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Session B

STEM+A FOR LIFE ON MOUNTAINOUS AREA:
A Process of Learning Development at Kor-ta Village in Thailand

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ABSTRACT

This article demonstrates that STEM education can be taught with rural way of living in a small rural school at Baan Kor-Ta, Omkoi district, Chiangmai, Thailand. Basic education in remote rural areas should not steer tribal students towards university entrance examination because those students did not avail themselves of such mainstream learning approach. Majority of the rural students, including many who went to the university, returned home to live a farmers' life in the same way as their parents who has no college degree. Besides, the basic education did not seem to provide them with the life – work skills they need.

The Rural STEM is based on daily life problems and could be sustained by the local teacher. There were 3 keys to the success. First, learning is based on problems that closely linked to students and teacher' life. Such topics present students with authentic learning process and are locally sustainable. Second, the teacher must be persistent to solve the problems and does not perceive this task as burden. Third, "inquiry-based training" is a driving mechanism that help the teacher to break the habitual way of teaching. It is evident that the teacher also applied the same mechanism for her student's learning process.

"Growing Beansprouts" was an initial project on which the rural STEM was developed. The project aimed to provide vegetables for school lunch. In doing so, Scientific thinking was taught through planting; Math was taught with measuring growth rate; Technology was learnt via experimenting choices of mediums. Engineering sense was nurtured with adapting beansprout growing methods. Students also learnt Art of by visual graphic in recording and presenting their works. These were rural STEM+A for Life that could develop new alternative learning process in rural remote area.

KEYWORDS: Alternative Education, Rural, STEM, Experiential Learning, Scientific method

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1. PRESENT CHALLENGE: STEM EDUCATION AND REMOTE RURAL AREA

STEM education is introduced to improve science education in Thailand. When STEM concept was first introduced to mainstream schools, most concerns was its implementations not relevancy. Science-Technology-Engineering-Math provides active learning approach to accelerate changes to learning in mainstream schools which are under the framework of Thailand national curriculum for compulsory education (Grade 1-12). In practice, this group of schools focused mainly on content-knowledge in order to ensure that students could pass Ordinary National Education Test (ONET). The classrooms were loaded with a lot of contents. The young spent most of their time in remembering and applying knowledge to pass the test. A more effective way is to join private tutoring schools where advanced techniques are given to those who could pay. This way of learning deprives a large number of Thai students from their problem-solving skills that is much needed in their future.

This is a big challenge in present education. It would not be so wrong to say that the system was obsolete because it aimed to produce graduates who were competent in reading and complying to the working tradition of 19th century office. Almost everyone agreed that we need change. The challenge, to human resource development, is that some of teachers who have to change are struggling to unlearn their pedagogy and to update their teaching approach to that of the 21st century. Training and mentorship must be cooperated from all sectors.

Universities in Thailand were criticized for its isolated role in society. Tertiary education – presumably the highest academic caliber – is extremely distant itself from majority of Thai communities in countryside and rural area. Unapologetic pride in their role of researchers, they explore into the new frontier of knowledge which to some extent, serve the industry and agriculture. To a large extent, the research works were purely academic and that were valued by number of publications. A national research institute for science and technology produced only 2 out of 10 research work that are of practical value.

Private sectors, mainstream public, and even the marginal in remote rural areas are waiting for such high caliber academic to help them with under-developed way of living. This is a gap which university in Thailand have to fill in. This article is a result of social works by a team from King Mongkut's Univertsity of Technology Thonburi. Education development is an important mission. The team has worked closely with local teachers in rural area for a decade. STEM is one of the topic that majority of the teachers need helps.

2. THE SCHOOL STEALS MY LIFE SKILLS

2.1 Because of 'education for all'

Even in rural areas, schools were to integrate STEM into their classrooms. In Thailand 4.0, there is an aim to close the gap of social inequity. Better education is introduced not only to the mainstream, but also the rural schools. To today job-markets, a number of bachelor degrees is of virtue but not much of value. Set of Competency units are the quality of graduates whom company wanted to employ. In many Thailand's remote areas, the rural high-school students can hardly compete with

the city students to enroll in the university. However, in the name of social responsibility, special quota were given to the outstanding form the rural. Those who got government jobs were able to do well enough for living. The rest cannot find any good job. Many graduates cannot work. For city dwellers, they naturally adapted with the help of their families. For the rural students, they returned home, continue their traditional tribal way of living, with no benefits of their degrees, and lack local tacit knowledge which could be gain through experiences in the mountain.

