’ science skills and confidence as science learners increased. The other teachers attending who did not participate in the project requested that the Education District organize a similar professional development program for them to participate in. However, the Education District officers were concerned that they would not have enough staff or expertise to take care of the increased observations and support for the project. Nevertheless, the symposium provided clear evidence that with proper administrative support and community involvement, place-based education can enhance teachers’ professional development and improve students’ achievement in science.

**Summary and Conclusions**

The results of this study provided evidence to answer the research question: In the context of rural Thai elementary schools, how do teaching and student achievement change as a result of the teachers’ participation in a place-based science professional development program? At the beginning of the project, the teachers lacked confidence and competence in teaching science. They were deficient in their science education backgrounds and in their understanding of the science curriculum and pedagogy. They had little understanding in how to connect the science lessons to the National Curriculum. The teachers worked in schools that were underfunded and had poor facilities and insufficient tools for teaching science. There was a lack of administrative support, parental involvement, and community connections with the science curriculum.

After participating in the professional development program, the responding teachers’ attitudes toward science teaching changed. By using the place-based education approach, they were able to successfully design lessons that brought in resources and
funds of knowledge from the community. The teachers understood that they did not need to be experts in science; instead they found that parents and elders could contribute to support student learning. As result, the science teaching and learning process became a collaborative endeavor between the school and community. Through peer observations and collaboration, the teachers were able to support each other. They learned how to teach place-based science lessons that integrated with other subjects such as math and language arts. The teachers became more confident and were able to design lessons that connected to the Thai National Curriculum.

Through place-based science education, the students became engaged in scientific investigations and experiments that were relevant and meaningful. Their science skills and understanding of science improved, as evidenced by the work they produced and by significantly higher science test scores on the annual national assessments. In class, the students became more confident to speak and use science vocabulary when they discussed their projects. The students were more motivated to learn because the science lessons were connected to their own community, culture, and language. They learned about local plants, cared for animals in their own community, or investigated the nutrition of local foods. Most importantly, in the Wai tradition, students also learned to respect their elders and understand the traditions and values embedded in their own culture.

The parents were very willing to support school activities, and as result of their involvement in the planning and teaching of science, they developed positive attitudes toward schools. Before, the parents thought that the schools were solely responsible for their child’s education. The administrators were also involved and supportive of the
project. They were able to observe their teachers develop confidence in their ability to teach science and were impressed with the positive results of student learning. Through the collaboration with the researcher, teachers, parents, administrators, and outsider observers, the place-based professional development program was very successful in supporting and improving the students’ science learning.

In Chapter 5, the results of this study will be further analyzed by addressing how this place-based science education study addressed problems related to teaching science and student learning that are common in rural schools in Thailand. Issues and implications involved with implementing a place-based science education professional development program will also be discussed, along with the beneficial changes in teacher professionalism and student learning that were evident in this project.
CHAPTER 5: DISCUSSION AND IMPLICATIONS

This research project was designed to help the researcher understand the primary research question: In the context of rural Thai elementary schools, how do teaching and student achievement change as a result of the teachers’ participation in a place-based science professional development program? In this project, the teachers had the opportunity to reflect on a new approach that connected science teaching and learning to the National Curriculum, situated learning in the community, and Buddhist philosophy (see Figure 1). This chapter discusses the context and issues for implementing a place-based science education professional development program in rural Thailand, the changes in teaching and student learning that occurred as result of connecting science instruction to the National Curriculum and local communities of practice, and the implications for implementing place-based science education in similar rural areas.

The researcher became interested in the application of place-based education in the context of Thailand for the following reasons. (1) Rural schools in Thailand are dependent on the Thai government for funding and for other resources to support their work. Sadly, the rural schools are at the end of the priority line when it comes to receiving resources. The largest investments go to the best schools in the major cities since most of the Thai population lives there. This creates a vicious circle in which good schools consistently have the opportunity to improve, but rural schools virtually never get such an opportunity because they are deprived of precious resources. (2) Neither residents nor teachers in rural communities are unaware of this situation. Accordingly, teachers seek opportunities to leave rural areas for teaching posts in, or closer to, the major cities; and rural residents seek all ways to send their children to city schools. Often
this involves their selling ancestral farmlands and abandoning the vocation of farming. Both of these phenomena have highly negative ramifications for rural areas, for the nation, and for national agricultural productivity. (3) The researcher thought that place-based science education had certain virtues that might help alleviate both of these problems.

Schools in Thailand are under the jurisdiction of the Ministry of Education but vary greatly in the quality of their teachers, administrators, and resources. The best and wealthiest schools are in major cities. Schools in small rural communities are often poor, inadequately staffed and lacking in even the most basic resources such as libraries, school texts and even adequate physical plants. The researcher undertook this study to improve the quality of the 2008 pilot project and expand it in five rural Thai schools by introducing teachers and administrators to place-based science education. The results of the project have enhanced our understanding of the administrative structure under which Thai public schools operate, the challenges faced by district and local school administrators, and the ways in which they have attempted to meet these challenges. As an example, administrators in rural school districts are faced with a severe shortage of financial and material resources. The place-based science education professional development program demonstrated to them that when community resources—sometimes financial, but also and mainly material and human—are drawn to the school by the heightened sense of community relevance and involvement that place-based science education professional development program foster, such shortages can be overcome. By connecting to the community, the administrators learned that each school needed to set its own goals and mission. The project has also provided an awareness of teacher needs and
shortcomings. The teachers, for example, needed to develop confidence in teaching science through various techniques and approaches that connect to the local community. They needed to learn to develop lesson plans and assessment strategies that supported placed-based science education.

Originally, this project was influenced by what the researcher observed in rural schools. It became evident that the Lave and Wenger (1991) studies on “communities of practice” were directly relevant to place-based education that invites and confirms community involvement in a school. The researcher saw merit in the idea that diverse people, working together out of shared interest, as community members seeking to support a school might do, could produce positive and even innovative results by the pooled application of their diverse skills, energies and outlooks in the context of the local environment and its history.

In fact, the researcher did not initially analyze the various elements that would support place-based education in terms of social capital, social networking, and communication. It was simply assumed that sufficiently motivated, strong leaders would be able to bring the needed support elements and constituencies to bear on behalf of the school. Since beginning the research, however, the researcher gained a heightened sense of the role of social capital, social networking and sensitive, effective communication in place-based education. The researcher was especially aware of the need to communicate in a way that honors all constituents and to be creative in involving them in the educational enterprise.
Research Study: 2009-2010

Common Problems in Rural Schools

In 2009, the researcher observed and collected data by interviewing the administrators at schools and following up with the teacher interviews. The researcher found that all seven schools that were interested in participating also had the same problems – specifically, there were no specialized science teachers in these schools; the teachers who were in these schools lacked knowledge and strategies for teaching science and connecting with the community; and not unexpectedly, all of these shortcomings were reflected in very low average student scores in national tests. It became clear that the problems extended further. Not only were qualified science teachers non-existent, but simple basic resources such as textbooks, library books and science laboratory equipment were also non-existent or at very low levels. After speaking with the administrators, the researcher suggested that place-based education could be useful in easing some of these problems. Therefore, it was proposed that a workshop be set up designed to introduce place-based science education to the administrators and teachers of six rural schools.

Issues of particular concern to the researcher were teacher professionalism, a lack of knowledgeable school outreach to the parents and community, and weakness of community support for the schools. The researcher found through interviews with teachers that their traditional concept of teaching professionalism seem to end at the boundaries of their past training, personal interests and classroom walls. They seemed to be resistant to expand beyond these boundaries. They had no experience in community outreach, for example, and consequently never asked much of the community to further the education of the community’s children. They presumed that the community was poor
and lacked the financial ability, generosity, and will to provide some of the resources their schools lacked. They did not see that community resources such as the local temple, family homes and farms, agricultural expertise, household management knowledge, community collaboration, rice fields, plants, trees, wildlife and other natural resources such as water, wind, air, and soil all might be available as valuable resources for use in support of school projects. Connecting to community resources is part of the teacher learning process and is a central tenet in the place-based science education model in which learning is situated and contextualized in the community. Moreover, teachers learned how to bring local knowledge into the science curriculum.

The problems faced by all of these schools fell into three general categories: a) demographics; b) facilities and equipment; and c) human factors. In the area of demographics, the schools faced declining student populations, which were the result both of declining birth rates and families relocating from rural areas to more urbanized centers. Although the participants in this study were Thai citizens, they represented different ethnic groups speaking multiple languages. For example, at the rural schools in this study, the population included local Thai people, Hill Tribe people, and the minority group known as Tailea. Secondly, school facilities were of poor quality, often in need of repair and poorly equipped, especially with regard to library resources, simple science training materials, laboratory apparatus and computers. The environment was not supportive of student learning. All of this was reflected in, and related to, what can be called, “human factors”. Parents did not trust the quality of public school education mainly because they observed the poor performance of their children as reflected in consistently low student test scores. Teachers were often inadequate and suffered from a
low level of professionalism, preparation, and resourcefulness. The curriculum was seen generally as having little relevance to local life. This reduced enthusiasm for schooling and played a key role in the generally poor relationships among the local school, school teachers, school administrators, the central government who managed the local schools and their communities.

The ultimate task of resolving these problems required the work of many people including teachers, parents, students, local leaders and everyone else in the community. Most of all, however, getting things headed in the right direction was the responsibility of the principals and other local and district school leaders and administrators to develop ways of getting the most use out of all available resources, including community leaders to come to the aid of the schools. Strong leaders can find ways of aiding teacher professionalism, even when financial resources are meager. By doing more with less, they can help the schools to achieve better results for their students and can thus inspire more confidence in the schools. Admittedly, administrators cannot work miracles by themselves, but through the example of their leadership, creativity and ability to manage well what resources they have, they can gain the confidence of both the community and the teachers and encourage a belief that the schools can improve. They can create a sense of pride among key school constituencies where, perhaps, resignation existed before.

**Reflections on Power Relationships**

As part of the process, the researcher became keenly aware of the impact of power relationships in communicating suggestions and possible directions. The researcher’s discussions with the teachers and the principals of the schools were difficult.
The researcher was received politely, but when any proposal was discussed with them, it was not received enthusiastically. Regardless of their kindness, the researcher was seen as an outsider speaking about things that she had no awareness or knowledge of. The discussions of place-based education must have appeared to them as an attempt to force upon them something from an outside culture that was pretending to be superior to their ways and knowledge. It appeared to the researcher that they were resistant to all ideas, suggestions and proposals. The researcher later learned later that they thought she was trying to bring to their village and classrooms ideas from the United States, which had no relevance to their lives and needs. They believed that it was not important for them to know about or understand what the researcher was discussing.

