CHAPTER 5

Discussion and Conclusion

This chapter provides the discussion referring to the finding results and theoretical supports. The ontology effectiveness and learning process improvement measurement by semantic annotation technique on Bloom's Taxonomy vocabulary are discussed in this chapter. The beneficial of this research, research limitation, the novelty of this research and the further work are provided in this chapter.

5.1 Effectiveness of tutorial ontology in learning process

This research provided the effective tutorial social science ontologies on organic rice farming as an appropriate technology based on sustainable development projects for non-science and technology educated farmers using knowledge engineering approach. An organic rice farming domain knowledge was captured, analyzed and structured from experts using CommonKADS and the social science ontology on organic rice farming will be identified and developed based on lower secondary school of Thai curriculum which provides biology, chemistry, math and physics concepts.

The rural people who graduated lower than under secondary school (Mattayom 3) were lack of social science knowledge as basic education. The Thai curriculum of elementary school level was not including basic science and social science subject that are not enough for understanding and applying the knowledge such as economy, appropriate technology, and rural development concepts. The lack of social science basic education of samples was proved using the test that designed by researcher who has science background and experts. Initial findings of the first year project showed explicit knowledge exist in the sustainable development project, but mainly in the form of economic information and documentation. Expert scientific and engineering knowledge was lacking. Universities, government officers, and a new generation of experts

conducted many projects. Most of rural people in Thailand had education at elementary education level, which are elementary school (Pratom 4-Pratom 6) 92.58%, lower secondary school (Mattayom 1-3) 46.82% and upper secondary school (Mattayom 4-6) 25.29% (Office of the Permanent Secretary, Ministry of Education, 1992). Moreover, it can be seen from Office of the Permanent Secretary, Ministry of Education, (2013) that most rural people at 91.36% in Thailand complete elementary education level more than other levels. The findings highlight a lack of specification of conceptualization understanding in basic education level of rural community people in Thailand being unsuccessfully transferred appropriate technological knowledge, which was maintained in the sustainable development projects. There 53.43 % of rural people in Phrao District had the highest education at elementary school level which was lacked of science and technology knowledge. Most rural people in case study were ages around or more than forty years old. The rural people graduated at basic level and secondary school level more than ten years then most of rural people forgot science and technology knowledge. It means that most people in this rural had basic education that was not enough to transfer knowledge from appropriate technology successfully for rural development to be a sustainable community. Non-science and technology knowledge educated people do not understand and apply knowledge, which have many conceptualization and social science vocabulary.

The methodology of this study developed additional social science ontologies from the organic rice farming knowledge as an appropriate technology to transfer knowledge to rural non-science and technology educated farmers of Phrao District, Chiang Mai Province, Thailand as a research case study. An organic rice farming as an appropriate technology from a suitable sustainable development project was identified to develop additional ontologies solution for appropriate technology. This study identified and developed first version of social science ontology into 92 ontologies, which were specification of conceptualization on organic rice farming. Only five adaptive organic rice farmers of the experimental group were tutored social science ontologies of the organic rice farming ontology knowledge based on four main social science ontologies derived from the biology, chemistry, physics and mathematics concepts of Thai's curriculum in lower secondary school by a researcher. The results of social science ontology effectiveness in learning process show that the experimental group, which was

with ontology training could understand, practice and apply knowledge from experts more than the control group, which was without tutorial social science ontologies. Some ontology could not be used on organic rice appropriately, and some ontology of their adaptive organic rice farmer samples could be reasoned and created which was related to expert's domain knowledge to apply for organic rice farming. Furthermore, the new domain knowledge on organic rice farming which was suitable for case study was created from non-science and technology educated farmers in experimental sample group who have additional ontology. The additional ontology for the non-science and technology educated farmers showed effectiveness of understanding, reusing and operating domain knowledge from expert's jargon (domain knowledge) to develop community. The samples who have additional ontologies can reason, apply knowledge from experts and local experts. Linda et.al (2010) recommended constructing ontologies to provide a well-structured explicit specification of the obtained knowledge for communication for the experts and the knowledge engineers involved in the networks' development. The ontology should not only accumulation the knowledge required for the different model understandings, but also any appropriate background knowledge. The previous research had shown that rigorously official representations are they logic-based or indicated in alternative mathematical language. They cannot readily be understood by domain experts who are not trained in such representations. When specified in a semi-official language that was available for the experts, a comprehensive ontology can offer processes of communication between the experts and the knowledge engineers, which assists to minimize the risk of excluding important information and of including inaccurate information. This study showed that a comprehensive ontology can provide a communication between academic experts and non-science and technology educated farmers.