The government has always wanted to change the learning process to increase ability of human resource to highest potential. In practice, most of teachers (or schools) have always taught in the same way. It is habitual. Ignorance to new teaching process, as well as the attitude of teachers and parents have been in preference of winning at entrance examination to university.

2.2 Tribal students met Industrial based curriculum

Dilemma of valuing indigenous knowledge in mainstream is not geo-political specific. At present, Education for adult and children in remote rural area is served by Non-Formal and Informal Education Office (NFE) and Border Patrol Police. Driven by functional literacy: reading, writing and arithmetic, the agents aimed to alleviate the quality of life. The focal point of these education agent is on health, work, and environment. Local knowledge was usually integrated into these non-formal schools. Community was part of the classroom. As Semali L., (1999: 307) explains that in Africa, "*the ability to use community knowledge…form important literacy skills that are critical to survival.*" Not only for the rural education, this is true but also in advanced tertiary institute such as computer and IT. "*In the ever-changing technological environment that universities send their graduates to work, the playing field is increasingly competitive. For the IS graduates this fact means not only possessing a wide range of technical skills, but also having a set of soft skills such as project management, team- work, presentation, and communication*." Real world projects are employed widely in attempt to integrate various technical and soft skills in order to solve real business problems. (Grant. D M., et.al, (2010).

Relevancy of STEM for remote rural school is often questionable. It is a valid approach to life, however, it depends on the degree to which educators and teachers make Science, Technology, Engineering and Math – relevant. Science and spiritual belief of tribal people could simply cause contradictory explanations to comprehensions of the tribe's world. While many science educators claim that everything is STEM, their true meaning is strict to development of cognitive skills which we could gain from explaining anything in the environment. In terms of cognitive development, as in Semali's further comments, "*Islamic forms of education, however, even though they were part of everyday life in many urban communities, were considered only as "personal" religious beliefs or practices, and so dismissed as a possible core of a common curriculum*." (Semali., L. (1999: 308-310) Indigenous literacy is a worldly psychomotor skills of living. It reflects "*local culture and is usually communicated through local languages. Innovations such as fishing techniques used in East Africa…the use of different herbs or plants to manage diseases, popular among the Maasai of Kenya and Tanzania*."

2.3 University Social Responsibility: Leader in Education Development

Balance between indigenous and functional literacies must be achieved, one

way or another. Otherwise, students who passed schools would miss the opportunity to gain life skills. If STEM was asserted as an emphasis on scientific process for higher level of functional literacy, without careful curriculum design[6], it would shift the balanced of the two literacies. It was so. We found that Tribal students live in the village in the forest reservations area which many urban ways of living cannot be applied. Of course, they have to interact with the outside world. Curriculum and incorporating real-world knowledge into the classroom is an urban way. In rural ways, shifting the focus to local way of life may help educators strike the better balance between knowledge learnt from classroom and community life. The shift caused most of students to seek a city job. Their tacit knowledge and skills in farming were weak because they lack experience furing school's years. An important question is how to change the learning process to shift the balance back.

The NFE office in Chiangmai, has recently been promoted the philosophy of the late King Bhumiphol – sufficient economy. Moderation and self-immunity are critical for rural education. There was no clear curriculum. Teachers were in need of guideline for efficient way of teaching this concept. They still have used the habitual way. No framework may turn out to be a good thing as Valdez, M. C. a. U. (2009) said "*Everywhere, people are faced with unique circumstances that cause them to form a distinct set of priorities for the natural world. Therefore, there is no cookie-cutter answer for environmental educators*." Ongoing inequity in mainstream education system has resulted in an increased need for alternative learning spaces for disadvantaged communities, such as *Barnardos' Learning Centers* (**Valdez, M. C. a. U.,** 2009). However, alternative learning space does not mean physical building but the learning process, particularly in Thailand.

University can take this role of leading designer for learning and teaching development. Sharing intellectual property is more important than donating books and computers. Coach and mentorship for 'the multipliers' such as senior teachers who could expand the ideas was proved a good strategy for educational gaps. The role of KMUTT team is to provide supports for these teachers whom we treated as social change agents. There were training programs for the trainers, coaching sessions, school visits, in order to initiate a new efficient-way of teaching. The team aims to strengthen each teacher's capability to their full potential. The conceptual framework of learning development in this case was concerned with 2 issues which are 1) The approach must be "self-sufficient" and "sustainable": 2) integration of education and real life problems in health, environment, and food security or occupation.