Because the proposal was not well received at first, the researcher tried to find better ways to explain the value of what was being suggested. The researcher therefore spent more time in give-and-take conversations with the teachers and the principal. She gave explanations in terms more closely related to the village and to the lives and problems of the area. When she did this, the researchers’ ideas and proposal were better understood and better received. The researcher realized that her early attempts at communication had been inappropriate for the audience, and she began to offer all communication in words and ways the people of the school and the community could understand. The researcher took care to show respect and not to make them feel small, inferior, or ignorant. Additionally, when beginning to work with them, the researcher “showed” them instead of only explaining. Finally, they began to understand both the intentions as well as the proposed project and to see both as something that could be a benefit for them.
Reflections on Communities of Practice

Connecting science instruction to the communities of practice was an extremely important in facilitating teacher and student learning in the place-based science education professional development program. As learning was extended to the beyond the classroom, teachers and students became engaged in interacting with community members and accessing resources within the villages. Teacher and student learning in science thus became situated locally within the Buddhist culture.

In relation to the project and the work in the five rural schools in Thailand, social networking, social capital, and communities of practice were all part of a larger whole. Social capital refers to the assets or funds of knowledge in a community that are shared among members through social networking (Lave & Wenger, 1991; Lin, 1999; Wenger, 1999). In this study, social capital was used productively by the group of teachers who worked together, supported each other, and shared funds of knowledge. The researcher’s work in place-based education was closely involved with the community in which the school existed and that supported the school. Part of the success of place-based education depended on the involvement of teachers and also of the community that supported the school. Accordingly, the success of the school was dependent, in part, on the ability to develop, inform and involve the social capital surrounding and supporting the school. For example, community resources that the teachers didn’t even know about (e.g., domestic frog farming) were identified through developing the place-based curriculum. This in turn, depended on the ability to build upon social networking across many constituencies including teachers, school principals, parents, the community in general, and community leaders.
While these constituencies might normally operate in different communities of practice, they can be brought together into a community that supports the school. When these constituencies were brought into specific circumstances where they act to support the goal of enhancing student development and learning and are permitted to interact in an environment that is loosely, as opposed to rigidly, structured, place-based education informs us that the interaction can yield creative, new ways of supporting student learning and development. This is what happened in the case of a Buddhist monk who had contracted dengue fever. His illness coincided with activities in the community designed to show what students had learned through place-based education. Coincidently, a broad section of the community and even Thai government personnel were brought together. Their activities, combined with the monk’s illness, created the opportunity for interactions that brought forth new learning opportunities both for the students and for various other community, school, and social constituencies.

The social networking and communities of practice established in this study helped to bridge the gap between the local culture and globalization. For example, the Buddhist concept of middle path means: not too much in the local and not too much in the global. The middle path is central to Thai place-based education. Neither schools or communities are the center of the learning process; instead, both must complement each other. If the schools have only one direction to prepare the students without the support of the community, then education will not be successful. When the school and community are connected through social networks, learning is more meaningful and relevant for the students. By following the middle path, students are also more likely to
identify with Thai culture while eliminating the gaps between localization/globalization and rural/urban education.

**Reflections on Teacher and Student Achievement**

The teachers learned how to connect local knowledge and academic knowledge so as to make classroom learning more meaningful, whether in science or other disciplines. The place-based education model helped teachers to develop a curriculum that used community resources for student learning. Teachers also learned how to use multiple-assessment techniques to measure student learning and academic achievement. A variety of assessments was used, not only standardized test scores. These assessments were more authentically related to the goals of helping students apply science skills from the National Curriculum in their completion of science projects. For example, by students studying weevil or frog behavior in-depth, teachers were able to observe student learning in science that connects to the community. The artifacts that students created (e.g. graphs, journals, poster displays) were further evidence of student’s science learning. When the students studied ecosystems in the community, the students were assessed on their actions and how they thought or wrote about using insecticides in the rice fields. The students also drew diagrams to represent their understandings and learned about the effect of oil pollution in their communities (see Figure 8). The students came up with ideas for science projects to sustain the environments surrounding the community. For example, the students experimented to find out the best plants for absorbing the oil. The students learned about being responsible in their own communities.
Administrators were introduced to the value and relationship of community resources to classroom learning and were encouraged to be creative in the use of these, especially when government-provided finance and resources which were lacking or inadequate. Place-based education in effect, encouraged both teachers and administrators to be more responsible for school success and more creative and determined in developing ways to achieve this.

At the beginning of the teacher professional development training, the attitude of the teachers was poor. They were not confident, and they viewed science as a difficult subject to teach that they were not interested in. After the training process, the teachers learned teaching strategies that supported the Buddhist way in which they supported and networked with each other. As the teachers participated in the place-based education training, the attitude of the teachers began to change. The interviews and symposium provided evidence that place-based education helped the teachers make connections between science learning and everyday life. Although most of the teachers had no or very little background in science, they began to understand why it was important to teach science. After the training, the researcher followed up to learn how teachers were doing in teaching science through the place-based approach.

Overall, the place-based science lessons were successful because of: (1) team support from peers; (2) student behavior change that came about as the students were more responsive to the activities that connected to their families and local communities; (3) parental support from the communities that became strong and clearly evident, and (4) strong feedback and/or support of the researcher, and school principals that emerged. Because of their lack of experience teaching science, the teachers initially lacked
confidence and they had trouble teaching science in depth. In comparing the first and second observations, however, the teachers gained confidence and were successful in engaging the students in science activities that connected to the local communities. Part of this success was due to the coaching and support for teaching place-based science lessons that the researcher provided the participants. The teachers were first engaged in model lessons taught by the researcher; later, the researcher and peer observers provided feedback and suggestions as the teachers taught the lessons. The teachers learned to apply an active way of teaching and learning in class. They tried many place-based education approaches to their teaching. By supporting each other through the peer observations and discussions, as well as through feedback and resources from the researcher, the teachers continued to work hard as they tried to improve themselves.

Students’ behavior changed significantly over time as a result of place-based education. At first, the students were quiet and did not talk in class. Later, the students became actively involved in talking about the results of their experiments and investigations in the local communities. They learned to talk with and ask questions of guest speakers and adults from the local communities, some of whom were strangers to them. From the researcher’s observations and interviews with teachers and parents, it became obvious that students became more curious, outgoing, and confident over time. The students also developed reasoning skills. They could explain what was going on in class and they were able to analyze problems, problem indicators, causes of problems, and potential solutions. According to the Buddhist way, students learned not to judge a problem from what you see. Instead they analyzed what different indicators there were of the problem, what caused the problem and then tried to apply solutions to eliminate or
diminish the problem. This was exemplified by students investigating the life cycle of the mosquito to find the best time to destroy the insect to keep it from reproducing or when students tested the water quality to identify the cause of the yellow color in the water. The students also applied their knowledge to related problems in the community. As result of place-based science teaching, most of the students performed well. Some students continued to struggle however, because of reading and writing problems although they were able to express their understanding of difficult information by orally answering questions. The students also did well as they gained more confidence in their teachers. Third grade students’ improving science test scores over a six-month period (67.84 average score in grade 3; 83.94 average score in grade 4, p value< 0.05, n = 50) were further evidence of students’ achievement, mastery of the subject matter and empowerment (see Appendix H).

The parents involved in the project did not originally believe that they were part of the schools, and certainly did not think they had a role in the science curriculum. However, they were very happy to collaborate with the teachers on the lesson planning and share their knowledge and experiences with the students. The parents were amazed with how the students were actively engaged in reasoning, problem solving, and discussing science. According to Buddhist tradition, the students were very respectful and appreciative of the elders that were involved in the project. Because it was important to connect science taught in the Thai National Curriculum with local funds of knowledge, the support of the community was critical to the success of the place-based education lessons.
The school principals wanted to see what would happen with the place-based science education approach. They could see that students were enthusiastic, engaged, and their performance was improving. The principals also observed what happened to the teachers as a result of the placed-based science professional development program – seeing that the teachers had developed a more positive attitude about science teaching. The teachers changed from thinking that their role was being a scientist (with which they did not feel comfortable) to understanding that their role was to be a guide to science learning by bringing in natural and human resources from the local community. Place-based science education helped to change their attitude toward making personal changes. Most importantly, the teachers developed a new found respect for science and their important and even critical role in enabling students to discover the wonders of science for themselves.

As evidenced by the success of the symposium, teacher professionalism, understandings of science, and outreach to the community were enhanced. Students also demonstrated increased confidence and competence in science.

**Limitations of the Study**

As participant observer in this study, the researcher conducted the professional development program. This may have influenced the teachers’ perceptions and the interpretation of the results. However, to avoid researcher bias, outside observers and peer observers were involved in the examination of classroom teaching. Data were by triangulated by interpreting data from multiple sources, including: teacher lesson plans; classroom observations; parent interviews; principal interviews, and student work. This work on place-based education was conducted in rural Thailand and because of the
unique culture and multiple languages of the participants; the study may not be transferable to other locations. However, as discussed below, this study does have implications for conducting similar studies in rural locations that connect science education to local communities, especially throughout Thailand.

**Implications for Implementing Place-based Science Education**

There are numerous problems in the public schools in this rural district of Thailand, which can be substantially muted and possibly even resolved by implementing a place-based education curriculum in the elementary schools. In this study, implementation of the place-based education model has demonstrated that it enhanced the connection and relationship between five schools and their community, by bringing more community resources and support to the schools, and providing new teacher training and administrator education, thus raising the level of professionalism among key school staff.

For the place-based education project to be successful in the schools, there need to be a substantial understanding and support of the concept by school administrators. In this study, the researcher collected information from interviews of principals, teachers, students, parents and members of the community. The purpose of implementing the place-based education approach was to enable school development by reorganizing the school curriculum and introducing a new previously untapped relationship between the school and community. Its purpose was also to use local resources that are helpful for the school and which are available essentially free of cost and thus, make reform possible that does not require government financial support.

