Teaching Experiences, Pedagogies, Practices and Praxes on the Subject of Applied Geo-Information System Technology

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Abstract
This paper has used teaching experiences from 2012 to 2019-based pedagogies and praxes on the subject of applied geo-information system technology (AGST) for graduate students on the Master of Science Program in Applied Information and Communication Technology, Faculty of Sciences and Liberal Arts, Rajamangala University of Technology ISAN, Thailand. The main purposes were to share teaching experiences with comparison of before-after studies on geo-information project-based learning which was evaluated by a number of thesis or independent study (IS). This research used purposive sampling with 14 graduate students who studied AGST during 2012-2019. The research tool was a before-after teaching plan and assessment. Based on the use of this teaching methodology it was found that of the14 graduate students during 2012-2019, 12 graduate students or 86% were able to use geo-information project-based learning to undertake their theses or ISs while the remaining 2 graduate students or 14% only acquired the knowledge although they did not use it on their theses or ISs. On the contrary, before-learning geo-information project, an evaluation was performed and 5 graduate students (35.71%), who were interested in doing thesis or IS on geo-information scored a total average of 80.19 points while the remaining 9 graduate students (64.29%), who were not interested scored a total average of 48.50 points. As a conclusion of the above mentioned over the eight years of teaching experience, approach of the active learning has showed a better performance as compared to the passive learning for undertaking theses and ISs.

Keywords: Teaching Experience, Geo-information project-based learning, Graduate Student

Introduction

Applied geo-information system technology (AGST), is a subject for graduate students, which is part of the Master of Science Program in Applied Information and Communication Technology, Faculty of Sciences and Liberal Arts, Rajamangala University of Technology ISAN (RMUTI), Thailand. This subject is a part of Geography Education (GE) as a way to learn about Geospatial Technologies (GTs) and sophisticated software, etc. Consequently, lecturers and graduate students have to develop or improve and learn GTs. GE is related to the application of GTs and has a high commonality in twenty-first century education which is facing a tremendous impact and change with the advent of the Internet and Web GIS. In other words, GE-based GSTs have to face social networks enabled through the use of digital technologies such as mobile phones, the Internet etc. which may be called, "Digital Networks" (Khosrow-Pour, 2013) so GE should rethink its educational strategies within the digital networking arena. Furthermore, GE ideas related to the use and application are the process of geospatial practices (GPs) as the way to learn about GTs and by using GTs (Solari et al., 2015). GTs can be used to develop project-based learning pedagogies and help students to acquire spatial reasoning and spatial citizenship skills in the context of education for sustainable development (Gonzalez et al., 2019).

The main purposes were to share teaching experiences with comparison of before-after studies on geographic project-based learning which was evaluated by a number of theses or independent study (IS).

Methodology

The aim of AGST is to produce graduate students who will be able to learn and undertake their theses or ISs further. Therefore, this research used purposive sampling with 14 graduate students who studied AGST between 2012 and 2019. The research tool was a before-after teaching plan in geo-information project-based learning. The before-teaching plan (passive learning) was designed by the basic and theoretical learning of geo-information (such as Geographical Information System, GIS; Remote Sensing, RS; Global Position System, GPS, often referred to as, '3S') and an assessment of 14 graduate students from tests and questionnaires based on thesis or IS on application of geo-information. The after-teaching plan (active learning) was designed by geo-information project-based learning and assessment of 14 graduate students from a number of theses or IS. The before-after teaching in geo-information project-based learning was planned as follows:

1. The before-teaching plan (passive learning)

The before-teaching plan or passive learning was designed by the basic and theoretical learning of geo-information and was evaluated by tests and questionnaire on thesis or IS on application of geo-information. Details of the basic and theoretical learning of geo-information were determined as:

1.1 Concept knowledge as a foundation

Describing the role of GE-based GTs in this AGST subject in graduate students is not a simple task because they have varied background knowledge of geospatial information and its fundamentals. The AGST subject has been prepared by teaching the sequential topics: basic and theoretical approaches of geo-information including pre-and post-testing. Furthermore, the AGST teaching has used other geospatial teaching experiences such as those described by Ghaffari et al. (2018) and Moorman and Crichton (2018). Both research approaches were helpful in providing insights into the specific curriculum and pedagogical strategies that can help students overcome these challenges.

