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Using social media to promote pre-service science teachers' practices of socio-scientific issue (SSI) -
based teaching

Using social media to promote pre-service science teachers' practices of socio-scientific issue (SSI) - based teaching

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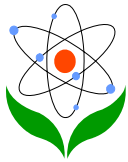**The University of Missouri, Columbia, USA**
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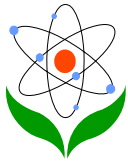based teaching

Abstract

This paper addresses using social media to promote pre-service science teachers' practices of Socio-Scientific Issue (SSI) based teaching in a science classroom setting. We designed our research in two phases. The first phase examined pre-service science teachers' perceptions about using social media to promote their SSI-based teaching. The participants of this phase were 37 pre-service science teachers of universities at Bangkok who were going to complete practice teaching during a field experience course in the 2014 academic year. We collected data using a questionnaire and analyzed the results using descriptive statistics and content analysis. For the second phase, we mentored two students as they learned to use SSI-based teaching. These two individuals were our case studies for this paper. Throughout the mentoring processes, we collected data from their posts on social media, and then analyzed it using content analysis. The findings indicated that most pre-service science teachers perceived that communication through social media provided opportunities for posing questions and requesting clarification with the goal of developing their SSI-based teaching. Moreover, we found five strategies that were effective in terms of promoting pre-serviced science teachers' implementations of SSI-based teaching. These strategies included using various social media as a channel for giving feedback; providing empirical examples for pre-service science teachers' holistic views of SSI-based teaching; providing a friendly atmosphere to encourage reflection in order to identify and address challenges associated with SSI-based teaching; motivating the pre-service teachers to collaborate with a cooperative teacher or mentor about SSI-based teaching; and continually following up on their progress in SSI-based teaching. We considered these findings in terms of further online mentoring program design.

Keywords: Pre-service science teachers, Socio-scientific issue-based teaching, Social media, Facebook, and Line
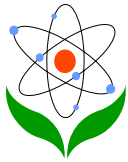
Introduction

As science and technology rapidly advance around the world, social dilemmas arise that are linked to the growth of both science and technology. Socio-scientific issues (SSIs) form a link between relevant social issues and science and, as a result, have become important topics in science education and achieving scientific literacy

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(Kolsto, 2001). Currently, Thailand is experiencing rapid scientific and technological change in response to accelerating economic development. As a result, several dilemmas have arisen. For example, the proposed construction of a new dam within Thailand's Mae Wong National Park has resulted in a SSI. The proposed government project will ensure that water volume will be adequate for local communities. However, the dam will eliminate approximately 17.6 square kilometers of low-lying forest within the national park and result in a loss of habitat for many animals including Thailand's tigers. Conservationists argue that without a proper study of the potential environmental impact of the dam, Thailand may lose one of its most abundant forest regions (Vipoosanapat, 2014). Another example of a socio-scientific issue involves a conflict between wild elephants and farmers. As farmers clear forest, build homes, and plant crops, wild elephants often leave the forest and forage for food within the farmers' fields. The plentiful food supply is very attractive to the elephants during periods of drought or food shortages within deeply forested regions (Wipatayotin, 2015). As elephants leave the forest for cultivated food sources, conflicts between the elephants and humans are becoming more prevalent, resulting in elephant attacks on tourists in the nearby Khao Yai National Park. The common dilemma posed by each of the issues is a conflict between human needs and the conservation of Thai resources. Consequently, a lack of understanding of the interaction between the needs of society and science may lead to feelings of fear, anger, and distrust towards the scientific community (Hodson, 2008).

Therefore, SSIs related to the conflict between economic development in Thailand and the preservation of the nation's natural beauty and wildlife underscore the importance of ensuring that school science provides Thai youth with the knowledge, skills, and values necessary to find acceptable solutions. Building a link between SSI curricula and science content learning is critical if students are to use their understanding of science to contribute to public debate and make informed and balanced decisions about SSIs that impact their lives (Sadler *et al*., 2007). In classroom settings, the Thai educational system places too much emphasis on technical knowledge (Pillay, 2002). Current educational practices are not connecting scientific knowledge to daily life (Ngamkeeree, 2006). To cope with this problem, the content of educational level in the Thai National Education Act B.E. 2542 (1999) and Amendments (Second National Education Act B.E. 2545 (2002) emphasizes:

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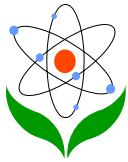based teaching

- Knowledge about the relationship between oneself and society,
- Knowledge of science, management and conservation, and
- Utilization of natural resources to ensure that the environment is balanced and sustainable (Office of the National Education Commission (ONEC), 2003).

The teacher is an important vehicle for effective education reform that promotes SSI-based instruction (Jurawatanaton, 2003). The quality of teachers and teacher education has also been a major concern of every Thai government from past to present. As reflected in Chapter 7 of the National Education Act (Sections 52-57), professional development is identified as a key component of educational reform and affects all teachers in every field including science (ONEC, 2003).