Under traditional science education approaches students have not done well on academic achievement tests because teachers do not help students to connect scientific
knowledge to real life. Moreover, most teachers, especially at the elementary school level, lack of any science background and might hold many myths and misconceptions about science. At the same time most schools do not have enough materials to support science learning because they feel they need substantial financing to support it. Place-based science education program can change much of this by helping build and support teacher professionalism and a curriculum that uses real life phenomena to support student learning. The new curricula were developed through experimentation using material resources from the community and connecting science to their everyday lives. According to Smith and Sobel (2010),

In the twenty-first century, being an informed citizen requires a working knowledge of scientific principles and insight into the way that human activities can impact the quality of a community’s health and long-term wellbeing. Unfortunately, much science education has become so preoccupied with the mastery of terminology that the links between the study of biology, chemistry, and physics and children’s lives outside of school have become attenuated. (p. 65)

This research study demonstrated the ways in which a place-based science curriculum seeks to enhance teacher professionalism and to both involve the community in the school and to encourage the school to reach out to the community and make use of its resources. If teachers do not understand how to connect scientific knowledge with local knowledge, science education will remain separate from the lives of the students in their communities. Members of the community will not see the relevance of science to student learning. In this project the administrators and teachers learned and shared ideas
during a workshop and subsequent successful implementation and experiences of place-based education in their community. They are in agreement that this is a large part of a solution that can improve and support school quality, such as teacher professionalism, student learning, academic performance, and school’s relationship with the community. In describing an effective place-based education program, Loveland (2003) wrote:

Place-based education is learning that is rooted in what are local - the unique history, environment, culture, economy, literature, and art of a particular place. The community provides the context for learning; student work focuses on community needs and interests, and community members serve as resources and partners in every aspect of teaching and learning. (p. 1)

It is clear that this project required much cooperation, and a good relationship between the community and the school. According to Smith and Sobel (2010), “place-community based education is a new way of thinking about the school’s role in society” (p. 2). It is important for the administrators, teachers, and staff to look at the community and environment where the school is located, and identify who they are, where they are, and what resources are important to the school that can affect the quality of education. School administrators should ensure that schools do not try to undertake programs that exceed the capabilities of the school. The resources and information should be meaningful and to the school and its student learning. However, by helping to improve student learning through the use of place-based science education, it is possible for administrators to gain more and better assistance from the governmental agencies such as the National Ministry of Education. In turn, with administrative support and guidance
from the Ministry of Education, teachers may then be able to benefit from continued professional development to support place-based science education.

Although this place-based science education project was successful in rural Thailand, the transferability of the project to other locations will depend on several factors: leadership, resources, and networking. In the project, the author/researcher served dual roles as coordinator of the professional development program and researcher investigating the process of teacher change and student achievement. As a career science educator in elementary schools, the researcher received a Masters in Elementary Education and a Certificate in Education Leadership Program from Srinakharinwirot University in Thailand. She was head of Department of Human Resources in a private school, teacher professional trainer in private schools for the Ministry of Education throughout Thailand, and a Ph.D. candidate in Curriculum and Instruction (Science Education) in the College of Education at the University of Hawaii at Manoa. This education and experience provided the researcher with the social capital, credibility, and experience to coordinate the project and conduct the research. The researcher was well positioned to draw upon a variety of resources within the educational community and outside the community to support the project. The researcher was well connected to officials in the Ministry of Education and professionals in the science education community in Thailand. Although initial acceptance of the project was difficult in the local rural districts, the researcher's experience, access to resources, and connections to the Ministry were helpful in establishing and strengthening networks within the local schools and communities.
Future research and the implementation of place-based science education in Thailand would require institutional support in both the Ministry and the higher education community. Graduate studies in all content areas in place-based education would prepare future teachers to work in rural communities. Embracing place-based education would require future teacher educators or researchers to be familiar with the local culture. In this study, the researcher was very knowledgeable and experienced within the context of Buddhist culture. Place-based science education programs in other rural areas in Thailand (e.g. south Thailand dominated by Muslim people) would require leaders who not only understand the local culture, politics, and religion, but would also be able to network, find resources, and work well with diverse people.

In conclusion, in Thai culture everyone is like a family. Placed-based education in Thailand embraced the Buddhist way of “kullayanamitra” or true friendship. *Kullayanamitra* was used in the professional development program as a means for teachers to support each other and challenge each other in a positive way. *Kullayanamitra* was extended to the schools to support student learning and relationships within the community. In place-based education, the school supports the community and the community supports the school. Schools in rural communities in Thailand will benefit by improving teacher competence and student achievement in science through participation in place-based education. Finally, place-based science education was essential for teaching the National Standards in rural schools in Thailand. In this project, the teachers were very successful in teaching students the science skills they need to be critical thinkers and productive citizens in Thai society.
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APPENDICES

Appendix A. Pilot Questionnaire

Student 3\textsuperscript{rd} and 4\textsuperscript{th} grade test score

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<th>1/2010 Fourth Grade</th>
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Appendix B. Approval of a Study Involving Human Subjects

CHS 06/07CHS #

Application for New Approval of a Study Involving Human Subjects
University of Hawai‘i, Committee on Human Studies (CHS)
Spalding Hall 253, 2540 Maile Way, Honolulu, Hawai‘i 96822
Telephone: (808) 956-5007

Date: May 1, 2008
PI (name & title) Rojjana Klechaya , Ms Email: rojjana@hawaii.edu
Phone:808 256-4941
Department: Curriculum Studies, College of Education

[   ] Faculty or Staff   [ x] Student - name of supervising professor: Dr. Pauline Chinn

Training in Human Subject Protection: When, where, & what? (optional) Informal training
with Dr. Pauline Chinn in EDCS 632 (Qualitative Methods) course in Spring 2008, EDCS769
and NIH web-based training course “ protecting human Research Participants” Fall 2008 to gain
information on human subject information and ethical research practices in the field of education.

Project Title: Developing Place-based Science Curriculum for Small Elementary Schools
in Lampang Province, Thailand
Proposed Sponsoring Agency: University of Hawaii at Manoa Hawaii USA Start Date: July 1,
2009
Complete Agency address: 2540 Maile Way, Spalding Hall 253, University of Hawaii Manoa,
Honolulu, HI 96822

Institutional Biosafety Committee (IBC) Review:
Researchers proposing projects involving r-DNA molecules or any biological materials,
toxins, agents, etc., referred to as biological commodities, must submit appropriate Biological Safety Program forms.
Does this project involve the use of biohazardous materials, recombinant DNA and/or
gene therapy?

[   ] Yes. If so, Institutional Biosafety Committee (IBC) approval must be obtained.
[ x] No
Has the Institutional Biosafety Committee approved the protocol?
[   ] Approved Date Approved:
[ ] Application Pending Date Submitted:
(for more information check: www.hawaii.edu/ehso )

1. Summarize your proposed research. Outline objectives and methods.
Title: Developing Place-based Science Curriculum for Small Elementary Schools in Lampang Province, Thailand

The objective of the research is to assess the impact of a place-based science curriculum on student achievement results, teacher professionalism, and school-community relations. The research will be conducted at 11 Elementary Schools in northern Thailand. Participants will include 33 teachers from grades 4-6, and 200 students from grades 4-6, 11 administrators, 11 community members, 50 parents.

I will gather qualitative and quantitative data and information from the training of teachers, grades 4-6, in the development of a place-based science curriculum. I will observe teacher and student response to the place-based science curriculum. Research methods include:

1. For the teacher training, data will be collected from pre-tests and post-tests, lesson plan evaluations, teacher evaluations of the teacher training seminar, and observation in the classroom.
2. For Curriculum evaluation, student achievement will be assessed based on student activity evaluations, pre-tests and post-tests, science projects, and student cooperation.

I will compare science teaching in the school before and after the implementation of the place-based science curriculum. Teacher training to develop and implement a place-based science curriculum is expected to impact student learning and test scores as well as how teachers write lesson plans, implement lesson plans, and evaluate students. Qualitative methods include interviewing students and teachers, and observing the relationship between the school and the community.

The project starts with a teacher training seminar in April, 2010. In November 2010, I will collect and analyze data. I will return to 11 Elementary Schools after 1 year to assess longer term outcomes. Following this, I will analyze data and develop recommendations for improvement of science teaching in grades 4-6.

2. Summarize all involvement of humans in this project (who, how many, age, sex, length of involvement, frequency, etc.) and the procedures they will be exposed to. Attach survey instrument, if applicable.

Direct interaction with researcher: Teachers, Grade 4-6, Total 33, Male and Female, during April 2010 and follow up summer 2011.

Check whether any subject of your research will be selected from the following categories:

- Minors
- Pregnant Women
- Mentally Disabled
- Fetuses
- Abortuses
- Physically Disabled
- Prisoners

3. Research involving humans often exposes the subjects to risks: For the purpose of this application, "risk" is defined as exposure of any person to the possibility of injury, including physical, psychological, or social injury, as a consequence of participation as a subject in any research, development, or related activity which departs from the application of those established and accepted methods necessary to meet his needs, or which increases the ordinary risks of daily life, including the recognized risks inherent in a chosen occupation or field or service.
a. Check all the risks to human subjects that apply to your project:

[ ] Physical trauma or pain  [ ] Deception  [ ] Experimental diagnostic procedures
[ ] Side effects of medications  [ x ] Loss of privacy  [ ] Experimental treatment procedures
[ ] Contraction of disease  [ ] Worsening of illness  [ ] Other – explain
[ ] Psychological pain  [ ] Loss of legal rights

b. Check procedures that will be used to protect human participants from risks:

[ ] M.D. or other appropriately trained individuals in attendance
[ ] Sterile equipment
[ ] Precautions in use of stressor or emotional material (explain below)
[ ] When deception used, subjects fully informed as to nature of research at feasible time (explain below)
[ ] Procedures to minimize changes in self-concept (explain below)
[ x ] Confidentiality of subjects maintained via code numbers and protected files
[ ] Anonymity - no personally identifiable information collected
[ x ] Others—explain

Safety protocols for science activities include clear explanations and information in advance combined with good preparation with increased precautions and emergency measures in place, if field trips are planned.

c. Has provision been made to assure that Human Subjects will be indemnified for expenses incurred as a direct or indirect result of participating in this research?

[ ] Not applicable
[ x ] No - The following language should appear in the written consent form: I understand that if I am injured in the course of this research procedure, I alone may be responsible for the costs of treating my injuries.
[ ] YES, explain:

d. Are there non-therapeutic tests that the research subjects may be required to pay for?