3. STEM AS A TOOL FOR COACHING EXPERIENTIAL LEARNING

Integration of STEM and life skills learning is designed in the framework of "The Experientialism" - a philosophy of education brought to light by William James and John Dewey. There are a number of practical approach one of which is Kolb's Experiential Learning Cycle.

Based on experiential learning cycles of Kolb., A. D, (1984), there are 4 stages of transferring experiences into knowledge. Kolb states that the cycles is a result of

[6] An example is *Education for Self-Reliance*, a national effort to indigenize curriculum in Tanzania. Semali., L. (1999).

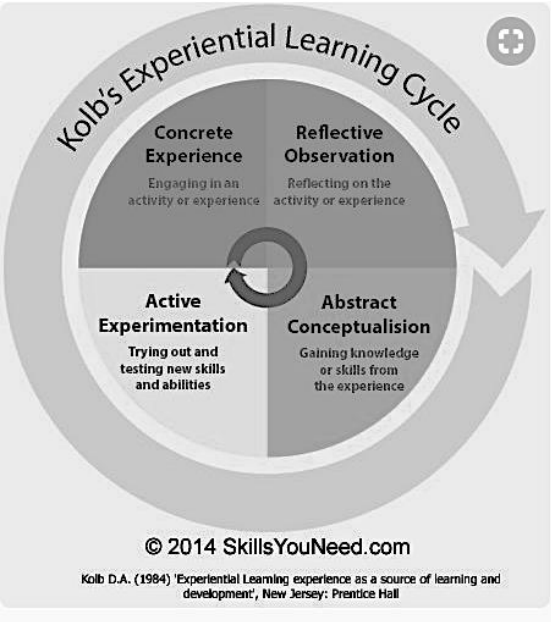
previous works of John Dewey, Kurt Lewin and Jean Piaget. These 4 stages have been through thorough re-examinations from scholars for more than 3 decades. It proves that fundamental concept of the model is still relevant.

1. Concrete Experience - (a new experience of situation is encountered, or a reinterpretation of existing experience). **Act**: Concrete experience: Facts (What happened) based on theory of action

2. Reflective Observation (of the new experience. Of particular importance are any inconsistencies between experience and understanding). **Reflect**: Reflective observation : Feeling (What did I experience) Assess behavior & consequence

3. Abstract Conceptualization (Reflection gives rise to a new idea, or a modification of an existing abstract concept). **Concpetualize** : Abstract conceptualization : Findings (Why did this happen) : Revise theory

4. Active Experimentation (the learner applies them to the world around them to see what results). **Apply** : Active **Experimenting** : Future (What will I do) Implement revised theory



Appropriate thinking about real world experiences would contribute to learning. In addition, scientific method could be integrated to make sense with reasons. For example, teachers prepared activities or simulated some situations for students. The students then learn by doing and merging into direct experiences. It is a process that is to observe – to ask the right question – to prove/ find answers logically by human and technology; in a manner that other can repeat the process. In this case, the significant issue was identification of problem that is truly important to life – student's life. Most often, the simulated situation was not only far from student's lives but also the teachers. Despite all the elements, such learning process would not be sustainable.

This paper reflects on the practical stages which KMUTT coaching team underwent with rural school teachers. Learning Cycles: the stages are used to described learning The coaching between the learning stages are Although mentorship is an important aspect of the university preparation of practitioners, its role has been overlooked in many service organizations. (King, G. (2009), p192)

McLoud S., (2013) shows that both Kolb's (1984) learning stages and cycle could be used to develop more appropriate learning opportunities and that *"Educators should ensure that activities are designed and carried out in ways that offer each learner the chance to engage in the manner that suits them best*." There are two different components that are in focus: learning and teaching. For experiential based teaching, it is important to understand how to coach students before and after their self-governed experience learning. A full cycle of adult thought development is conceptualization of concrete experience, resulting in abstract thought. In this case, adult means maturity of thinking rather than age.