The university education faculty plays an important role in providing effective training for pre-service teachers during teaching practice in the classroom context. I, the first researcher, have been working as the research advisor in the Faculty of Education of the University in Bangkok for three years. I do not have significant experience as an education research advisor since I have been in the field of education only since I graduated from the Faculty of Science. My Ph.D. is in science education and my thesis was focused on teaching science based on the Science, Technology, Society, and Environment (STSE) approach. Before this time, I had never explored SSI-based instruction, but as an assistant professor, I learned to mentor graduate students who used SSI-based teaching. I learned from direct experience the mentoring strategies that were most effective for me, but I still wondered whether I was effective as a research advisor in the field of SSI-based teaching.

Every year, I was assigned both undergraduate and graduate research advisees. The advisees were interested in SSI-based instruction. This year, I was assigned two new advisees who were awarded scholarships from the Thai government to study in a two-year Master of Science Education Program. This program is under the management of the Project for the Promotion of Science and Mathematics Talented Teachers (PSMT), a Thai government agency concerned with the development of national science and mathematics curricula, sponsorship of science education, and the promotion of science in general. The main objective of this project is to produce highly qualified science teachers for teaching gifted students in Enrichment Science Classrooms within Thai secondary schools. Before beginning the Master of Science Education Program, the students had completed a bachelor degree in science, but

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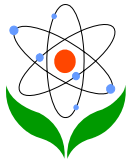
neither had prior experience with science teaching. I understand their background because I too was a scholar from the PSMT project prior to completing my Ph.D.

William and Nancy (pseudonyms) were to be my new advisees for the 2014-15 academic year. Both completed coursework for the first year of the program and were starting the practicum stage during which they were expected to complete an action research project as the thesis for the completion of the degree. Neither William nor Nancy were familiar with SSI-based teaching, nor were they interested in implementing science instruction focused on controversial issues. Such hesitancy is a common complaint; Pedretti *et al.* (2007) found that in the early years of teaching, many teachers were reluctant to incorporate controversial issues into science instruction.

I discovered that many pre-service science teachers use social media to communicate with one another. Bangkokbiznews (2014) indicated that the Thai people have more than 28 million Facebook accounts, and Twitter and has experienced a growth of 350%. Social media is not only used as a communication channel but also as an educational tool for sharing ideas that lead to the construction of knowledge (Schlenkrich & Sewry, 2012). For higher education, Zanamwe, Rupere, & Kufandirimbwa (2013) found that 124 university students from five institutions of higher learning in Zimbabwe used social media technologies such as Facebook and Myspace for academic purposes and more specifically for collaboration, Social media can be utilized as a tool to encourage students to engage with each other and to share their ideas and creativity (Wisconsin Center for Education Research (WCER), 2011). Therefore, I decided to explore using social media as a means to network with my advisees, William and Nancy, as they worked to successfully implement SSI-based instruction into their classrooms.

Research questions

We had two research questions for our study: 1) What do pre-service science teachers perceive about professional development for SSI-based teaching and using social media as a tool for promoting their SSI-based teaching? And 2) What are the effective strategies for mentors using social media to enhance advisees' implementation of SSI-based teaching?

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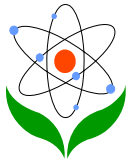
Literature review

1. Teacher Knowledge

A teacher's prior knowledge and beliefs are based on experiences as students of science within K-12 education and the university (Dana & Tippins, 1998). Therefore, teacher education, for both pre-service and in-service teachers, is expected to develop their knowledge and belief about new classroom practices (Bell, 1998). Magnusson, Krajcik & Borko (1999) proposed five domains of teachers' pedagogical content knowledge: an orientation toward teaching science, knowledge of science curriculum, knowledge of students' understanding of science, knowledge of instructional strategies, and knowledge of assessment in science. These aspects of teacher knowledge act as a mirror of what they know, what they think, and how they act in the classroom (Borko & Putnam, 1996). SSI-rich instructional contexts may well provide a productive context that promotes integration of knowledge structures including pedagogical content knowledge (Zeidler *et al*., 2005).

However, in SSI-based teaching, many factors affect pre-service science teachers' understanding of SSI-based teaching. Relationships, personal experiences, and societal discourses have all been shown to be important factors affecting students' thinking about SSI (Brotman, Mensah, & Lesko, 2010; Kolstø, 2006). Similarly, Sadler (2004) noted that personal experience, values, and beliefs play integral roles for students' learning about SSI. Due to limited knowledge of and experience with SSI, pre-service science teachers may design units that are focused content that they felt familiar with (Forbes & Davis, 2008). Nuangchalerm (2009) indicated that if pre-service science teachers understand the nature of science in the context of SSI-based teaching, it will help them to understand that one strength of science lies in its subjectivity.