1.2 Geography and spatial thinking

Conceptualizing geospatial thinking can be considered as the first step forward in differentiating geography-unique spatial thinking from the spatial thinking practiced in other disciplines, such as medical sciences, engineering and architecture (Baker et al. 2015; Ishikawa 2013). An alternative opinion is that spatial thinking is not unlike other research-oriented approaches, it is merely different in terms of space (ESRI, 2003). Moreover, knowing where something is, how its location influences its characteristic, and how its location influences relationships with other phenomena are the foundations of geographic thinking. This mode of investigation asks graduate students to see the world, and all that is in it, in spatial terms. Consequently, graduate students who have had such course experiences, demonstrated a better understanding of geospatial patterns and transition, geospatial profiles and transition, geospatial associations, geospatial shapes and geospatial overlay. This is discussed by Verma and Estaville (2018). Furthermore, this AGST teaching methodology has used the approach of experiences of 'spatial thinking' from Collins (2018), Flynn (2018), Metoyer and Bednarz (2017).

2. The after-teaching plan (active learning)

In pedagogy and praxis, this assignment would be given to graduate students who have to select three or five varied case studies which use GT and present them to the lecturer before they undertake geo-information project-based learning. The lecturer would use the concept of geo-inquiry process to question them. The geo-inquiry process is referred to by Myles (2019), ESRI (2003) and National Geographic Education (2017) as including 5 stages: ask, collect, visualize, create and act. After the graduate students satisfactorily complete their initial presentation, they will be assigned to undertake the geo-information project-based learning. Graduate students' presentations are evaluated by the lecturer asking to see the world, and all that is in it, in spatial terms. Similarly, research methods also ask one to explore, analyse, and act upon the things one finds. The steps of geographic inquiry are shown in Figure 1.

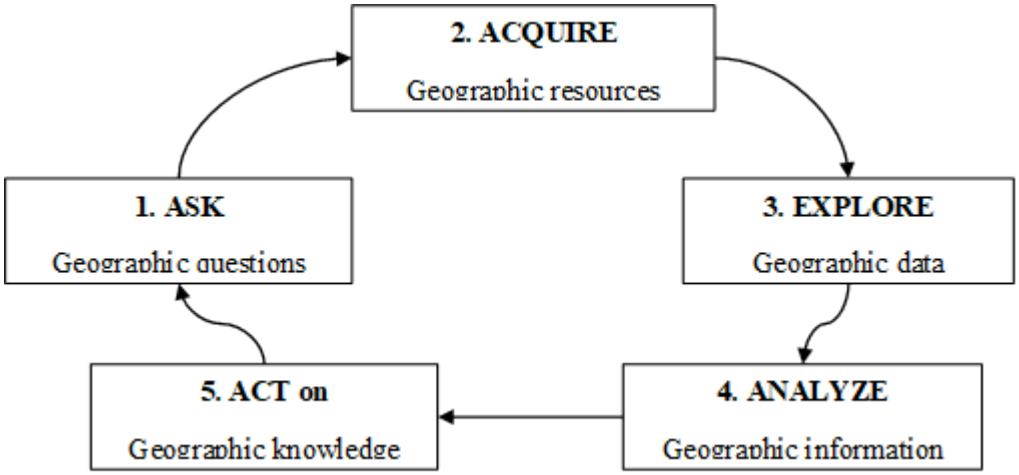

Figure 1: The steps of geographic inquiry (Modified from ESRI, 2003)

2.1 Ask geographic questions

Students are directed to think about a topic or place from the graduate students' case studies, and identify something interesting or significant about them. Then, the lecturer poses a question, e.g., 'Why do these case studies select this study area?' or 'Does it matter if that study area is moved to other areas?' By turning an interesting observation into a question, one can focus the exploration. Good geographic questions range from simple to deeper questions. Importantly, a good question should set up a good exploration.

2.2 Acquire geographic resources

This step is about acquiring geographic resources, help graduate students to consider at least aspects of the issue: geography, time and topic. Essentially, the lecturer should question them as follows:

- What is the geographic focus in each of the case studies? Defining the geographic focus helps students define the scale (global, regional, local) of their inquiries, and helps them define the extent (a city, a country, a continent, the globe) of their inquiries.
- What period of time does each case study need to collect the data? This question focuses on past events, requires historical rather than contemporary data.
- For any specific topic, what data does each case study require? This question helps students define their focus, and thus the less likely they are to get lost in piles of unrelated and unnecessary data.