[ x ] Not applicable
[ ] No
[ ] Yes - explain below. The following language should appear in the written consent form: I understand that I may be responsible for the costs of procedures that are solely part of the research project.

4. Describe mechanism for safety monitoring: How will you detect if greater harm is accruing to your subjects than you anticipated? What will you do if such increased risk is detected?

There are two kinds of possible harm, health and safety and psychological. Health and safety instructions and training will be provided to teachers and students with individual responsibilities identified. In case of an emergency or issues with safety, there will be a clear plan of action with person/responsibilities identified.

Procedures will be in place for participants to communicate with the researcher of psychological discomfort associated with participating in the research. Participants will be able to withdraw from the research at any time.
5. Briefly describe the benefits that will accrue to each human subject or to humankind in general, as a result of the individual's participation in this project, so that the committee can access the risk benefit/ratio.

1. Teachers will understand place-based learning, develop lessons supportive of more active, meaningful learning and gain a variety of teaching and assessment strategies;
2. The school will develop its own place-based curriculum based on learning grounded in the real life of the community.
3. Teachers will benefit from professional development;
4. Teachers will learn to connect classroom instruction to the community, a change expected to lead to greater student engagement and learning;
5. The school and community will develop a supportive relationship as students and teachers connect school, community, and global knowledge.
6. The research may be applicable to similar situations in schools in Thailand and other countries.

6. Participation must be voluntary: the participants cannot waive legal Rights, and must be able to withdraw at any time without prejudice. Indicate how you will obtain informed consent:

[ x ] Subject (or Parent/Guardian) reads complete consent form & signs (‘written’ form)
[   ] Oral briefings by PI or project personnel, with simple consent form (‘oral’ form).
Explain below the reason(s) why a written consent form is not used
[   ] Other- explain

7. Are there any other local IRB's reviewing this proposal? [ x ] No    [   ] Yes, Location: _____
I affirm:
(i) that the above and any attachments are a true and accurate statement of the proposed research and of any and all risks to human subjects.

Signed: _______________________________ Date: ______________

Principal Investigator

Signed: _______________________________ Date: ______________

Supervising Professor (required if PI is a student)

* Submit the ORIGINAL plus 12 copies of this form with the following attachments:

Three (3) copies of proposal
Thirteen (13) copies of all consent forms
Thirteen (13) copies of any other information to be read or presented to the participants
Thirteen (13) copies of verbal information to be given if short form is used
Thirteen (13) copies of the survey instrument
( Please consult with the CHS staff if providing the survey instrument is a problem.)

* This is for proposals needing to go to full Committee review only. Not all applications need to go to full Committee. If this is a project that may qualify for either exempt or expedited approval, the required submission is an original signed application and related forms described above, and one copy of each (two complete sets). Please check with CHS Staff if you have questions about the level of review of your proposal.
Assent Form for Students to Participate
Teacher Training Program using Place-based Curriculum in Grade 1-6
in Wat Ton Tong Elementary School, Thailand

Rojjana Klechaya
Primary Investigator
USA: 1 808-256-4941, Thailand: 66 86-504-2554
Email: rojjana@hawaii.edu

My name is Rojjana Klechaya and I am doing a research project for my Doctorate degree in Education, Curriculum Studies at the University of Hawaii at Manoa Hawaii, USA. I am asking you to participate in my project. This project is going to look at how you learn science through place-based learning. I am asking you to participate because you are in the 4th Grade.

For this project I will ask you to attend 2 days of enriched science classes, 4 hours per week for about one month during the semester. In these classes, we will learn about earth science, ecosystems, local environment and community. You will learn it both from 2 field trips and like you do in the science classroom with demonstrations, presentations, and experiments.

Also, we will listen to lectures, write, take photographs, record videos, do experiments and listen to outside speakers. You will take pre and post-tests and also demonstrate your science knowledge and practical skills by undertaking science projects. Then, I will ask you students to tell me what you learned from the science lessons. Tutors and trainers will be there to help you with reading, writing, science projects and technology.

You can stop being in this project at any time. You are free to withdraw from participation at any time during the project with no bad consequences or loss of benefit to which you would be otherwise entitled. You do not have to do anything that you do not feel like doing.

Do you have any questions?

Thank you very much for your support and understanding.
Permission to Participate in  
Teacher Training Program Using Place-Based Science Curriculum in Grade 1-6  
in Wat Ton Tong Elementary School, Thailand  

Rojjana Klechaya  
Primary Investigator  
USA: 1 808- 256-4941, Thailand: 6686 -504- 2554  
Email: rojjana@hawaii.edu  

My name is Rojjana Klechaya. This research project is for my Doctorate Degree at the University of Hawaii Hawaii, USA. The purpose of the project is to train teachers the Wat Ton Tong Elementary School in Thailand to use a place-based science curriculum for teaching science in grades 1-6. As part of my research I will study the impact of place-based learning on student achievement and on school-community relationships. You are being asked to participate because you are a teacher at Wat Ton Tong Elementary School.

Participants will learn to: use place-based science curricula that also address traditional and national science standards; develop and apply personal safety and environmental measures for practical experiments; develop pre-test and post-test assessments, and teach using a variety of methods including hands-on learning. Teachers will attend seminars 2 days per week during the summer semester. These seminars will focus on developing place-based science curricula, applying techniques for teaching, multiple assessments, activity-oriented lessons, integrating local community knowledge into the curriculum. You will apply these lessons in your classroom and will assist the students and the primary investigator in this project.

Data will be collected through questionnaires, interviews, classroom observations, pre- and post-test assessment and evaluation, lesson plans, photography, and video and audio recordings during the class sessions. The investigator believes there is little or no risk to participants in this research project.

Participating in this research may be of no direct benefit to you. It is believed, however, that the results of this teacher training and curriculum development project will help improve the quality of science teaching, curriculum and student learning at Wat Ton Tong Elementary School. The project may also assist in fostering better relationships with the parents and the community, and may possibly serve as a model for use in other elementary schools in Thailand.

Research data will be confidential: records will be stored in a locked cabinet in the primary investigator’s office for the duration of the research project. All research records will be destroyed upon successful completion of the project. All tapes will be destroyed immediately following transcription.
Participation in this research project is completely voluntary. You are free to withdraw from participation at any time during the project with no adverse consequences or loss of benefit to which you would be otherwise entitled. If you have any questions, please contact the researcher Rojana Klechaya (1-808) 256-4941 (Hawaii) or 66 86 504 2554 (Thailand); or my faculty supervisor Dr. Pauline Chinn at the University of Hawaii, (1-808) 956-4411.

If you have any questions regarding your rights as a research participant, please contact the UH committee on Human Studies at (808) 956-5007.

Headmaster/Teachers/Administrator/Parent/Community Member as Participants:

Please check one of the two choices below:

☐ Yes, I give permission to the researcher to photograph, video and/or audio record for the purpose of this project.

☐ No, I do not give permission to the researcher to photograph, video and/or audio record for the purpose of this project.

I have read and understand the above information, and agree to participate in this research project. Also, I understand that if I am injured in the course of this research project, I alone will be responsible for the costs of treating any injuries incurred.

___________________________________  _____________________
Participant’s Name (printed)          Position / Title

___________________________________  _____________________
Signature                            Date
My name is Rojjana Klechaya. I am doing a research study as part of my Doctoral Degree in education, curriculum studies at the University of Hawaii at Manoa Hawaii, USA. I am seeking your permission, for your child to participate in this project. For this research I will use a Place-Based curriculum in teaching science and will then evaluate its effectiveness in enhancing student learning and understanding of science concepts. Participating students will be in grades 1 – 6. I will co-teach, observe, test and collect data of 4th grade students.

Participation consists of your child attending 2 days of enriched science classes, 4 hours per week for about one month during the summer semester. These classes will focus on earth sciences and ecosystems. They will pay particular to the local environment and community and will feature practical experiments and 2 field trips. There will be presentations and demonstrations of these subjects in a traditional school science manner, i.e. scientific investigations, video viewing, text reading, and worksheets. Children will be presenting, experimenting, investigating, and collating and analyzing data based on their lessons.

Data for the researcher will be collected through photographs, video and audio recordings during the class sessions. Other forms of data collected will be student writings, and student presentations of their science projects. As the primary investigator, I will review safety protocols before undertaking any experiment or field trip activities. Therefore, I believe there is little or no risks involved in participating in this research project.

Research data will be confidential: records will be stored in a locked cabinet in the primary investigator’s office for the duration of the research project. All research records will be destroyed upon successful completion of the project. All tapes will be destroyed immediately following transcription.

Participating in this research may be of direct benefit to your children. It is believed that the results of this teacher training and curriculum development project will help improve the quality of science teaching at Wat Ton Tong Elementary School, will foster better relationships between the teachers and the community at large and possibly serve as a model for use in other elementary schools in Thailand.
Participation in this research project is completely voluntary. Your child is free to withdraw from participation at any time during the project with no adverse consequences or loss of benefit to which you would be otherwise entitled. If you have any questions, please contact the researcher, Rojjana Klechaya, (808) 256-4941(Hawaii), Thailand +66 86 504 2554 or my faculty supervisor Dr. Pauline Chinn at UH Manoa at (808) 956-4411.

If you have any questions regarding your child’s rights as a research participant, please contact the UH committee on Human Studies at (808) 956-5007.

**Parent (Father or Mother) or Legal Guardian of Participant:**

Please check one of the two choices below:

- ☐ **Yes, I give permission** to the researcher to photograph and/or video and/or audio record my child for the purpose of data analysis.

- ☐ **No, I do not give permission** to the researcher to photograph and/or video and/or audio record my child for the purpose of data analysis.

I have read and understand the above information, and agree for my child to participate in this research project. Also, I understand that if my child is injured in the course of this research project, I alone will be responsible for the costs of treating any injuries incurred.

___________________________________  _______________________________________
Name of Parent/Guardian (printed)     Child’s Name (printed)

___________________________________  ___________________________
Signature of Parent/Guardian          Date

___________________________________
Relationship to the Child
Appendix C. Classroom Observation Protocol

Science Instruction Visitation Form No......../2010

Preliminary Information
Instructor ...........................................  Grade ..................  School ...........................
Unit No.......  Plan No....... Number .  Hours Taught Today  Hour ....... Time ...... Min.
Teaching Method .................................................. Subject..........................................