Moreover, the samples who have additional ontology can acquire knowledge from others resource such as own experiments, books and Internet. The most important of methodology effectiveness of tutorial ontology was the samples that have additional ontology can discuss and explain domain knowledge to experts and communities. The samples who have ontology are able to describe the mechanisms of a complicated system. Aristomenis et.al (2006) presented training approach that could be appropriate valuable in education for sustainable development because it can support students

initially understand that ongoing global environmental issues are related and interrelated among themselves and to assist them deliberate the differing understandings of these issues before reaching a decision. Additionally, the provided training approach allows learners to learn, in a time-efficient and simple way, knowledge in the construction of environmental systems that perform as the foundation for the analysis of environmental impacts and the management of environmental resources. Thus, learners would be able to improve understand the complexity description of the problems that have directed to the unsustainable development currently, as well as be mindful of the fact that these interrelated and general problems need a new method based on different techniques of acting and thinking. Consequently, the training approach presented empowers the sustainable behavior of learners, improves their ability to manage sustainable development, and encourages them to go more in searching for answers in questions.

Although ontologies can be advantageous in numerous ways, this study emphasized the benefits of ontologies in supporting knowledge for non-science and technology educated farmers. The resulting knowledge scenario should relate the basic entities defined in the ontologies with text and images, which support enhanced understanding of the ontology construction. The adaptive organic rice farmers in Phrao District, Chiang Mai Province as knowledge workers could also use the additional social science ontologies to develop this work as a vocational tool to improve their competency and disseminate knowledge to people in rural areas in order to develop their community.

The most important role of tutorial ontology was to enable and to enhance knowledge sharing and reusing which the ontology closes knowledge gap among experts who are academic lecturers, practitioners, local experts, governance officers, business man and non-science and technology educated farmers. This study has focused on ontology creation by semantic annotation on experts' jargons with ontology using a CommonKADS methodology, which provides tools to support structuring knowledge. The effective social science ontology on organic rice knowledge between the organic rice farmers will solve the problem of knowledge loss and misunderstanding between different local areas. Non-science and technology educated farmers can learn from this domain knowledge structure by reasoning ontology to improve and develop their communities.

5.2 The measurement of learning process by semantic annotation technique on Bloom's Taxonomy vocabulary

The effective social science ontologies contain the conceptualization within the biology, chemistry, math and physic concepts and the relations between them. This study has developed ontology, enabled annotation using knowledge engineering with a perspective on provision of a knowledge scenario. In this research, ontologies provide a means for modeling of the relevant organic rice farming knowledge. The semantic annotation technique on Bloom's Taxonomy vocabulary measured learning process and cognitive level of learners in appropriate technology knowledge from sustainable development projects.

This study measured the effective additional ontology which a commonly-agreed understanding of expert's jargons (domain knowledge) that can be shared, reasoned, reused and operationalized across communities in learning process by semantic annotation technique on Bloom's Taxonomy vocabulary to assess learning process improvement of samples.

The vocational learning process was experimented with semantic annotation on Bloom's Taxonomy vocabulary framework to evaluate additional ontologies effectiveness and vocational life-long learning of case study. The learning process measurement of the organic rice farming knowledge by semantic annotation technique on Bloom's Taxonomy vocabulary has been proved the effectiveness of tutorial ontology that can improve learning process of samples.

The test at Q1, Q2, Q3, Q4 and Q5 scores of learning process measurement by semantic annotation on Bloom's Taxonomy vocabulary showed that additional ontologies could improve learning process behavior of samples as sample in experimental group. The measurement of learning process of both non-science and technology educated control and experimental sample groups used semantic annotation on Bloom's Taxonomy vocabulary as research innovative assessment to identify the cognitive level of each sample in both groups in learning process improvement. The answers and observation of all adaptive organic rice farmer samples were modeled using CommonKADS, then these domain knowledge models were manually semantic annotated with Bloom's

Taxonomy vocabulary together with scored evaluation. The all five adaptive farmer samples in an experimental group that were tutored additional ontologies are in analysis cognitive level and just three samples could extend to creating cognitive level of Bloom's Taxonomy. There were no samples in control group, which could reach to analysis, evaluating and creating cognitive level on Bloom's Taxonomy.