2.3 Explore geographic data

Geographic data were explored using maps, tables, and charts. In particular, maps are valuable because they give graduate students a powerful view of patterns, or how things change over space. Maps also allow them to integrate different kinds of data from different sources – pictures (aerial photos, satellite images) and features (roads, rivers, borders) – in layer after layer. By integrating maps with tables, charts, and other representations, some patterns may begin to appear; patterns that might spur graduate students to refine their original questions, or to seek out one more set of data.

Such refinement at this stage is common and sensible. For example, when first exploring regional rainfall patterns, one might not have anticipated that one would need the locations of mountain ranges, but having this data might just make a difference.

2.4 Analyze geographic information

The lecturer should ask the students to highlight key comparisons, or expose patterns that had lain hidden during initial explorations. This leads to the following stages: focus on relationships between layers of information; make inferences about the distribution of things; calculate the degree to which the presence of something affects the presence or character of something else. The next step is the deeper questions – 'Why is it there?' and 'so what'

2.5 Act upon geographic knowledge

Graduate students have used GIS or paper-pencil techniques to integrate data from multiple sources and to weave them into knowledge that enables them to act. Being geographically wise means acting on the geographic knowledge that they have gained. Understanding the widespread linkages and helping others see how their lives are affected means 'thinking globally, acting locally.' Acting on geographic knowledge means being willing to answer the question, 'Now what?'

Results

Based on teaching experience over the period 2012-2019, this teaching methodology has continually applied the before-after approaches of pedagogy and praxis to AGST subject for RMUTI graduate students. Under this before-teaching and assessment approach in geo-information project (Table 1), it was found that out of the 14 RMUTI graduate students, during 2012-2019, 5 graduate students (35.71%) who were interested in doing thesis or IS on geo-information technology with level 8 had a total average score of 80.19 points while 9 graduate students (64.29%), were not interested with level 4 had an average score of 48.50 points. On the contrary, the after-teaching and assessment approach in geo-information project (Table 2 and Table 3), found that graduates were able to use geo-information project-based learning to undertake their theses or ISs (12 graduate students or 86%) got a total average score of 91.78 points, while the remaining 2 graduate students or 14% only acquired the knowledge, although they did not use it in their thesis or IS, had a total average score of 83.44 points. Interestingly, the 14 graduate students, interested in doing a thesis or not, got into learning geo-information project, had more geo-information skills (which can be seen from the sum of average scores of the two groups in Table 2). Importantly, these theses or ISs and published papers exhibited a development of graduates' knowledge, skills, and practice of geospatial thinking in a variety of educational contexts. Each of the IS or theses or the published papers addresses an aspect of the research gap that deserves timely attention in the field, focusing on curriculum design, pedagogical approaches, exemplary resources or tools, and strategies to move forward for the promotion of geospatial teaching and learning. Continued research efforts to accumulate knowledge about curriculum, instruction, and assessment, as well as teachers' professional development that can help students become 21st-century citizens equipped with geospatial literacy is to be encouraged. Further research is

recommended on the theories that can help explain and guide the development of graduate students' geospatial knowledge and skills in both formal and informal education, and effective ways to incorporate geospatial thinking into teacher preparation programs. Furthermore, over the eight years of the study, lecturers have faced advances in geospatial technology including cloud-based GT applications and increasingly sophisticated software, etc. Consequently, lecturers and graduate students have to develop or improve and learn how to use advanced GT for research, these and also IS too.

Table 1 Teaching and assessment of the before-learning in geo-information project

Teaching topics	Average score-based on five graduate students	Average score-based on nine graduate students
1. Concept knowledge		
1.1 GIS	14.10	10.11
1.2 RS	13.70	9.15
1.3 GPS	10.41	9.12
2. Geography and spatial thinking		
2.1 Knowing where something is	12.16	5.56
2.2 How its location influences its characteristic	11.11	5.71
2.3 How its location influences relationships with other phenomena	10.71	4.85
3. Interesting for doing thesis or IS or not and why (Understanding level from 1 (the lowest) to 10 (the highest))	8.00	4.00
Total average score (of 100- full score)	80.19	48.50

Table 2 Teaching and assessment of the after-learning in geo-information proje**ct**

Teaching and asking topics	Average score-based on twelve graduate students	Average score-based on two graduate students
1. Asking basic geographic questions	19.21	18.06
2. Acquiring geographic resources	18.01	17.03
3. Exploring-geographic data	18.22	17.11
4. Analyzing-geographic information	17.78	15.23
5. Acting on geographic knowledge	18.56	16.01
Total average score (of 100- full score)	91.78	83.44