2. Teacher Practices

Teaching is a very complex process. The teachers may have knowledge of strategies and teaching methods but may not understand how to apply these methods and strategies to specific situations occurring in everyday teaching experiences (Korthagen & Kessels, 1999). Consequently, students' competencies will not improve unless teachers' teaching practices improve (Loucks-Horsley et al., 2003). These teaching practices are influenced by educational backgrounds

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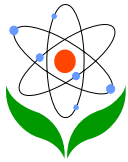
(Thomas & Pedersen, 2003) and many types of teacher knowledge (Even & Tirosh, 1995), and teaching experience improves the understanding of teaching (Guskey, 2002). Therefore, it is important to provide pre-service teachers with meaningful experiences of science teaching and learning. Teaching practice is one of the indispensable aspects of teacher preparation programs because it provides pre-service teachers with opportunities to practice teaching and develop a greater understanding of teaching and learning (Poster, 1996). Learning to teach does not only occur during university-based courses, but it also takes place during field experiences (Geddis & Roberts, 1996 cited in Geddis & Wood, 1997). For SSI-based teaching, there are some factors that have an effect on science teaching practice. Forbes & Davis (2008) found that pre-service science teachers might shy away from discussing the broader issues that require integration of topics with which they were not familiar.

3. Teacher Preparation

In science teacher education, a pre-service science teacher is considered an adult learner, and this actively influences their views of teaching and learning science (Northfield, 1998). Pre-service teachers are also required to have active involvement with knowledgeable people, such as university supervisors and cooperating teachers. We can view mentors and supervisors as facilitators and scaffolders (Bell, 1993) who support pre-service teachers' learning.

For successful development of pre-service science teachers, many educators suggest that professional development programs should relate to individual needs (Darling-Hammond & Sykes, 1999), have sufficient time and on-going professional support (Radford, 1998), and provide necessary resources (Loucks-Horsley *et al*., 2003). It takes time and persistence for knowledge and belief to change (Loucks-Horseley *et al*., 2003). This changing process can occur when pre-service teachers recognize a need, make plans to improve, implement improvements, and allow time to evaluate the effectiveness of the new practices (Boling & Martin, 2005). Loucks-Horsley *et al.* (2003) proposed multiple strategies focused improving teaching, such as reflection on experiences in the classroom and evaluation of students' learning and these strategies can include action research, mentoring, study groups, lesson study, case discussions, and examining student work.
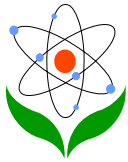
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4. Mentoring with social media

Mentoring is a professional development strategy that provides long-term, ongoing, professional learning. Mentoring can occur between a teacher new to a field and an experienced teacher taking on a new role or new teaching approach. An effective mentor serves as coach, content specialist, guide, facilitator, advocate, collaborator, and resource provider. The primary purpose of mentoring is to provide support for the new teachers, so mentoring provides support for the new teachers as they become more deliberate about effective teaching, learning, and assessing (Loucks-Horsley *et al.*, 2003). However, most Thai pre-service teachers cannot link theory to practice in field settings, and mentor teachers often provide little instructional support in these areas (Faikhamta, Coll, & Roadrangka, 2009). Therefore, technology for professional development can be considered as communication and delivery to support and expand on in-person professional development or provide distance learning with or without facilitation. The use of technology for profession development can increase teachers' science content knowledge, deepen understanding of student thinking and learning, and enhance the teachers' use of varied teaching strategies. There are many technologies for professional development such as the Internet, e-mail, real-time electronic conversation, or video conferencing. These technologies are now used instead of face-to-face interactions, and to provide follow-up support after in-person learning events (Loucks-Horsley *et al.*, 2003).

A social network is an interactive platform that allows people to create, share, and exchange information or ideas. There are many kinds of social media such as Facebook, Myspace, hi5 , video-sharing Sites, YouTube, Micro Blog, Twitter, and so on (Cheung, Chiu & Lee, 2010). Knouse (2001) has suggested that the Internet provides several unique advantages over traditional one-on-one mentoring with its immediate access to tremendous amounts of information. In addition, many research reports which indicate that using social media can promote students' learning (Churchill, 2009; Goldfarb *et al*., 2011). However, there is still a question about using social media to mentor pre-service science teachers' teaching according to SSI-based teaching.
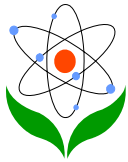
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Methodology

Context of Study

The two-year master's degree in science education program is under the management of the Project for the Promotion of Science and Mathematics Talented Teachers (PSMT), which is supported by IPST in order to produce high quality science teachers for teaching in Enrichment Science Classroom of secondary school. In this program, pre-service science teachers take courses not only about teaching methods but also about research before doing action research in the classroom context. The curriculum of the master's program in Science Education consists of 47 credits.

During the master's program, the pre-service teachers are required to study coursework for three semesters and then participate in teaching practice for two semesters. These pre-service teachers attended educational courses such as Research Methods in Education, Foundations of Education for Science Teachers, Science Curriculum Development, Development of Teaching and Learning (Chemistry or Biology or Physics), Assessment in Science Education, Psychology of Learning and Teaching, Language and Culture for Science Teacher, Construction and Utilization of Science Instructional Media and Innovation, and Seminar. Some courses relate to SSI-based teaching such as the Seminar where students has to present a topic that interests them, and some pre-service science teachers have presented on SSI-based teaching. In the Development of Teaching and Learning course, they learned SSI-based teaching in the classroom as only a strategy for teaching. Typically, teaching practice is one of the indispensable parts of teacher preparation programs, which gives pre-service teachers opportunities to practice teaching, and develop their understanding about teaching and learning (Poster, 1996). Therefore, in the fourth semester, which is focused of this study, the pre-service science teachers have study field experiences and do classroom research.