The average throughput of organic rice farming domain knowledge in learning process provided applying cognitive level of Bloom's Taxonomy was counted and validated in terms of applying domain knowledge, effective domain knowledge with their community and acquiring knowledge by themselves in control group and experimental group. The tutorial social science ontology effectiveness on organic rice farming knowledge was validated via a count of number of applying domain knowledge by semantic annotation using CommonKADS from both control and experimental groups effectively to measure the ontology effectiveness in learning process. The research results of ontology effectiveness in learning process improvement showed that the experimental group that was with ontology training could understand and apply knowledge from trainers better than the control group, which was without tutorial social science ontologies. This study concluded that the benefits of ontologies in supporting knowledge for non-science and technology educated farmers. The tutorial ontology effectiveness and cognitive level of samples were assessed using the measurement in learning process by semantic annotation technique on Bloom's Taxonomy vocabulary. The results defined in the ontologies effectiveness which improved learning process, supported and enhanced understanding the organic rice farmers in Phrao District, Chiang Mai Province as knowledge workers could also use the additional ontologies as a vocational learning tool to improve their competency and distribute domain knowledge to people in order to develop and solve the problem issue in their community. Moreover, the both sample groups were tested by writing their explanations on contingency plan for organic rice farming management to test the effectiveness of ontology, the training outcome, outcome stimulation and closed gap between experts and knowledge workers. There are six disasters for organic rice farming that were verified by experts. There are including chemical exploration, storm, flood, cold weather, drought, disease; pests and weeds. The result showed that all five samples in experimental group were in creating cognitive level. The five samples in control group

were in remember cognitive level and no samples in this control group could reach to analysis, evaluating and creating cognitive level. Non-science and technology educated farmers can learn from this domain knowledge structure by reasoning ontology to improve and develop their communities which are measured by semantic annotation technique on Bloom's Taxonomy vocabulary as innovative of this research which it provides tools to support structuring knowledge and identify cognitive level of learners in learning process. The measurement of learning process by semantic annotation on Bloom's Taxonomy vocabulary can prove that the additional ontologies could improve the learning process of non-science and technology educated farmers to life-long learning.

The unexpected findings were found in this research that are as following:

1. The rural community people of case study in this research interest, believe and prefer to apply domain knowledge from practitioner expert more academic expert. The samples can accessible easily to practitioner and the practitioner expert usually does the activities like them. The sample could understand the episodic scenario from the practitioner more than the academic expert.
2. Although the samples graduated in Bachelor degree, they didn't studied or graduated in science and agricultural subjects that they could be understanding, applying and reasoning the domain knowledge with their ontology at the equal average number of domain knowledge with the sample who graduated at elementary school. This finding has been found from both sample groups in this case study of this research.

The research problem has been solved by this knowledge transfer model using additional ontology to tutor non-science and technology educated farmers to understand and apply knowledge from experts. The learning process improvement has been measured by semantic annotation technique on Bloom's Taxonomy vocabulary. The research solution showed that tutorial social science ontologies as knowledge representation for transferring knowledge can close gap between academic lecturer, practitioner and local expert. The non-science and technology samples who have ontology can understand and apply domain knowledge to develop their work on organic rice farming. The appropriate technology knowledge from the sustainable development

projects would be increased transferring to rural community when using the tutorial ontology as a solution.

The learning process improvement of non-science and technology educated farmers could be measured by semantic annotation technique on Bloom's Taxonomy vocabulary. The measurement approach showed that the tutorial ontologies are effective in learning process improvement to life-long learning of non-science and technology samples who have additional ontologies.

5.3 Beneficiary

The appropriate technology knowledge transfer model by using tutorial ontology for non-science and technology to understand specification of conceptualization of experts can generalize to developing countries where most people who lacked of basic education. The appropriate technology in rural development can uses ontology to tutor basic concepts for learners before they participate in training course from experts. The Thai curriculum of lower secondary school (Mattayom 1-3) would be developed and modified by using ontology as a sequent in subjects such as agriculture subject. Moreover, the farmers who had ontology could be a smart farmer as leader in their community because they understand and apply appropriate technology knowledge to solve their problem issues in their community.

The real situation from the case study was shown that the additional ontology was useful for learners to apply and design experimental tasks for organic rice farming. Some farmer samples who had ontology set and arranged organic rice filed to try, test and apply the domain knowledge from experts in order to prove knowledge effectiveness.

This was additional ontology in appropriate technology for basic educated working class people to enhance their vocational life-long learning and learning process measurement by innovative semantic annotation technique on Bloom's Taxonomy vocabulary: a case study of organic rice farming in Thailand.