Table 3 Theses or ISs and published papers for graduate students during 2012-2019

No.	ISs/Theses Name (Year)	Graduate student	Published paper
1	Geo-Infomatics System of The Health Survellance for Patient's Home Visiting in Non Thai District, Nakhon Ratchasima province (2012)	Ms.Pitiwan Faikhoksung	Faikhoksung, P., Janatakat, Y. and Kranka, S. (2013). Geoinformatics for Health Surveillance of Nonthai Hospital: A Case Study of Nonthai District Nakhon Ratchasima Province, Thailand. The 33rd Asian Conference on Remote Sensing, Japan: Curran Association, Inc., 518-523.
2	Development of Information System for Cooperative Education in Faculty of Humanities and Social Sciences, Nakhon Ratchasima Rajabhat Univerisity (2012)	Ms.Marisa Kaekangplu	Kaekangplu, M. and Jantakat, Y. (2013). Development of Information System for Cooperative Education in Faculty of Humanities and Social Sciences, Nakhon Ratchasima Rajabhat Univerisity. 2013. 2nd Phayao Research Conference on January 12-13, 2013 at Phayao University, Phayao province.
3	Model of Public Park Areas' Expansion in Nakhon Ratchasima City Municipality (2013)	Mr.Teerawat Siriwimonpong	Siriwimonpong, T., Jantakat, Y. and Kranka, S. (2013). BIOCLIM-GIS for Studying Distribution of Public Parks in Nakhonratchasima City Municipality. (2013). The 1st Geoinformatics Conference for Graduate Students and Young Researchers (GI-GRAD2013) on June 20-21, 2013 at Suranaree University of Technology, Thailand.

Table 3 Cont'd

No.	ISs/Theses Name (Year)	Graduate student	Published paper
4	Monitoring System for Building Construction Permission of Civil Engineering Office Nakhon Ratchasima City Municipality (2013)	Mr.Tossaporn Desutti	Desutti , T., Jantakat, Y. and Kranka, S. (2013). Monitoring System for Building Construction Permission of Civil Engineering Office Nakhon Ratchasima City Municipality. The 1st Geoinformatics Conference for Graduate Students and Young Researchers (GI-GRAD2013) on June 20-21, 2013 at Suranaree University of Technology, Thailand.
5	Modelling of Ordered Weight Averaging and GIS for Road Sections' Risk and Factor Ranking on Highways (2013)	Ms.Wammai Amornkanjanawat	Amornkanjanawat, W., Jantakat, Y. and Kranka, S. (2013). System Development of OWA-GIS on Web for Finding Road Sections' Risk. The 1st Geoinformatics Conference for Graduate Students and Young Researchers (GI-GRAD2013) on June 20-21, 2013 at Suranaree University of Technology, Thailand.
6	GIS Web Application for Breast Cancer Data Service Ranking of Fort Suranaree Hospital (2013)	Ms.Praewpailin Hormklin	Hormklin, P., Jantakat, Y. and Kranka, S. (2013). Spatial Modeling of Communities in 10 periods (from 2002-2012) for Risk of Breast Cancer Occurrence using The Geographically Weighted Regression (GWR). The 1st Geoinformatics Conference for Graduate Students and Young Researchers (GI-GRAD2013) on June 20-21, 2013 at Suranaree University of Technology, Thailand.
7	Application of Geographical Information System and Tree Diagram Concept for Supporting Spatial Data of Telecomunication in Nakhon Ratchasima Province (2014)	Mr.Pratchayasan Konin	Pratchayasan Konin, Yaowaret Jantakat and Sanun Kranka. (2015). Geo-Informatics Technology Application for Telecommunication. The 7th Conference of Electrical Engineering Network of Rajamangala University of Technology ISAN (EENET 2015).