Before the field experience, the pre-service teachers attend an orientation program to gain information about schools to help them know what they should do in schools. To prepare themselves for teaching and be familiar with school students and teachers, the pre-service teachers observe classroom teaching and learning one week prior to their teaching practice. Cooperating teachers and university

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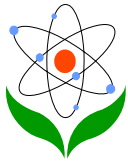
supervisors support the students and track their progress while giving feedback on the strengths and weaknesses of their teaching. Typically, the pre-service science teachers who take these courses spend four days a week in a local school and practice teaching for 8-12 hours per week. Pre-service science teachers who were interested in SSI-based teaching could practice it in the real science classroom context.

Research Participants

For the first phase of this study, the participants were 37 pre-service science teachers who were studying at a teacher education institution that has a commitment to generating and developing pre-service science teachers of high quality. These participants received scholarships from the Thai government to study in the two-year program of master's degree in Science education. Twelve of the participants were male and twenty-seven of them were female. The range of their age was 23-34 years old. Fifteen of them were studying chemistry education, thirteen of them were studying physics education, and eleven of them were studying biology education. Prior to this master's program, they had earned a bachelor's degree in science, majoring in chemistry, biology, or physics and had no teaching experience.

For the second phase of this study, the participants were two pre-service science teachers who had become our subjects because they met three criteria: (1) they volunteered to be research participants; (2) they were interested in SSI-based teaching; and (3) they identified issues in the classroom related to SSI-based teaching. William and Nancy, their pseudonyms, were selected to examine the influence of classroom action research on understandings and practices of SSI-based teaching and students' learning outcomes resulting from SSIs-based teaching. We assigned the pseudonyms William and Nancy for ethical reasons.

William was twenty-six-years old, and his GPA was 3.93 when the study began. He did not have any experience in SSI-based teaching. His inspiration for implementing SSI-based instruction in his action research resulted from his experience of students rarely sharing their ideas or opinions in the classroom. When the students discussed SSI, they used emotional reasons more than scientific reasons to support their ideas. He thought that he had to promote his students' arguments by using SSI-based teaching. Before his teaching practice in the school, he worried whether SSI-based teaching would be appropriate for students.

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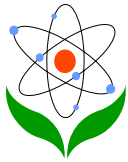
Typically, his students were used to learning with lecture-based instruction coupled with tutoring in preparation for the national test.

The second case study was Nancy. She was twenty-three years old, and her GPA was 3.86. She did not have any experience with SSI-based teaching. She described her students as passive and hardly involved in higher practice skills such as argumentation, reasoning and decision making. They always kept quiet during discussion. Therefore, she thought that SSI-based teaching might promoting her students' higher practice skills. Before her teaching practice in the school, she was not confident teaching and needed more advice.

Data Collection

For the first phase of this study, I wanted to elicit pre-service science teachers' perspectives about professional development in SSI-based teaching and using social media as a tool for promoting their SSI-based teaching. I collected data using a questionnaire at the end of the second semester of the 2013 academic year before their practicum in the first semester of the 2014 academic year. The questionnaire was framed in two parts and included demographic questions and individual perspectives on SSI-based teaching. In the section on demographic information, there were five open-ended questions related to gender, age, major fields, grade point average (GPA), and SSI-based teaching experience. In the section of perspectives of SSI-based teaching, there were four open-ended questions. These questions were about the need for professional development for SSI-based teaching, the strategies for professional development about SSI-based teaching, using mentoring as a professional development strategy for SSI-based teaching, and using social media as a professional development strategy for SSI-based teaching (Appendix).

For the second phase of this study, we used an action research cycle composed of plan, act, observe, and reflect (Kemmis, 1990). This cycle was an ongoing process for me as a self-investigating practitioner, and I logically and systematically examined what I should use as a research adviser for our two cases. During this time I was a visiting scholar in the University of Missouri and studying under a well-known expert in SSI and SSI research. For this planning step, the decision was made to use social media such as e-mail, Facebook, and the Line cell phone application as communication tools to provide advice about lesson planning in SSI-based teaching. Since pre-service science teachers are young people who are

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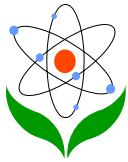based teaching

very comfortable with social media and see social media as a natural form of communication, they would be comfortable communicating with us as their mentors, as well as their cooperative teacher and their peers about their teaching experiences.