5.4 Research Limitation

This research has the limitation and this knowledge transfer model was able to utilize and apply in the rural communities in the developing countries. The appropriate technology knowledge utilization in the rural community was limited because the rural people in community have not enough money to support. The fertilization and material utilization for organic rice farming have to following the rule of Green Net organization. The accessibility of the information from both sample groups was difficulty because the samples have not much time to participate the research process reflecting to the limitation of data and information to analyze.

5.5 Academic contribution to KM, Novelty and Originality

This research used additional tutorial social science ontology model as knowledge representation to solve local issue problems associated with a lack of social scientific knowledge within the appropriate technology from sustainable development projects and knowledge transfer requirement from academic researches and appropriate technology knowledge for local community. The appropriate technology knowledge and academic research knowledge was selected, structured, captured, stored, and delivered. In keeping with the problem-solving philosophy of the sustainable development projects this knowledge can be expanded across Thailand and used to deliver knowledge beyond experts. Knowledge of the sustainable development projects and academic research will be analyzed, synthesized and structured using a reasoning model so that it can be used for the specification of conceptualization of a training course along with a detailed strategy knowledge script. The training course can store and reuse a substantial amount of appropriate technology and academic research knowledge using reasoning structure and social science ontologies as knowledge representation. This training course from experts will provide scientific knowledge of appropriate technology from sustainable development projects based on the King of Thailand's philosophy for rural community utilized from this knowledge in order to improve their skill, and solve local issue problems in their community, which will in turn allow them to develop their community and disseminate knowledge to people in local areas via form of learning process.

As a contribution to the field of knowledge management, this research will provide novelty and originality through its reasoning knowledge transfer model which was new, and can be followed by others when attempting to extract, structure, store and disseminate knowledge within geographically disperse and socially responsible projects. This contribution was reflected in publications within the knowledge management literature, which will seek to highlight the unique aspects of this methodology and showed its application to the Phrao District, Chiang Mai Province as a case study.

Traditionally, knowledge from appropriate technology and academic research has been utilized in a piecemeal way at local geographic scales. This has led to duplication in effort and the full potential of project knowledge not being realized. The novelty of this study proposed a new model of knowledge transferring, which was integrated with SECI model in order to effectively disseminate appropriate technology and research knowledge sustainability for case study, Phrao District, Chiang Mai, Thailand as shown in **Figure 5.1**.

"Socialization", is a social process of knowledge sharing experts' tacit knowledge. Interview approach was used to elicit tacit knowledge of experts. By this stage, all appropriate technology and researches, documents, reports about appropriate technology, were captured.

Externalization is an analysis and a synthesis of tacit knowledge from experts. Along with this process, knowledge is transformed from tacit into explicit knowledge, in terms of knowledge model and ontology by using knowledge engineering approach.

In stage of Socialization to Externalization, social network analysis will be used to qualify the chosen experts (academic researchers, practitioners, knowledge workers and local experts). The chosen experts would have knowledge of local requirements and use it for local issue problem solving related to appropriate technology and research knowledge.

Combination is the combining of tacit (experts) with explicit knowledge process and knowledge base of repositories, which captured from appropriate technology and

researches using knowledge engineering approach. Knowledge engineer analyzed and synthesized experts' knowledge into the knowledge model. The tacit expert knowledge, academic research publication as explicit knowledge and basic knowledge of rural community were combined and providing as easily understanding knowledge training course for the community.

Internalization, the appropriate technology knowledge and research in form of training course, episodic knowledge scenario and publication were effectively stored and shared via the training course and tutorial ontology for stakeholders of case study as knowledge users, who use this knowledge to improve their community.

In this knowledge transferring model, knowledge is transformed from a tacit expert knowledge to an explicit knowledge to learn and apply knowledge to solve their local communities' problem issue as best practice, then knowledge will be returned to the socialization process again. The learning process was measured by innovative semantic annotation technique on Bloom's Taxonomy vocabulary.