Learning Objectives
............................................................................................................................................
............................................................................................................................................
............................................................................................................................................

Observation Results

1. Activity
1.1 Introduction

1.2 Teaching (Content)

1.3. Conclusion

1.4. Participation of students in carrying out activities. (Please use examples)

1.5. Meeting teaching targets and expanding knowledge

1.6 Time management

2. Teaching Techniques and Media
2.1 Reinforcement

2.2 How do the media correspond with the content?

2.3 Various methods of evaluation

2.4 Helping students by supporting them and motivating them to think and learn

3. Integration of Virtue, Morality and Locality, or Integration with Other Subjects

4. Impressions of Teacher
4.1 Atmosphere of the classroom

4.2 Personality of the teacher

4.3 Others
Positive Recommendations

Image reflecting my feelings today

Signed ................................................................

......................................................................

Visitor from .................................. School
Date:.............................................
For the Teacher

Name of Teacher .................................. Grade ................ School ..................
Unit No................................... Subject ..................................................... Period No. ..................................

1. What do you think were the problems/obstacles in today’s teaching?

2. What have you learned from today’s visitor? (Please specify examples.)
   1. 
   2. 
   3. 

3. What did you exchange with today’s visitor? (Please specify examples.)
   1. 
   2. 
   3. 

4. Teaching techniques of other teachers that impressed you and that you will adapt for your own use. (Please specify examples.)
   1. 
   2. 
   3. 

5. What do you think of visits by fellow teachers?

Overall, this is how I felt about today’s class.

Signed .................................................. Teacher
(...........................................................)

Date:
For Visitor
Name of Teacher .......................... Grade ........... School ........................................
Unit No...................................... Subject ................................................................

1. What did you learn from the teacher today? (Please specify examples.)
   1. 
   2. 
   3. 

2. What did you exchange with the teacher? (Please specify examples.)
   1. 
   2. 
   3. 

3. Teaching techniques that impressed you and that you will adapt for your own use.
   (Please specify examples.)
   1. 
   2. 
   3. 

Additional Comments (if any)

Signed (Visitor)......................................................

(Signature)

School ........................................................

Date: ..............................................................

Motivation from fellow teachers

Dear
Teacher........................
... 
..............................
........
..............................
........
Appendix D. Open-ended Interview Questions for Teachers

Initial Interview

Interview Question 1. After you finished the pilot research project in 2008, were you able to continue teaching by using place-based science education?

Interview Question 2. How do you feel about your science teaching?

Interview Question 3. What do you think about place-based science education?

Interview Question 4. Do you think science is too difficult for you to teach? Why or why not.

Interview Question 6. Do you have any lesson plans in science? Why or why not.

Final Interview

Interview Question 1. What did you think of the place-based professional development program in science?

Interview Question 2: What do you think about peer observations?

Interview Question 3. What do you think about teaching science?

Interview Question 4. What do you think about your students’ work in science?

Interview Question 5. How do you connect community resources to science teaching?
Appendix E. Open-ended Interview Questions for Community Members/Parents

Interview Question 1: How have you been involved in school or been a guest speaker?

Interview Question 2: What do you think about being part of the learning activities in science?

Interview Question 3: How do you feel about student learning in this project compared to before?

Interview Question 4: What do you think about how the teacher organized the lesson?

Interview Question 5: How much do you think students can bring science to everyday live.

Interview Question 6: Do you think place-based education can help preserve the communities knowledge?
Appendix F. Interview Questions for Students

*Interview Question 1:* Do you like to learn science through the television? How does this compare to the way you are learning science through activities?

*Interview Question 2:* What activities do you like the best? Why?

*Interview Question 3:* What did you learn about science projects?

*Interview Question 4:* Which do you like better – classroom lecture or experiments where you are part of the activities?

*Interview Question 5:* How do you feel when we have a guest speaker come to the classroom?

*Interview Question 6:* What do you think about studying science outside the classroom?
# Appendix G. Sample Lesson Plan

## Evaluation of Learning Standard and Indicators – Science – Primary Grad 4

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**Syllabus 1 Living organisms and living processes**

1. Experiments and explaining the job of xylem and stomata of plants

2. Explaining the requirements of water, carbon dioxide, light and chlorophyll that are needed in certain ways for the growth and the synthesis of plants through light

3. Experiments and explanation for the reaction of plants to light, sound and touch

4. Explaining the behavior of animals when reacting to light, temperature and touch, and applying the knowledge usefully

**Syllabus 5 Energy**

1. Experiments and explanation for the movement of light from its source

2. Experiments and explanation for light being reflected back from objects

3. Experiments and classification of objects based on the characteristics seen from the source of light

4. Experiments and explanation for the refraction of light when passing through two kinds of prism

5. Experiments and explanation for the transformation of light into electric energy, and applying the knowledge usefully

6. Experiments and explanation
**Standard Wor. 6.1**

6 The process of changes in the world
1. Survey and explaining the source of soil
2. Specification of types and properties of soil used for growing plants in local areas

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<th>2nd Unit</th>
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</tr>
<tr>
<td>Syllabus 7 Astronomy and Space</td>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
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<tr>
<td>Syllabus 8 The nature of science and technology</td>
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</tr>
<tr>
<td>1. Asking questions concerning issues, subjects or circumstances to be studied as determined and as based on interest</td>
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</tr>
<tr>
<td>2. Planning of observations, suggesting methods of examining or research, and anticipating the things to be found through experiments</td>
<td></td>
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<tr>
<td>3. Choosing the right and suitable equipment for experiments</td>
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<tr>
<td>4. Recording of data pertaining to quantities / amounts; presenting and summarizing results</td>
<td></td>
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</tr>
<tr>
<td>5. Creating of new questions for further experiments</td>
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<tr>
<td>6. Expressing opinions and summarizing the things learned</td>
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</tr>
<tr>
<td>7. Taking records and explaining results of experiments in a straightforward manner</td>
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</tr>
<tr>
<td>8. Presentation of results in oral or written form by explaining the processes and results so that other people may understand.</td>
<td></td>
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</tbody>
</table>
Content of Science Curriculum of PW School in accordance with the Basic Education Core Curriculum

Elementary school grade 4 by teacher’s name ………………..80 hours/school year 2010

Item 1. Living Things and the Process of Life

Study standard W.1.1 Understanding the basic components of living things, the relationships between the structures and the functions of structures and systems of living things. Learning through a process of knowledge seeking, communicating what has been learned and using this knowledge in the students’ own lives and in caring for living things.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Content of Basic Education Core Curriculum</th>
<th>Study Activities</th>
<th>Local Development Strategy</th>
<th>Time (hours)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conducting experiments and explaining the function of Xylem/Phloem and Stomata.</td>
<td>Inside the stem of plants there are Xylem and Phloem and in the leaves are the Stomata which allow water to be released</td>
<td>Formulating questions, making observations, planning, writing a hypothesis, conducting experiments, recording data, discussing and expressing opinions, testing hypothesis, summarizing and explaining the results of the experiments concerning the function of Xylem/Phloem and Stomata.</td>
<td>1. Exploring local plant life. 2. Benefits of local plants. 3. Local names of locally found plants.</td>
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</tr>
<tr>
<td>2. Explaining how water, CO2, light and Chlorophyll are essential to the growth of plants and Photosynthesis.</td>
<td>Important factors in the growth and photosynthesis of plants are water, CO2, light and Chlorophyll.</td>
<td>Formulating questions, making observations, planning, writing a hypothesis, conducting experiments compiling data, recording data, discussing and expressing opinions, testing the hypothesis, summarizing and discussing the results of the experiments and the prerequisites of Photosynthesis.</td>
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</tr>
<tr>
<td>3. Conducting experiments and explaining how plants respond to light, sound and touch.</td>
<td>Plants respond to light, sound and touch, which are environmental conditions.</td>
<td>Formulating questions, observing, planning, conducting experiments, compiling data, recording data, summarizing and explaining the results of the experiments on how plants respond to light and touch.</td>
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<tr>
<td>Evaluation Criteria</td>
<td>Content of Basic Education Core Curriculum</td>
<td>Study Activities</td>
<td>Local Development Strategy</td>
<td>Time (hours)</td>
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<tr>
<td>4. Explaining the behavior of animals in response to light, temperature, touch and putting this knowledge to good use.</td>
<td>1. Various animal behavior is a response to stimuli such as light, temperature, and touch.</td>
<td>Formulating questions, observing, planning, recording data and explaining the behavior of animals in response to light, temperature and touch, and putting this knowledge to good use.</td>
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<tr>
<td></td>
<td>2. Putting the knowledge about animal behavior to good use by creating a favorable environment for the raising of farm animals</td>
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</tr>
</tbody>
</table>
## Unit 5. Energy