When I used these social media platforms, I identified the problems that I found while mentoring William and Nancy within social media and developed an action plan concerning strategies that could solve these problems. I also shared action plans specifically designed to support both Nancy and William as well as my other mentees. The action plans consisted of effective strategies for implementing SSI in the classroom. In this step, I collected data from our conversations recorded on social media such as Facebook message or Line message. I also observed and videotaped their teaching practice and reviewed the class documentation (e.g., weekly journal entries, course outlines, lesson plans, and worksheets, etc.) that William and Nancy posted on social media. Additionally, I used an informal interview via social media to gather data from them with the aim of eliciting answers on the topics that are not clear or when I wanted more detail about SSI-based teaching. I asked them for their permission to tape record the interview, and each interview took approximately 20 to 30 minutes. For the reflection step, co-author and I considered data that I gathered from William and Nancy about whether these strategies affected their changes based on SSI-based teaching.

Data Analysis

We analyzed data about pre-service science teachers' perception about using social media as a tool for promoting their SSI-based teaching both in quantitative and qualitative terms. Quantitative data analysis involved using descriptive statistics to identify which categories were most commonly answered in the questionnaires. For qualitative data analysis, the answers in the questionnaire were analyzed through content analysis. We started this analysis by reading raw data to interpret and construct categories that would capture relevant characteristics of the documents' contents. My co-author validated the coding. In the second phase, we analyzed all collected data from William and Nancy by qualitative content analysis. We started analyzing data by reading their posting on social media and then interpreted and constructed categories to capture the relevant characteristics of the postings' contents. We open-coded data looking for emerging themes linked to the research questions about how mentors can use social media for enhancing the advisees' implementation of SSI-based teaching.

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Research Findings

We will present the findings from the data analysis according to the two research questions: 1) What do pre-service science teachers perceive about professional development for SSI-based teaching and using social media as a tool for promoting their SSI-based teaching? And 2) What are the effective strategies for mentors using social media to enhance advisees' implementation of SSI-based teaching?
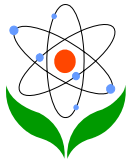
Phase I: Pre-service science teachers' perceptions about professional development for SSI-based teaching and using social media as tool for promoting their SSI-based teaching

1. The need for professional development about SSI-based teaching

We found that most pre-service science teachers (35 PSTs) needed professional development about SSI-based teaching. Some of them (18 PSTs) believed that SSI-based teaching benefitted their students. One sample of their replies: "SSIs-based teaching is good to promote students' application of their knowledge to daily life such as solving problem, critical thinking" (Questionnaire, PST29). A few of them (9 PSTs) thought they did not have enough knowledge about SSI-based teaching so they needed professional development about it. An example of their answers stated that "I need to know how to teach according to SSI-based teaching" (Questionnaire, PST03). In addition, a few respondents (6 PSTs) said that they were aware of SSI-based teaching and wanted to observe good examples of SSI-based teaching for application in their future practice. An example of their answers stated that "The main reason that I need PD is because I want to see a good practice of SSI-based teaching" (Questionnaire, PST11). However, one candidate did not want professional development about the using of SSI-based teaching because he thought that SSI-based teaching is difficult in a real classroom situation. He stated: "I think that teachers cannot use SSI-based teaching more often. It depends on time and chance" (Questionnaire, PST01).

2. The strategies for professional development about SSI-based teaching

A few pre-service science teachers (5 PSTs) stated that social media could be used for professional development because they could set up groups to exchange their ideas about SSI-based teaching and provide learning resources for lesson design. One respondent said "Create group in social media to discuss about SSI-based teaching can be the learning resource for us to develop SSIs-based teaching skills

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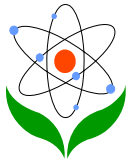based teaching

(Questionnaire, PST33)". The same number of pre-service science teachers (5 PSTs) suggested using a workshop as the main strategy for professional development. "Providing a workshop about SSI-based teaching is the good way for development of this teaching approach (Questionnaire, PST01)". Also, the same number of pre-service science teachers (5 PSTs) identified that the best way to develop their SSI-based teaching is through direct experience. One respondent said, "The best way for me to develop SSI-based teaching is havingreal experience from teaching practice such as seeing an example of the good SSI-based teaching or practice teaching of SSI-based teaching by myself" (Questionnaire, PST06). However, one pre-service science teacher wanted to attend some courses concerning SSI-based teaching as example of her answers stated that "I think that I can develop myself about SSI-based teaching from attending an SSI-based teaching course (Questionnaire, PST34)".

3. Using mentoring as a professional development strategy for SSI-based teaching

Most of the respondents (27 PSTs) thought that mentoring is a good professional development strategy for SSI-based teaching. One example of their replies was, "If a mentor has knowledge about SSIs-based teaching, they can give good suggestions such as developing lesson plans, teaching, do learning assessments (Questionnaire, PST36)". In addition, a few pre-service science teachers (2 PSTs) who thought that mentors could be good SSI-based teaching models for them. An example of their answers stated that "I think that a mentor will be a good model for the teaching of this approach (Questionnaire, PST11)". A few pre-service science teachers (2 PSTs) thought that mentoring was a good strategy for providing them with an opportunity to ask questions. Their answers stated that "I can ask questions about SSI-based teaching and we can exchange our ideas" (Questionnaire, PST19), and "It is the way for pre-service teachers to communicate with a mentor" (Questionnaire, PST23). However, a few pre-service science teachers (3 PSTs) thought that mentoring is not the best strategy for them to develop SSI-based teaching. An example of their answers stated that "I think that development of SSI-based teaching depended on me not only depending on a mentor (Questionnaire, PST15)".