Table 3 Cont'd

No.	ISs/Theses Name (Year)	Graduate student	Published paper
8	Geo-Infomatics Application for Taxation Ranking of Households in Moo No.3, Neunkho Municipalities in Klaeng Rayong Province (2016)	Ms.Wannita Navanin	Navanin, W. and Jantakat, Y. (2015). Geo-Informatics Application for Households' Ranking To Income Taxation, Moo3 of Neunkho Tambon Municipality. The 7th Rajamangala University of Technology National Conference (7th RMUTNC) at Rajamangala University of Technology ISAN, Nakhon Ratchasima province.
9	Applied Geo-informatics Technology for Estimating Carbon Credit in Urban Green Area of Nakhonratchasima City Municipality (2016)	Ms.Jiruttigarn Supgetwong	Supgetwong, J. and Jantakat, Y. (2016). Applied Geo-Informatics Technology for Estimating Carbon Credit in Urban Public Park: Interpretation of Land Use and Urban Public Park. 7th Engineering, Science, Technology and Architecture Conference on July 25-26, 2016 at Rajamangala University of Technology ISAN.
10	Application of Geographical Information System for Risk-Spot Assessment of Agriculture and Agricultural Cooperatives Bank's Business Loan, Huai Rat Branch, Buriram Province (2016)	Mr.Kisda Thuaprakhon	Thuaprakhon , K. and Jantakat, y. (2016). Application of Geographical Information System for Risk-Spot Finding in Case of Business Loan of Bank for Agricultural and Agricultural Cooperatives (BAAC) at Huai Rat District of Buiram Province. 7th Engineering, Science, Technology and Architecture Conference on July 25-26, 2016 at Rajamangala University of Technology ISAN.
11	Geoinformatics for Ranking Accessibility of Base Stations' Mobile Phone Signal in Muang District of Nakhon Ratchasima Province (2016)	Mr.Rat Sorathitikran	Sorathitikran, R., Jantakat, Y. and Kranka, S. (2016). Geo-Informatics Application for Communities' Access Ranking on Mobile Phone Network. 12th Graduate Research Conference on May 14, 2016 at Phranakhon Rajabhat University.
12	Geographic Information System for Supporting Internship Management (2016)	Ms.Supattra Rengprapan	Rengprapan, S., Jantakat, Y. and Rabiabpho, T. (2016). Geo-Informatics Technology for Supporting Internship via Web. 7th Engineering, Science, Technology and Architecture Conference on July 25-26, 2016 at Rajamangala University of Technology ISAN.

Table 3 Cont'd

No.	ISs/Theses Name (Year)	Graduate student	Published paper
13	Potential Assessment of Maize Cultivation based on AHP in Muang District of Nakhon Ratchasima Province (2016)	Ms.Uthaiwan Julramusik	Julramusik, U. and Jantakat, Y. (2016). Geo-Informatics Technology Application for Suitable Rating of Exiting Maize Area in Muang District of Nakhon Ratchasima Province. 7th Engineering, Science, Technology and Architecture Conference on July 25-26, 2016 at Rajamangala University of Technology ISAN.
14	Web Application for Medical and Wellness Tourism in Affluent Group Case Study Wang Nam Khiao District and Pak Chong District, Nakhon Ratchasima Province (2018)	Ms.Ruetaichanok Apainiphat	- Apainiphat, R. and Jantakat, Y. (2017). Studying of Tourists' Behavior for Group of Affluent and Medical and Wellness Tourism in Nakhon Ratchasima Province. The 11th National Graduate Conference on November 23-24, 2019 at Kasetsart University. - Apainiphat, R. and Jantakat, Y. 2018. Information System for Medical and wellness tourism in Affluent Group case study Wang Nam Khiao and Pak Chong district, Nakhon Ratchasima Province. The 3rd National Conference (RTUNC 2018) on May 25, 2018 at Ubonratchathani University, Thailand.

Conclusion

Using this teaching methodology it was found that 14 graduate students during 2012-2019 were able to use geo-information project-based learning to undertake their theses and ISs (12 graduate students or 86%), while the remaining 2 graduate students or 14% only acquired the knowledge although they did not use it in their theses or IS. On the contrary, before-learning geo-information project, an evaluation was performed and 5 graduate students (35.71%), who were interested in doing thesis or IS on geo-information technology scored a total average of 80.19 points while the remaining 9 graduate students (64.29%), who were not interested scored a total average of 48.50 points. In addition, the collection of 14 ISs or theses and 15 published papers illustrates an increased attention to and keen interest in the practice of geospatial teaching and learning in geography. The AGST teaching encourages continued research efforts to accumulate knowledge about curriculum, instruction, and assessment, as well as teachers' professional development that can help students become 21st century citizens equipped with geospatial literacy.

Further research is recommended on the theories that can help explain and guide the development of students' geospatial knowledge and skills in both formal and informal education, and effective ways to incorporate geospatial thinking into teacher preparation programs. Furthermore, over the eight years of the study, lecturers have faced advances in geospatial technology (GT) including cloud-based GT applications

and increasingly sophisticated software, etc. Consequently, lecturers and graduate students have to develop or improve and learn how to use advanced GT for research, these and also IS too.

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