**Study standard W 5.1** Understanding how energy and life are related. The transformation of energy and interaction between materials and energy. The effects of energy use on our lives and the environment. Learning through a process of seeking knowledge, communicating what has been learned and putting it to good use.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Content of Basic Education Core Curriculum</th>
<th>Study Activities</th>
<th>Local Development Strategy</th>
<th>Time (hours)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Conducting experiment and explaining how light travels from its source.</td>
<td>Light travels from its source in all directions and in a straight line.</td>
<td>Writing a hypothesis and designing the experimental set-up is followed by conducting the experiment of how light travels from its source. The process involves designing the set-up of the experiment, each stage of the experiment and the choice of suitable materials for the experiment. Once the experiment has been conducted according to the predetermined steps, the actual results are recorded. The results are summarized, discussed and the final results are presented.</td>
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</tr>
<tr>
<td>2. Conducting experiment and explaining how light is reflected by objects.</td>
<td>Light falling on objects is reflected at the same angle as the incoming light</td>
<td>Formulating questions, observing, writing a hypothesis and conducting experiment of how light is reflected by objects. This involves choosing suitable equipment for the experiment, conducting the experiment according to the predetermined steps, recording and analyzing the results. The results are discussed, summarized and the results of the experiment are presented.</td>
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<tr>
<td>Evaluation Criteria</td>
<td>Content of Basic Education Core Curriculum</td>
<td>Study Activities</td>
<td>Local Development Strategy</td>
<td>Time (hours)</td>
<td>Marks</td>
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<tr>
<td>3. Testing and classifying objects according to their visual properties as seen from the light source</td>
<td>Different objects reveal different properties when impacted by light waves and can be divided into different types of media: transparent, light transmitting and light absorbing</td>
<td>Writing a hypothesis, designing the experiment, defining the purpose, method, objects, and equipment to be used, and defining the variables for the execution of the experiment. Once the experiment has been conducted, different materials are classified according to their visual properties as seen from the light source and the results are presented.</td>
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<tr>
<td>4. Conducting experiment and explaining the refraction of light waves as they pass through two types of transparent media.</td>
<td>As light waves pass through different media they change direction: this is called refraction.</td>
<td>Formulating questions, writing a hypothesis, designing the experiment, conducting the experiment and explaining the refraction of light waves as they pass through two types of transparent media. Observing, measuring the angle, recording result, summing up and discussing the result, writing a report and delivering oral report on the process of conducting the experiment and it's result.</td>
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<tr>
<td>Evaluation Criteria</td>
<td>Content of Basic Education Core Curriculum</td>
<td>Study Activities</td>
<td>Local Developmen t Strategy</td>
<td>Time (hours)</td>
<td>Marks</td>
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<tr>
<td>5. Conducting experiment and explaining how light changes into electric energy and putting this knowledge to good use.</td>
<td>Solar cells can turn light into electric energy. Various types of electrical equipment contain solar cells. Many calculators are powered by solar cells.</td>
<td>Formulating questions, writing a hypothesis, designing the experiment, conducting the experiment, recording the result, compiling data and explaining how light energy turns into electric energy and putting this knowledge to good use. Searching for information linking the knowledge about how light energy turns into electric energy with electrical appliances we use in our daily lives and presenting this information.</td>
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<tr>
<td>6. Conducting experiment and explaining that white light consists of variously colored light. Putting this knowledge to good use.</td>
<td>When white light passes through a prism the light is broken into variously colored light. This explains the natural phenomenon of the rainbow.</td>
<td>Formulating questions, planning, writing a hypothesis, designing the experiment, conducting the experiment, recording the result, compiling data, explaining that white light consists of variously colored light and giving an example of the beneficial use of white light.</td>
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</tbody>
</table>
Unit 6. The world in Transformation

Standard W.6.1 Understanding the various processes occurring on the earth's surface and within, and how they affect the change in climate, topography and the earth's appearance. Learning through a process of seeking knowledge, developing the scientific mind, communicating what has been learned and putting it to good use.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Content of Basic Education Core Curriculum</th>
<th>Study Activities</th>
<th>Local Development Strategy</th>
<th>Time (hours)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Surveying and explaining the formation of soil.</td>
<td>Soil is formed from ground up rock, mixed with decayed plant and animal matter.</td>
<td>Formulating questions, observing, planning a survey, compiling data, analyzing the data, discussing, summing up the result of the discussion and explaining and presenting the stages of soil formation.</td>
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</tr>
<tr>
<td>2. Defining the type and properties of the soil used for growing plants locally</td>
<td>Soil consists of varying proportions of ground up rock, organic matter, water and air. There are different types of soil and different plants need to be planted in the type of soil that is suitable from them in order for the plants to grow well.</td>
<td>Formulating questions, planning a survey, observing, surveying the plants in different areas of the community and what type of soil they best grow in. Compiling data, analyzing and expressing an opinion, and drawing a chart showing the types of soil used for growing plants in the local community and their properties.</td>
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</tbody>
</table>
Unit 7. Astronomy and Space

Standard W 7.1  Understanding the evolution of the solar system, galaxy and universe, and interactions within the solar system and their effect on life on earth. Learning through a process of seeking knowledge, developing the scientific mind, communicating what has been learned and putting it to good use.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Content of Basic Education Core Curriculum</th>
<th>Study Activities</th>
<th>Local Development Strategy</th>
<th>Time (hours)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Building a model to explain the qualities of the solar system</td>
<td>Our solar system has the sun at its center. The sun is orbited by eight planets, dwarf planets, minor planets, asteroids, and other small objects. Meteors, shooting stars, minor planets or other objects can cause the appearance of a trail of bright light.</td>
<td>Formulating questions, observing, planning a search for information, searching for information about the solar system, compiling information, recording information, analyzing the information, planning the design and designing a model of the solar system in order to explain the qualities of the solar system and presenting the information.</td>
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</tbody>
</table>
Unit 8. The Nature of Science and Technology

**Standard W 8.1** Using scientific methods and the scientific mind in seeking knowledge and solving problems. Knowing that most natural phenomena occur in natural ways and can be examined and explained with the information and tools at hand. Understanding that science, technology, society, and the environment are all related.

<table>
<thead>
<tr>
<th>Evaluation Criteria</th>
<th>Content of Basic Education Core Curriculum</th>
<th>Learning Activities</th>
<th>Local Development Strategy</th>
<th>Time (hours)</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Formulating questions about the subject to be studied according to instructions and the students' interests.</td>
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<tr>
<td>2. Planning how to observe, suggest methods to be used to survey, examine, study and research. Making predictions as to the likely findings of the survey and examination.</td>
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<td>To be inserted in points 1-7, in study activities for developing thinking skills.</td>
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<tr>
<td>3. Selecting the appropriate equipment for the survey.</td>
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<tr>
<td>4. Recording data as quantitative variables and presenting the results. Summing up the results.</td>
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</tr>
<tr>
<td>Evaluation Criteria</td>
<td>Content of Basic Education Core Curriculum</td>
<td>Learning Activities</td>
<td>Local Development Strategy</td>
<td>Time (hours)</td>
<td>Marks</td>
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<tr>
<td>5. Formulating new questions for further survey and examination.</td>
<td>To be inserted in points 1-7, in study activities for developing thinking skills.</td>
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<tr>
<td>6. Expressing opinions and summarizing what has been learned.</td>
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<tr>
<td>7. Recording and explaining the results of survey and examination in a straightforward manner.</td>
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<tr>
<td>8. Presenting and displaying the final work or producing a written description of one's work to communicate to others.</td>
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</table>
Condition of Community and Locality in School Area
Baan Hua Fai School, Baan Hua Fai Community
Located at Village Number 4, Kluay Phae Sub-District, Muang Lampang District, Lampang Province

1. **Province slogan**: Widely acceptable coal, renowned horse-drawn carriages, famous ceramics, the distinguished Phrathat, the well-known national elephant

2. **Important local persons**: 1. Mr. Anat Fanjaksai, Community Leader  
   2. Mr. Kiattipong Kammawong, Advisor to the Mayor  
   3. Mr. Kan Khantaphaph, Kelang Municipality Member  
   4. Mr. Mok Oonpook, President of School Committee

3. **Environment around the school**: The Baan Hua Fai School is a Thai Leu Village, located in the middle of a grove forest about 800 meters from the village at Village Number 4, Kluay Phae Sub-District, Muang Lampang District, Lampang Province. The school is surrounded by trees that include teak, “hiang,” barking deer’s mango, and mango, as examples. Fifty-six students travel to the school on bicycles. The community has many factories. The forests in the school area and around the school are sparsely wooded on the sides of the school. The ceramics factory and drinking water factory are located in front of the temple. The people in the community work hard and most are contracted workers. There are farms and canals. There is a grove forest in front and beside the school. The school focuses on self-sufficiency, the group process, and unity, emphasizing the sufficiency economy principle.

What is the way of life like in your community?

<table>
<thead>
<tr>
<th>Culture</th>
<th>Tradition</th>
<th>Occupation and Economy</th>
<th>Resources and Environment</th>
<th>Knowledge</th>
<th>Data Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Example Lanna</td>
<td>Pour water on the hands</td>
<td>Plant rubber trees</td>
<td>Forest</td>
<td>Making stomach pain medication from guava leaves</td>
<td>Local expert</td>
</tr>
<tr>
<td>- Thai Leu</td>
<td>- Tan kuai salak</td>
<td>- Various contracted work in ceramics factory</td>
<td>- Farm</td>
<td>- Making Thai pancake</td>
<td>Mae Chon</td>
</tr>
<tr>
<td>- Thai Leu language</td>
<td>- Pouring water on elders</td>
<td>- Various trade</td>
<td>- Forest</td>
<td>- Ceramic molding</td>
<td>Mae Naam</td>
</tr>
<tr>
<td>- Long sapao chang Thai Leu</td>
<td>- Agriculture</td>
<td>- Various trade</td>
<td>- Red soil</td>
<td>- Basket weaving</td>
<td>Mr. Sam</td>
</tr>
<tr>
<td>- Pouring water on Baan Hua Fai temple Buddha relic</td>
<td>- Hired krathong decorating</td>
<td>- Agriculture</td>
<td>- Making khanom ping</td>
<td>- Making fried pork skin</td>
<td>Mr. Makiew</td>
</tr>
<tr>
<td>- Tan kuai salak</td>
<td>- Secondhand goods purchasing</td>
<td>- Hired krathong decorating</td>
<td>- Making fried pork skin</td>
<td>- Making fried pork skin</td>
<td>Mrs. Tam</td>
</tr>
<tr>
<td>- Pouring water on elders</td>
<td>- Long sapao</td>
<td>- Secondhand goods purchasing</td>
<td>- Making fried pork skin</td>
<td>- Making fried pork skin</td>
<td>Mae On Mae</td>
</tr>
<tr>
<td>- Long sapao</td>
<td>- Long sapao</td>
<td>- Secondhand goods purchasing</td>
<td>- Making fried pork skin</td>
<td>- Making fried pork skin</td>
<td>Mae Rian</td>
</tr>
<tr>
<td>- Tan kuai salak</td>
<td>- Pouring water on elders</td>
<td>- Secondhand goods purchasing</td>
<td>- Making fried pork skin</td>
<td>- Making fried pork skin</td>
<td>Mae Pan</td>
</tr>
<tr>
<td>- Long sapao</td>
<td>- Long sapao</td>
<td>- Secondhand goods purchasing</td>
<td>- Making fried pork skin</td>
<td>- Making fried pork skin</td>
<td>Mrs. Wilaiwan</td>
</tr>
<tr>
<td>- Tan kuai salak</td>
<td>- Pouring water on elders</td>
<td>- Secondhand goods purchasing</td>
<td>- Making fried pork skin</td>
<td>- Making fried pork skin</td>
<td>Homkanchan</td>
</tr>
</tbody>
</table>
### 4. Local Background