4. Using social media as a professional development strategy for SSI-based teaching

Most of them (25 PSTs) considered social media a learning resource for the

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development of SSI-based teaching. An example of their answers stated that "It will be a resource for information about SSI-based teaching. I will apply this to my practice (Questionnaire, PST17)". Moreover, some pre-service science teachers (19 PSTs) mentioned that social media is a good way to communicate because it is fast and more convenient. An example of their answers stated that "It is a site for sharing experience about SSI-based teaching and get a good place to get advice" (Questionnaire, PST18).There was only one pre-service science teacher who thought that social media could promote her collaboration with others. She said, "It can promote collaborative working but we have to be aware of our word choices that we use to communicate because we don't know each other's emotions by reading the text" (Questionnaire, PST38). However, one pre-service science teacher did not agree that social media should be used as a professional development strategy for SSI-based teaching. She said, "I think that discussion with experts about SSI-based teaching in social media should be face to face interaction. Face to face discussion is better" (Questionnaire, PST21).
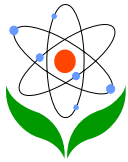
Phase II: The effective strategies of a mentor using social media to enhance pre-service science teachers' implementation of SSI-based teaching

Based on my experience advising pre-service science teachers, I would like to suggest some effective strategies for advising them how to use SSI-based teaching in their classrooms.

1. Use various social media as the channel for giving pre-service science teachers feedback.

This strategy came from their needs to get some feedback whenever they encounter problems during teaching practice. At the beginning of my research advising processes, two pre-service science teachers and I made common goals about classroom action research and SSI-based teaching. We also made appointments to meet each other almost every week. During the group meetings, I let them present their own progress in classroom action research and discuss their difficulties. They could also get some ideas from their friend's discussions and feedback. Nancy mentioned that:

I learned what my friends think and can apply their ideas to my teaching and classroom action research. For example, I have never used role playing in my lesson because I think that it takes time. During discussion, I found that students of my friends were more active for argumentation when they learn with role playing

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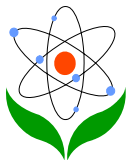based teaching

so I try to design my lesson with role playing to promote my students' argumentation (Facebook Message, September 2, 2014).

So, this meeting seemed to be a good way for me to give feedback on how to do classroom action research and SSI-based teaching. However, they spent most of their time practicing teaching at school, and when they encountered problems in their SSI-based teaching, they did not feel confident enough to continue their work. When they needed immediate advice, they could not wait for our weekly meeting for mentoring. They needed more channels for sharing their problems and receiving feedback.

Based on my literature review, I found that teachers could use social networking to promote students' learning. There is benefit in using social media to communicate with students or for out-of-classroom discussions. By making connections with other people, students learn and exchange knowledge with others who they may not have had the opportunity to interact with. In addition, Social media allows for a quick response from the mentor which may 'save the day' for the teacher. Thus, I used many kinds of social networking as part of my advising processes. I observed that all of them had a Facebook account, and they communicated with their friends via Facebook for many hours each day. Therefore, I created Groups on Facebook named *"ศิษย์รักสควค"*. (*My lovely PSMT students*), which was a private group and able to build stronger professional communities. They could post their ideas or upload words and PDF files, video, or photos on a timeline of the Facebook group. All of them could give each other advice. If they wanted private advice from me, they could send me a Facebook message. They were happy that I created a new connection channel for research advising because, as Nancy mentioned, "It is very convenient to directly contact my adviser for discussing issues that I found in my teaching and doing classroom action research" (Facebook Message: September 11, 2014).It seems that the implementation of social media as a mentoring tool resulted in the creation of a community of learners. This community engaged in posing questions and proposing solutions for the implementation of SSI into the classroom. Unfortunately, I found that messages we post on Facebook sometimes created confusion, and sometimes, it also took time to receive responses. Consequently, I was continually searching for the most effective way for the community of pre-service teachers to share their experiences and collaborate on possible solutions to issues or problems posed.

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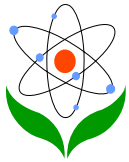
Besides Facebook, they also frequently used Line, which is an application on smart phones and personal computers. They could send free text messages, graphics, and video and audio, and they could conduct voice calls and hold audio or video conferences. I created a group chat to discuss some urgent problems they found during their teaching practice. I also used voice calling to give them some direct advice. They could understand what we discussed better than just reading the message. As William said, "I think that these social networks make communication better. I prefer the channel that we can see the face of other people, listen when they talk, and respond to them directly" (Line Message, September 25, 2014)".Unfortunately, this application at that time did not provide a method for sending word or PDF files via cell phones, so I still uploaded Word or PDF files to the Facebook group. However, I have to be careful about posting their works back on the Facebook group because some of them might imitate each other. Therefore, I agree with them about how to use Facebook posts and Line Messages as the connecting channel for research advising. Normally, I sent work directly to each person's Facebook message inbox. As the result of using social network, both of them felt more confident in both their classroom action research and their SSI-based teaching. As Nancy stated, "I have more confidence about my practice than before because I always get immediately *[sic]* feedback not only from advisor and my friends" (Facebook Message, February 20, 2015).Therefore, one of the benefits of using social media as a means of communication between mentor and mentee is that the pre-service teachers commonly use social media as a means of communication, and this means that receiving feedback from a mentor via social media is the norm.