The key training was use of "question" as a driver for coaching KMUTT team design a coaching process for the teachers who are interested in meaningful learning activity process. For example, What was suitable in your village? How can we believe the information that you reviewed? NO ANSWER is given but specific guiding questions. How to growing plant - how much water is needed daily? What factors was concerned with growth? – What are temperature in the evening? This is an important driving mechanism that could develop changing from teaching to learning.

4. STEM+A: EXPERENTIAL LEARNING AT BAN KOR-TA

4.1 *Stage* Zero: Reflecting on Former Experience

Baan Kor-ta Community Learning Center, is under administration of Non-Formal and Informal Education Office in Omkoi district, Chiangmai, Thailand. At each learning centre, there were teachers working in pair who are gate keepers of knowledge from the mainstream. Kor-Ta Learning Center was running "Lunch for Students Project" in same way as all other 108 learning centers. One of Kor Ta activities was to grow vegetables so that students could have fresh raw material for lunch. The only available space in learning center area is school backyard. But, Kor-Ta Learning Center had problem with soil quality. Vegetables could not grow. The teacher discussed this problem to the KMUTT's team to ask for soil improvement methods or new ways to grow vegetables. Hydroponic method was also proposed but most of materials and equipment must be brought from the city. There was no electricity to create water flow.

There was the step by step in problem solving process. Expand At each meeting, KMUTT's team designed "questions" to ask in each teacher - depend on their progress, topic of project, capability, limits. Each teacher had time to spent for research/review to find out the answers. Next meetings, teachers experienced this cycle again with the new set of "questions."

The team led the teacher to rethink about her goal and obstacles. The reflections process had been stimulated. The teachers underwent experiential learning by teaching and her students went through real life project; 'growing vegetable for lunch.' It took the school almost a year to taste their first meal of stir-fried bean sprouts. After 2 years, teachers concluded her experience and presented alternative approach to teach science in the rural village, which the teacher and her new batch of students continued to do so till today.

The reflective observation did not happen during our coaching. It came to the teacher after our training. We call this stage "*Coaching Cognitive In between Stages*".

It is the step in which the learners rethink about their experience. Coach helps learners rearrange the experience into a chain of separated thoughts so that learners could assess them on their own.

4.2 Coaching In between Stage of– Conceptualize and Experimentation: Re-thinking the Problem at hand

The teachers had to have a clear picture of what they wanted to do. It is a process of setting up the research question into designing experiments. Based on the teachers' presentation, during the monthly workshop, the university team started the discussion with teachers. In order to materialize ideas, we break the elements down and guide the teacher to prioritize them. For example, 'the growing bean sprouts" consisted of many elements. Soil, as the key problem, direct the teacher to focus on planting media (materials for plants to grow). Other issues could be a good project as well but to learn from her experience, soil represented planting medium in this case.

We guided the teacher to review relevant literature, to gain more knowledge about the topic until they are clear about what to do next. The question 'how to' is the driving tool. When Kor Ta teachers gained knowledge about how to make planting media – compost, mixed materials etc., the first question of experimentation was how to make the suitable compost *by yourself* with *local materials* in Kor-ta village.

Growing bean sprout project could start as locally self-sufficient but the green-bean seeds must be imported from outside. She remembered beansprout is farmed in the area and grow quicker. Teachers decided to substitute the seeds of green-bean with soybean. This issue brought to the new questions: can soybean grows into bean sprout; how to: conditions for growing.

The next question was the quality of compost: was it good enough for vegetable growth and how to measure quality of the compost. It is the objective assessment that led the teacher to plan scientific experiments.

The NFE teachers are volunteering model to compliment the shortage of teachers within the marginal culture. Individual teacher is assigned to work with one community. This tendency causes the lack of professional learning community and workgroup, thereby lack of coaching and training. It is critical for teachers to have opportunity to share and learn with their peers. Development. To improve, they *require opportunity for mentorship; feedback; dialogue and reflections. They require coaching for professional development*. (King G, 2009: 193)

4.3 Coaching In between Stage of Active Experimentation – Concrete Experience

It is a process of data collecting – comparison and summary of vegetable growth in different plant media. This stage included students' participation. Kor-ta learning center has used compost consistently for vegetable plant. No expectation is placed upon yield of product. It is experiential learning that aim to improve cognitive skills of the teachers.

Effectiveness was criteria for next step improvement. The teachers were asked if the school could control the vegetable crop period, (which was about 1 month) and how to produce weekly supply to serve students need.