<table>
<thead>
<tr>
<th>Local Traits</th>
<th>Clear Examples</th>
<th>Calendar of Events</th>
<th>Subject Integration</th>
<th>Expert</th>
<th>Location for Source of Information Address/Tel</th>
</tr>
</thead>
</table>
| **1. Culture** | - Thai Leu  
- Leu language  
- Thai leu attire | Daily life  
Loy krathong  
Various ceremonies | Maths Thai Science Social Studies Health Art Vocational and technology English | Mrs. Chitlada Wongsai  
Mr. Manop Muensap  
Mrs. Son Intonwichit  
Mr. Sawai Homkanchan  
Mr. Mok Oonpook  
Mr. Kiattipong Kammawong  
Pho Nankat Sriyod | Baan Hua Fai  
Pho Nankat Siroyd |
| **2. Tradition** | - Tan kuai salak  
- Giving new rice to temple  
- Renewal  
- Removing curse  
- Pouring water on Buddha image  
- Continuing Thai Leu tradition | End Buddhist Lent After harvesting All year All year May Loy krathong Thai leu | Maths Thai Science Social Studies Health Art Vocational and technology English | | Baan Hua Fai |
3. Occupation and Economy
- Trade
- Tying up and decorating krathongs
- Construction
- Ceramics
- Raising cattle
- Civil service
- Basket weaving
- Making chopsticks
- Farming

|            | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | Mr. Chaiya Chansui
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Ui Ma Sriyod
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mr. Ong-at Oonpook
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mr. Payom Oonpook
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Ui Tor
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mrs. Thanom Netkamyuang
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mae Pan
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mr. Prachum Sri-eunkaew

4. Resources and Environment
- Forest

|            | √ | √ | √ | √ | √ | √ | √ |

5. Knowledge
- Tying and decorating krathong
- Basket weaving
- Making chopsticks
- Ceramics molding
- Making khao kaeb
- Local cooking
- Making organic fertilizer

|            | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | √ | Úi Than
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mae Cham
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Thongcham
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Mr. Khanati
|            |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   | Fanchaksai
Assessment of Students / Classroom Condition

1. Grade: Primary 4, Total number of students: 9, male: 5 persons female: 4 persons
   Average age: 10 years, Handicap children: - person(s)
   Students from Tai-Lue minority 7 persons, tribal minority: - person(s), i.e. - minority
   Students from other provinces: from the provinces of Chumpon, Chonburi 2 persons
   Language used by students in the classroom: 1. Central Thai 2. Tai-Lue

2. General condition of the students (explaining the relationships among the students, collective problems and students’ individual problems concerning learning and at home as far it is known)
   Most students come from poor families. The parents work as day laborers. They are diligent but lack the time to look after their children. The students lack a sense of responsibility and dare not display their thoughts. Average level of intelligence, collective character traits: rather selfish.

3. Classroom condition (refers to room size / condition of windows / educational media? lab room?)
   The small number of students does not cause any overcrowding. Doors and windows are in good condition, good ventilation. There are problems concerning the reading room มุมหนังสือ and ᠠᤤᤝᤢᤤᤝᤞ lab room?. There is a lack of educational media and books.

4. Students’ problems with and obstacles to learning science
   1. Lack of observation skills
   2. Not outgoing enough when it comes to asking / answering questions
   3. Lack of analytical skills
   4. Students do not experiment on their own; prefer the carefree watching of TV
   5. Lack of writing and skills
   6. Lack of responsibility

*****
<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Lesson Plan</th>
<th>Grade Level Standard</th>
<th>Key Performance Indicator</th>
<th>Teaching Method/Learning Process</th>
<th>Duration (Hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Plants Around Us</strong></td>
<td>P.1 Structure of Plants</td>
<td>Sc. 1.1 (1)</td>
<td>SC. 8.1 (1) - (8)</td>
<td>Cooperative teaching method by using group learning techniques</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>SC. 8.1 (1) - (8)</td>
<td></td>
<td>Scientific teaching method</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>P. 2 Growth of Plants</td>
<td>SC. 1.1 (2)</td>
<td>SC. 8.1 (1) - (8)</td>
<td>Investigative process teaching method</td>
<td>6</td>
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<td>P.3 Food Production of Plants</td>
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<td>SC. 1.1 (3)</td>
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<td><strong>2. Cute Animals</strong></td>
<td>P.5 Response of Animals</td>
<td>SC. 10.1 (4)</td>
<td>SC. 8.1 (1) - (8)</td>
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<td><strong>3. The Soil in Our Region</strong></td>
<td>P. 6 Learn About Soil</td>
<td>SC. 6.1 (1)</td>
<td>SC. 8.1 (1) - (8)</td>
<td>Teaching method focused on skills Process: Group process Investigative process teaching method</td>
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P. refers to Lesson Plan No.
SC. Science stand No.
<table>
<thead>
<tr>
<th>Unit No.</th>
<th>Lesson Plan</th>
<th>Grade Level Standard Key Performance Indicator</th>
<th>Teaching Method/Learning Process</th>
<th>Duration (Hours)</th>
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</table>
| **4. Light Energy** | P. 7 Light and Vision            | SC 5.1 (1) – (4) SC 8.1 (1) – (8)               | - Scientific teaching method  
- Investigative process teaching method  
- Teaching method focused on skills  
Process: Group process  | 4  
11  
3 |
|                  | P. 8 Solar Cells                 | SC 5.1 (5) SC 8.1 (1) – (8)                    | - Cooperative teaching method by using group learning techniques                                | 3               |
|                  | P. 9 White Light Dispersion      | SC 5.1 (6) SC 8.1 (1) – (8)                    | - Investigative process teaching method                                                        | 4               |
|                  | Review / Test                    | -                                              |                                                                                                 | 2               |
| **5. The Universe and Space** | P. 10 The Solar System          | SC 7.1 (1) SC 8.1 (1) – (8)                    | - Investigative process teaching method                                                         | 5               |
|                  | Review / Test                    | -                                              |                                                                                                 | 2               |
| **Total Annual Learning Hours** |                                  |                                                 |                                                                                                 | **80**          |

P. refers to Lesson Plan No.
Lesson Plan - Unit 1

1. Analyze standard content and scope of learning management

<table>
<thead>
<tr>
<th>Learning content group</th>
<th>Science</th>
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<tr>
<td>Grade level</td>
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<tr>
<td>Name of learning unit</td>
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<tr>
<td>Content according to learning standard no. 31.1 / Wo. 8.1</td>
<td>1. The Structure of Plants  2. Necessary Components in the Growth of Plants  3. Some Necessary Components for Photosynthesis  4. Response of Plants to Stimulus</td>
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<table>
<thead>
<tr>
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<td>The Growth of Plants</td>
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<td>Food Production of Plants</td>
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<td>Response of Plants</td>
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<td>Review/Test Unit 1</td>
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<tr>
<th>Main learning process</th>
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<tr>
<td>- Cooperative teaching method by using group learning techniques</td>
</tr>
<tr>
<td>- Scientific teaching method</td>
</tr>
<tr>
<td>- Investigative process teaching method</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Integrative learning process</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Integrate learning sources by searching for information regarding plants from various learning sources and using the information gathered to create a report.</td>
</tr>
<tr>
<td>2. Integrate Thai language learning by writing a letter to a friend to introduce knowledge of plants.</td>
</tr>
<tr>
<td>3. Integrate scientific method to design experiment to measure response of plants to music.</td>
</tr>
</tbody>
</table>
Determine targets of lesson plan for Unit 1

Knowledge
1. The Structure of Plants
2. Necessary Components in the Growth of Plants
3. Some Necessary Components for Photosynthesis
4. Response of Plants to Stimulus

Process Skills
1. Experimentation Skills
2. Scientific Process

Desirable Characteristics
1. Honesty in seeking knowledge
2. Interest in learning
3. Rationality (reason)
4. Participation in sharing ideas and willingness to listen to the ideas of others
5. Able to work creatively with others

Target of learning

Plants Around Us

Evidence of learning

Work load during class
- Practice learning method of investigation, observation, experimentation, and learning development activities (Total of 12 pieces)

Total results of learning
- Practice thinking process and searching for knowledge from activities to develop thinking (Total of 4 pieces)

Self-evaluation projects
- Report on the functions of root, stem and leaves of plants
- Letter introducing knowledge to friend
- Experiment designed to measure the response of plants to music
③ Designing lesson plan
1. Main target of learning

**Content 1: Living Things and the Process of Living**

**Standard Wo. 1.1:** Understand the basics of living things, the relationship between the structure and function of various systems of living things that work together, develop a process of seeking knowledge, communicate what you have learned and use that knowledge to sustain one’s own life and care for living things.

1. Experiment and explain the functions of the vascular bundle and stomata of plants.
2. Explain water, carbon dioxide gas, light and chlorophyll as necessary components in the growth of plants and in photosynthesis.
3. Experiment and explain the response of plants to light, sound, and touch.

**Content 8: Nature of Science and Technology**

**Standard Wo. 8.1:** Use the scientific and psychological processes in seeking knowledge, solving problems, recognizing that most natural phenomena that occur do so in a concrete format that can be explained and verified under the information and tools that are available at that time, understand that science, technology, society and the environment are related to each other.

1. Create questions regarding the main point or matter or situation to be studied as per as determined and according to interest.
2. Plan observation, present inspection and verification methods, study, research and anticipate things that may be discovered from investigation.
3. Select appropriate materials and equipment for investigation.
4. Record information in quantifiable form and present results.
5. Create new questions for investigation.
6. Express opinions and conclusions developed.
7. Record and explain the results of investigation in a direct way.
8. Present and exhibit results by explaining verbally or in written form both the process carried out and the results of the investigation for the understanding of others.

2. Overall concept
When this unit has been completed students must have lasting knowledge and understanding as follows:
- Within a plan is a vascular bundle for transferring water and food, and in the leaves are stomata whose function is to release water.
- The key components in the growth of plants and in photosynthesis, which include water, carbon dioxide, light and chlorophyll.
- Plants can respond to light, sound and touch, which are external environmental factors.

3. Core learning point
According to students, how does learning about plants affect the way we live our lives?

4. Measuring and evaluating results of learning

4.1 Evaluation before studying
1) Create test before studying
2) Create activities for learning
   - Observe the images of two plants and compare and contrast the structures of the plants
   - Observe images and discuss as a group about the needs of plants for growth
   - Observe images of various parts of plants and discuss as a group what plants need to produce food.
   - Observe images of the response of plants and discuss as a group about stimulus.