2. Providing an empirical example for the holistic view of SSI-based teaching

In the beginning, my two pre-service science teachers and I jointly set common goals for our working and planning about classroom action research and SSI-based teaching. They seemed to know what they would do in the future to accomplish their goals. However, they had not experienced classroom action research and SSI-based teaching before, so they did not feel confident to move their work forward. For classroom action research, they were not sure how to write research proposals and link those proposals with SSI-based teaching. They had difficulty with the statement of problems, what exactly their research questions were, how to develop research instruments, how to collect data, and how to analyze data. Their work progress was slow, and they were not confident enough to move forwards with their work because they were unclear about classroom action research and
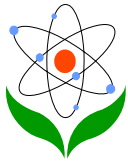
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SSI-based teaching. As William stated, "In the beginning, I did not have a clear view on what I was doing because I did not have much experience. I got confused so I could not make my work progress quickly" (Line Message: July 20, 2014).Therefore, I tried to share my experiences with them about how to do classroom action research and SSI-based teaching in the classroom in order to make them have a more holistic view. They seemed to understand, and as Nancy pointed out, "You sharing your experience benefits me because I did not have experience in SSI-based teaching and doing classroom action research so I was hesitant and I could not see the overview and detail of my works" (Line Message, August 18, 2014).

However, while they were developing lesson plans as a research instrument, neither of them felt confident and they got stuck in the process again. I learned that just telling of my experience doing classroom action research and teaching based SSIs to them was too abstract. William stated, "I think that what you share with me are the ideals of SSI-based teaching. When I practiced teaching and did classroom action research in a real situation, they are different from the ideal" (Facebook Message, September 19, 2014). To cope with this problem, I provided them with research articles of classroom action research related to SSI-based teaching. I also gave them examples of lesson plans concerning SSIs. I did not give these examples at first because I wanted them to work independently. I was afraid that they would directly copy ideas from these articles, so I coached them in ethics in doing research. As a result, the progress of their work was faster. They understood the holistic views of their work more easily and they knew what they would do for the next steps. Nancy indicated, "I now have an overview of SSI-based teaching and doing my research more clearly. Some points that I did not understand were eliminated after reading the articles" (Facebook Message, September 14, 2014).

3. Providing a friendly atmosphere for increasing their reflection in order to reduce the problems with SSI-based teaching

At the beginning of their teaching practice, I found that my two pre-service science teachers did not want to share their ideas about classroom action research and SSIs-based teaching when I met with them. They did not feel confident and were afraid that I would blame them for their mistakes in their classroom action research and SSI-based teaching. Therefore, they preferred to ask me for advice whenever they encountered a problem. As Nancy stated, "I am afraid to make an appointment

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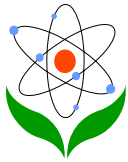
with you or ask you questions because I do not have experience and I worry about making mistake during my teaching practice. As result of this mistake, my students will not learn effectively" (Line Message, September 22, 2014). In addition, they thought that I was a strict person and wanted them to be perfect because I sometimes gave them emotional advice and got angry when they did not follow my suggestions. I always listened to their comments but hardly gave them compliments about their work. I learned that they needed encouragement as William pointed out, "Sometimes, I feel tired from teaching. I encounter various problems in school. I need someone with whom I can share my experiences and clearly explain what I am thinking about" (Facebook Message, October 6, 2014).

Therefore, I tried to speak about the good things they did before commenting about their works. In addition, I also gave them some reasonable compliments. As a result, they seemed to be more comfortable with my personality and could reflect on their own work more than before. "I am able to talk and discuss with you more than before because I understand your style of working. I do not have to worry about you blaming me for mistakes. (Nancy, Facebook Message, October 15, 2014)" However, I also observed that they informally spoke about their work with their friends more than with me. To increase their candidness with me, I changed from individual meetings to group meetings, and I spoke softly about the good things they did before providing them with any negative comments. Then I found that they felt more confident sharing their ideas about classroom action research and SSI-based teaching. They also learned from their friends and helped me to advise their friends. William pointed out, "I liked to discuss my work with my friends who understand my work. I also learned from them and they also learned from me" (Line massage: October, 24 2014). Eventually, the number of problems that they asked me to advise about in the area of classroom action research and SSIs-based teaching decreased.

4. Motivating pre-service science teachers to share ideas with cooperative teachers or experienced teachers about SSI-based teaching

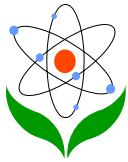At the beginning of their teaching experience, my two pre-service science teachers found it difficult to design their lessons according to SSI-based teaching. They also found problems during the implementation of their developed lessons in the real classroom context. They revealed that this problem came from their lack of appropriate facilities in the classroom, and interruptions in their teaching schedule.