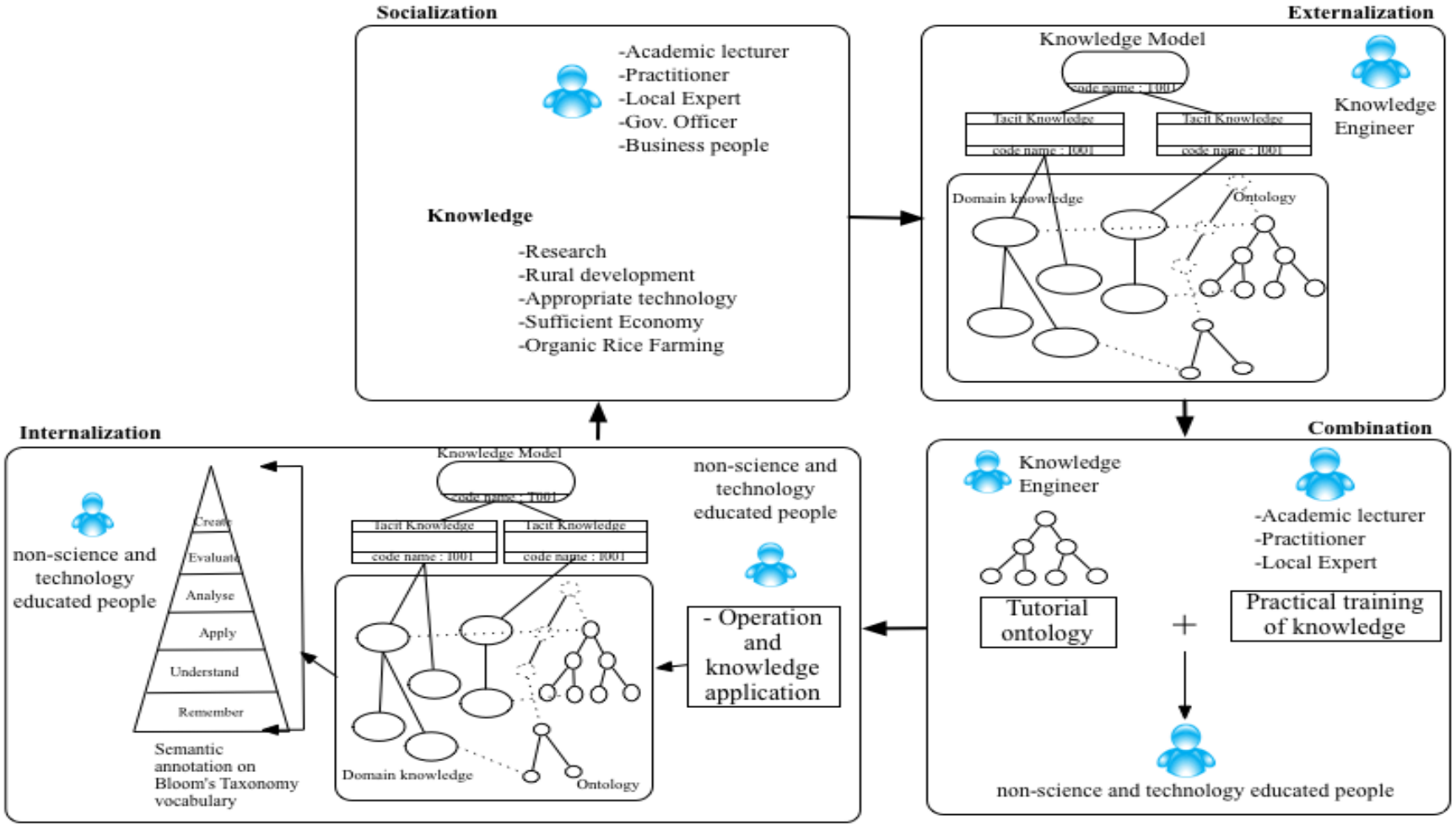

Figure 5.1 The new knowledge transferring model

5.6 The Future Research

Most rural people in Thailand where is a developing countries are lack of basic education in science and technology knowledge, this methodology could prove the idea and solution of tutorial ontology and measurement of learning process by semantic annotation on Bloom's Taxonomy vocabulary. Consequently, the other groups and other problem could be implemented by this research solution. This research methodology and results can be extended to further study in alternative idea to rural communities confronting with trouble in appropriate technology transfer to develop their communities.

The additional ontology for tutorial non-science and technology-educated farmers' implementation require applying on the other areas across Thailand. The methodology, idea and solution can be generalized to other developing countries where their populations are lack of basic education and the appropriate technology knowledge transfer unsuccessfully. Moreover, the idea and solution can be applied to knowledge transfer of academic research, higher education knowledge or knowledge from university for rural people to apply valuable knowledge to develop and solve their problem issues in their communities.

It can be concluded that this is innovative learning by additional ontology in appropriate technology for basic educated working class people to enhance their vocational life-long learning and learning process measurement by semantic annotation technique on Bloom's Taxonomy vocabulary: a case study of organic rice farming in Thailand. Significantly, this knowledge transfer model is suitable only in the rural community in developing countries.

The unexpected finding of the rural community people of case study in this research was that sample interests, believes and prefers to apply domain knowledge from practitioner expert more than academic expert. This unexpected finding would be analyzed to propose the idea and solution to solve this finding for further study.