4.2 Evaluation during studying
1) Experiment by raising branch of plant.
2) Experiment the functions of the root and stem.
3) Experiment with the release of water of leaves.
4) Design experiment for key components for the growth of plants.
5) Experiment that water is a key component in the growth of plants.
6) Experiment that light is a key component in the growth of plants.
7) Experiment that nutrients are key components in the growth of plants.
8) Experiment with the food production of leaves.
9) Experiment that light is a key component in photosynthesis.
10) Experiment with the response of plants to light.
11) Experiment with the response of plants to touch.
12) Seek information regarding the response of plants to stimulus.

4.3 Evaluation after studying
- Create test to measure achievements for Unit 1.

4.4 Evaluation of overall learning behavior
1) Evaluate images and answer questions.
2) Draw mind map showing key components in the growth of plants.
3) Draw mind map showing photosynthesis and explaining key components of photosynthesis.
4) Use keywords to write explanation of photosynthesis.
5) Speculate the results of experiment and write explanation of reasons.
4.5 Self-evaluation
1) Report on the special functions of the root, stem and leaves of plants.
2) Write a letter introducing knowledge of plants to a friend.
3) Design experiment for response of plants to music.

5. Media/source of learning
1. Learning media
2. Evaluation before studying
3. Material and equipment according to work form
4. Game to guess leaves
5. Various leaves collected by the teacher
6. Idea development activity form
7. Sources of learning, including persons, library or the Internet
8. Science book, grade 4
Learning Unit 1: Plants Around Us

Subject Code / Course Name  Wo. 1401
Group
Grade 4

Science Content

Lesson Plan No. 1: Structure of Plants

Duration: 7 Hours
Semester 1/2008
Instructor: School:

1. Learning standard

Wo. 1.1: Understand the basics of living things, the relationship between the structure and function of various systems of living things that work together, develop a process of seeking knowledge, communicate what you have learned and use that knowledge to sustain one’s own life and care for living things.

2. Year indicator/objectives of learning

<table>
<thead>
<tr>
<th>Objectives of learning</th>
<th>Evidence / work / workload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Final objective Mo. Tho. Wo. 1.1(1)/W. 8.1 (1) – (8) 1. Able to specify the functions of vascular bundle and stomata of plants.</td>
<td>- Idea development activity no. 1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Enabling objectives</th>
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</thead>
</table>
| 1. Experiment and explain the functions of the root and stem 2. Experiment and explain the functions of stomata of plants | - Form for experiment of functions of root and stem  
- Form for experiment of water release of leaves |

3. Learning content

- Structure of plants

4. Learning activities

| Activity No. Functions of the Root and Stem Duration: |
|------------|---------|
| 3 Hours    | (Cooperative teaching method by using group learning techniques) |
Advance preparation
Teacher experiments according to learning development activity no. 1 (knowledge form) and present the results of the experiment to the students to discuss together in class.

Activity leading to

☆ Orientation
1. Teacher informs students of learning objectives of studying Unit 1.
2. Teacher has students complete evaluation before studying.
3. Teacher has students look at images of two types of plants (knowledge forms) and then the group discusses the structure of plants and compare and contrast the structures of the two types of plants to note similarities and differences between them.
4. Play a game of ten questions (instructions are in the insert).

Learning development

☆ Teaching steps
1. Teacher organizes learners into groups of four, with mixed genders and abilities. Each member of the group is assigned a number between one and four.
2. Teacher announces to the students that the work of the student is considered work of the group.
3. Members in the group have the following roles:
   - Member 1: Read the information in the book and work form or activity form
   - Member 2: Collect equipment for analysis of information on experiment, store it and return it
   - Member 3: Carry out experiment and/or activity
   - Member 4: Record results of experiment and answer questions
4. Teacher assigns workload to all groups as follows:
   - Study information from knowledge form regarding the root and stem
   - Carry out learning development activity number 1 by anticipating the results
   - Carry out experiment according to learning development activity number 2, work form titled “Functions of the Root and Stem”

Hour 2

1. Teacher presents the experiment according to learning development activity number 1 that was done in advance to the students after each group has anticipated the results. After that each group records and summarizes the results.
2. Each member of the group carries out their role, working together to accomplish the mission assigned by the teacher.
3. As a group discuss the results of the experiment to conclude information for the group and record results.

**Hour 3**

4. Each group presents the results of the experiment, which should be as follows: before soaking the plant in the red water, the stem of the plant is green. But after soaking the stem in the red water for 30 minutes, the root and stem of the plant became red in color.
5. The students in each group share their opinions—as a group—about what they noticed when the stem of the plant was cut diagonally and where that substance came from.
6. Students discuss as a group and conclude from the activity carried out that the root of the plant draws up water and nutrients into the stem, and the stem’s function is to act as the path for water and nutrients to travel to other parts of the plant.

**Conclusion steps**

1. Teacher and students can conclude that within the plant is a vascular bundle that transports water and food.
2. Teacher asks students to read knowledge form and carry out learning development activity number. .
3. Teacher praises students who cooperated in the activity and experiment and explains further if there are points that students do not understand.
4. Teacher checks the recorded information and results of the experiment as per learning development activity numbers 1 and 2 of students in each group and praises the students who perform the best while encouraging and advising the groups that still need improvement.

**Activity No.  The Leaf and its Function** (Scientific teaching method) Duration: 4 Hours

**Advance preparation**
Teacher collects various leaves from the area to use in the learning activity and enhances learning by using the local names of the plants, as additional information.
1. Separate students into groups of three to four members and let the groups compete in a leaf guessing game. The teacher will show a leaf to the class and students must race to raise their hands for a chance to answer. The group whose member raises their hand first will have the chance to answer first.

2. Teacher allows students to continue playing the game as appropriate and encourage other groups to applaud the group with the most points. Then the teacher announces the objectives of learning to the class.

| Learning development activity |

Teacher divides students into groups of three to four members and students use the scientific method to seek knowledge.

**Step 1: Ask a Question**

1. Teacher gives students the information that, “Trees create humidity” and then allow the students to work in groups to express their opinions regarding the topic and discuss whether they think the statement is true or false and why.

2. Teacher gives additional information that “Trees create humidity in the atmosphere before plants release water into the air.” From this statement the teacher then allows the students to ask a question or problem, which should be, “How do trees release water?” or “With what method do trees release water?” or “Which component of a plant releases water?”

**Step 2: Construct a Hypothesis**

Teacher explains to students that constructing a hypothesis means to guess a possible answer to the question. Then students in each group should form a hypothesis to guess the answer to the question they have determined previously. The hypothesis to be studied should be that plants release water through their leaves.

**Step 3: Collect Information**

1. Teacher suggests that students study the work form about the release of water from plant leaves and if they have any questions the teacher can explain further.

2. Members of each group plan an experiment.

3. Each group answers the question in their work forms before carrying out the experiment. Students then perform their experiments. The teacher observes the activity and offers advice as needed, and students then record their results.

**Step 4: Analyze Information**

1. Students analyze the collected information and form a conclusion.
2. Students discuss as a group to conclude the accurate information.

**Step 5: Conclude Results of Study**

1. A representative from each group presents the conclusion they derived from their group discussion.
2. Teacher and students discuss, as a group, to reach the conclusion that leaves have the function of releasing water, which occurs through the tiny pores on the surface of the leaves.

**Activity to sum up**

1. Teacher lets each group of students study further information from knowledge forms 11-12 to expand their understanding.
2. Teacher assigns students to do evaluation form number 1 (knowledge form 15) to test their understanding.
3. Teacher assigns students with workload to collect points and then allows each student to carry out learning development activity number 1 (knowledge forms 13-14).
4. Teacher assigns students creative integration activity for self-evaluation (knowledge 54) where the students in each group must create a report on the functions of the root, stem and leaves, and teacher and students will decide together when the assignment should be due.

**5. Media and Sources of Learning**

1. Learning media (examples: media Mo. Mo. Tho. Core Curriculum, Science, Grade 4)
2. Evaluation form before studying
3. Leaves guessing game
4. Various leaves collected by the teacher
5. Materials and equipment according to work form

*Teacher allows students to study additional information from the grade 4 science book (permitted edition), Unit 1, Chapter 1: Structure of Plants, to enhance knowledge and expand understanding of this lesson.

**6. Measuring and Evaluating Results**

**6.1 Evidence of Learning (Final assignment that demonstrates overall learning behavior)**

1. Learning development activity number 1
2. Report on the functions of the root, stem and leaves

**6.2 Method of measuring and evaluating results**

1. Check completed learning development activity number 1
2. Check research report
3. Evaluate experimentation skills
4. Evaluate scientific method
5. Observe group work behavior
6. Observe behavior during class and while carrying out activity
7. Observe behavior during class and outside of class

6.3 **Tools for measuring and evaluating results and criteria**

1. Learning development activity number 1 - 70% to pass criteria
2. Work evaluation form
3. Experimentation skill evaluation form
4. Scientific method evaluation form
5. Group work observation form
6. Desired traits evaluation form
7. Form to evaluate five aspects of learner’s capability
8. Eight-aspect desired traits evaluation form

**7. Recommended**

If the school has a microscope, teacher should allow each student to study the pores on the leaves of plants with the microscope and draw the images that they observe.

**8. Teaching Log**

1. **Learning results**
   1.1 Learners that pass indicators
   Number...........................................persons
   Percentage.............................................
   1.2 Learners that did not pass indicators
   Number........................................... persons
   Percentage.............................................
   1) .........................................................Reason
   (if known)................................................
   2) .........................................................
   Reason......................................................
   Solution......................................................
1.3 Learners with special abilities include
1) .........................................................
2) .........................................................
   Method of development / enhancement
   .................................................................................................................................
1.4 Learners receive knowledge (K)

1.5 Learners develop processing skills (P)

1.6 Learners have virtue, morality, values (A)

2. Obstacles (if any)

3. Recommendations (if any)

Signed

(..........................................................)
Appendix H. 3rd and 4th Grade Student Test Scores

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<th>1/2010 Fourth Grade</th>
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<tr>
<td></td>
<td>Average</td>
<td>67.84</td>
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There is a significant difference between A and B (P-value ≤ 0.05)