The project went well. Students understood the process of growing beansprout and be able to solve problems encountered along the production.

Coaching at this stage is a mental support for the teachers. In order to change teaching methods, teachers have to work harder. It is known that the teachers in rural areas are often overloaded. There is limits of time and resources. School's activities include main mission (teaching) and humanity mission (active citizen of the community). STEM project should not be treated as special task or research. Activities should be integrated into cycle of the way of local living. The integrations help the teachers save time and resource but it take up much of will-power.

It is therefore very important that positive attitude of teachers are sustained and alleviated so that they could be persistent in the search for new effective teaching method.

5. STEM+A AS ELEMENTS OF EXPERIENTIAL LEARNING QUALITY

Deriving from lack of fresh green leaf-vegetable, daily life activities are combined into learning-teaching at the community learning center. STEM or conventional – it was not of the teacher's concerns. Nonetheless, student's lives were integrated with way of learning. The daily life made them learn many subjects. For example, ***Science***-factor effected to growth, soil and planting materials scientific method and observation. ***Mathematic***- weights and measures of seeds, length of vegetable/sprout body, weights of yields. ***Engineering***- processing of experimental designed, preparing of material, and scientific process management. ***Technology***-technology reviewed and chosen in planting materials/compost made. ***Art***-designed and painted for presentation. These were **STEM+A** for Life, a new alternative education.

STEM+A acts as tangible criteria which the team used as measuring tools of two expected outcomes of STEM projects that are ***self-sufficient*** and ***sustainable***.

5.1 STEM makes Experience Sensible

Science require that teacher look for knowledge in her surrounding. Used of basic science to understood what the factors effected to planting. They found their mainly disadvantage and became to research question This learning process represented used of science and scientific method in closely problem.

Solid science is based on real life. The STEM for life in rural area could surely be operated, especially in non-formal and informal education, teacher could provide real life activities, not real-world context, because the centre is within the village. Even though, it seems teachers who taught in this way need to be trained intensively by expert. But, in this case, represent the teacher, who had only basic science and the advantage of real life learning- environment; could teach scientific thinking. Science become sensible to students because the fact that they proved, were in their lives.

With hindsight, one of the key success is that food problem made it so real and present to the students in remote rural area. This is universal. A case study from Australia showed that "*The tutors and managers reported that the prime benefit was the enhancement of the children's well-being as the children were not able to access adequate food otherwise.*" (Tracey D, Craven, R. G., Yeung, A. S., Tregeagle, S., Burnstein, J. a., & Stanley, H. (2015). Learners are most motivated when they are stakeholders.

5.2 STEM makes Experience Measurable

Mathematics provides the team with the idea that many things in this projects should be made '*measurable*' therefore it guides teachers and students to try to find assessment and objective explanation of what happened in the project. It is a ground on which we prove and make decisions based on facts rather that feeling. It brought to infallibly summarized for each issue.

Difficulty in objective assessment help us clarify a considerable gap in our knowledge about the interaction of different goal and existing situation. The gap encouraged us to set up new, well-designed studies to uncover solutions and new problems – new goal. "*In any case, researchers should construct new assessment instruments that can register which types of content goals are salient in different learning settings*" (Monique B., E. D. K., and Vedder. P., 2006: 49)

5.3 STEM+A makes Experience Challenging, Attainable and Creative.

When integrating experience learning with **T**echnology Key question of learning is to ask how it made? and what is the most effective way? Technology is tools and know-how of human to manipulate resources for the purpose. To search for know-how, reviewing of technology from outside raised possibility of using it in the village.

For this project, Lack of modern technology to solve soil problem push teachers back into the local culture and re-search for local technology. When available technology is locally available, students can actively participate and could offer ways to solve problems and improve know-how.

Success of the project encouraged, the teacher and students to plan for all year production of beansprout. The teachers stored large amount of soybean seeds for the next year project. Shortly, the seeds were destroyed by moths. The students told the teacher that the storing place was problematic. The most appropriate place was above fire stove where heat, smoke and steam, help preservations of the seed. Students saw the method in their home but the school had no stove. They had to ask one of the students' parents to help them store soybean seeds. The teacher and students still run the beansprout project for their food until now. Sometime they experiment with types of sprouts for example sun flower sprout.

Engineering is the ability to adapt, design. From this project, the teacher and students were not engineer, nonetheless they demonstrated the spirit of engineer who always want to find solutions for their problem at hand. To maximize output, they increase the production scale with end-results and clear crop-planning. They designed the number of planting buckets, storage, and humidity control. Goal, alignment and conflicts must be coherent. Learning could hardly be novelty all the time.

5.4 STEM+A for Experience Learning Nurtures Self and Social Esteems.

The teacher wanted students to learn happily as well as to test students' understanding, visual graphic and journal were designed to allow freedom in present their learning. Art is about life and expression of human thoughts. When goal in life

is clear and present, student could present their thought and life through artwork. Technique of drawings and paintings are not as important as the content in this case. This complied with idea of recognitive measure (Fraser and Honneth 2003) which is *to acknowledge the cultural exclusivity of educational contexts and seek to create learning environments that privilege cultural relevance and value and respect the culture of all participants to ensure social esteem*. (Tracey D, Craven, R. G., Yeung, A. S., Tregeagle, S., Burnstein, J. a., & Stanley, H. (2015) p12) At Kor Ta, students recorded and drew what were considered important experience to them. It shows that some students were highly creative and good painting skills. Within the Learning Center, such recognitive measures are showed when family-like relationships are established with teachers that value students as a person; as their own children. Connections between the students and others in their local community are strengthened. Ideal self is utmost development of education however the fight for survival is real. STEM answered to this aspect. Art is however to maintain existence prior to reaching higher state of life. Simple activities could turn to be meaningful idea if conceptualization and reflective observation are taken in the forms of artworks.

6. CONCLUSIONS

Teacher and students have taken scientific process to undergo real life experience. STEM provides guiding elements to solve their life problem, systematically. Three year later, the school still use this STEM+A approach to provide student with real life experience learning.

It is evident that students also underwent reflective observation, conceptualization and experimentation, that resulted in metacognitive transfer. Experiential learning process for students. By shifting their focus on lower order of thinking, (remember, understand, and apply) into facilitate students to achieve higher order of thinking (analyze, evaluate, and create). This way put students to know how to learn.

There were 3 keys to the success. First, learning is based on problems that closely linked to students and teacher' life. Such topics present students with authentic learning process and are locally sustainable. Second, the teacher must be persistent to solve the problems and does not perceive this task as burden. Third, "inquiry-based training" is a driving mechanism that help the teacher to break the habitual way of teaching. It is evident that the teacher also applied the same mechanism for her student's learning process.

Integration of STEM (scientific method) and Tribal ways of living (Real life experience) requires equilibrium between new and existing. If STEM was the main component, too often, science education tried to place the students'lives into STEM classroom, resulting in lacks of active participatory learning. KMUTT team saw everyday experiences of the tribal students as the main component. We therefore brought out STEM and Art from the students' lives, thereby, STEM+A appears naturally local and relevant.

7. REFERENCES

Kolb, D. A. (1984). *Experiential Learning, Experience as the Source of Learning and Development*. Englewood cliffs, New Jersey: Praentice Hall, Inc.

King, G. (2009). A framework of personal and environmental learning-based strategies to foster therapist expertise. *Learning in Health and Social Care*, *8*(3), 185-199. doi:10.1111/j.1473-6861.2008.00210.x

McLeod, S. A. (2013). Kolb - Learning Styles. Retrieved from www.simplypsychology.org/learning-kolb.html

Monique Boekaerts, E. d. K., and Paul Vedder. (2006). Goal-directed Behavior and Contextual factors in Classroom: An Innovative Approach to the study of Multiple Goals. *Educational Psychologist*, *41*(1), 33-51.

Semali., L. (1999). Community as classroom: Dilemmas of valuing African Indigenous Literacy in Education. *International Review of Education*, *45*(3/4), 305-319.

Tracey Danielle, Craven, R. G., Yeung, A. S., Tregeagle, S., Burnstein, J. a., & Stanley, H. (2015). A place to learn: cultivating engaging learning environments for young rural Aboriginal Australians. *International Journal of Inclusive Education*, *20*(6), 641-658. doi:10.1080/13603116.2015.1102341

Valdez, M. C. a. U. (2009). Incorporating Community Education in the Strategy for Harpy Eagle Conservation in Panama. *The Journal of Environmental Education*, *40 Summer*(4), 15