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William said, "My school sometimes has extra-activities *[sic]* so I have to reduce my teaching periods. Moreover, some of my developed lessons did not come along with media, tools, or equipment provided in the classroom because I designed lessons for students' learning in the laboratory room but it was not available at the time of the lesson" (Line message, September 8, 2014)". Therefore, I needed to advise my pre-service science teachers to design their lessons appropriately. They needed someone who was familiar with the real classroom context to provide them with suggestions.

To deal with this problem, I asked them to have more discussion the development of SSI-based lessons with their cooperative teacher or with an experienced teacher who used this teaching approach in their schools. Based on my review of the literature, I found that the cooperative teacher is also an important person who assists the student teacher in lesson and unit design and in creating appropriate learning activities, and he or she assists them in understanding how to organize physical space. As a result, they got more ideas from their cooperative teacher that they could effectively apply to their classroom. Nancy stated, "My cooperative teacher helped me to design SSI lesson plans. She made suggestions about the suitable classroom setting and the length of time for teaching in each concept" (Facebook Message, October 10, 2014). They also reflected that they felt more comfortable in teaching, and the relationship between their cooperative teacher and themselves was better. "My cooperative teacher and I had a good relationship. We always shared ideas about teaching. Sometimes, she learned how to use new teaching techniques from me" (William, Facebook Message, November 18, 2014).
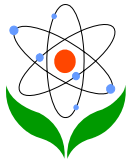
However, some cooperative teachers were not familiar with SSI-based teaching so they were not sure about their suggestions to these pre-service science teachers. As Nancy mentioned, "My cooperative teachers was not keen in SSI-based teaching. She was not quite sure how to give me suggestions about it so she has to help me to search for information about it for designing lessons" (Line Message, December 2, 2014). Therefore, as a science educator, I think it is important to increase cooperative teachers' understandings about SSI-based teaching. This would be a benefit for my students. I provided the opportunity for my pre-service science teachers and cooperative teachers, and we exchanged ideas about SSI based lesson together. In addition, I also encouraged my students to discuss issues with both their cooperative teacher and with an experienced SSI-based teacher in their school. Eventually, they could develop and implement SSI–based lessons that would

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include the important characteristics of this approach. As Nancy said, "I have more understanding about SSI-based teaching not only from you and my cooperative teacher, but I have also been able to learn from other experts in school. I am quite sure that my developed lessons come along with this teaching approach" (Facebook Message, December 12, 2014).

5. Continually following pre-service science teachers' progress in SSI-based teaching

Previously, I always had group meetings with two pre-service science teachers to understand their works and problems related to SSI-based teaching. Both of them tried to bring their understanding from these meetings to their teaching practice. Normally, if they did not have any problems or questions about SSI-based teaching, I would not have a meeting so that they could have more time to do their work. I would wait for them to schedule an appointment with me. Nancy seldom asked me for an appointment to get my suggestions but William always did. As a result, William made more progress in his teaching because I could provide beneficial comments that directly concerned his struggles. "I think that I got many essential comments for improving my work which is why I always made an appointment with you in order to receive your advice" (William, Facebook message, February 5, 2015).When compared with Nancy, who rarely met with me, his teaching always had fewer mistakes and it was easier to solve some problems. The progress of Nancy's work was slower than Williams, and as she indicated, "I am not sure if what I did was correct or not. I am so ashamed that you always helped me to solve problems that occurred in my classroom. I should meet you before the problem occurred" (Facebook Message, February 13, 2015). Therefore, I believed that the more they met me and reported what they did, the more their work progressed. I started changing my practice from providing them freedom to manage their own work to continually following their progress in SSI-based teaching. Every week, I asked them to report to me what their progress was via various methods such as a one-page written report, an oral report, or a message post in our groups on Facebook or Line. I also provided quick essential feedback to them. They seemed to be energized by this process. As a result, they produced progress faster than before. "Your following techniques made my work progress faster. I got direct feedback that increased my confidence in SSI-based teaching" (Nancy, Line Message, February 20, 2015). As result of continually following their progress in SSI-based teaching, William got a reward from The National Graduate Conference

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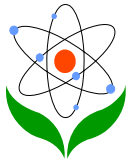
in Thailand, and he wrote, "Thanks so much for your suggestions, I finally got the good reward from the conference" (Facebook message, March 30, 2015).

Conclusion and Discussion

As a result of this study, many pre-service science teachers had a good perception about using online mentoring to develop their use of SSI-based teaching. Individuals can access Web pages on mentoring or send an e-mail at any time of the day or night, seven days a week (Wah, 2000). Action research also affected because I learned how to change my practice for advising them how to do classroom action research related to using SSIs-based teaching in their classrooms. Loucks-Horsley *et al.* (2003) indicate that action research is utilized as a way of involving teachers in changes that improve teaching practice for the researcher. I found five social media strategies that were effective in terms of promoting pre-serviced science teachers' implementations of SSI-based teaching:

- Using various social media as a channel for giving feedback
- Providing empirical examples for their holistic views of SSI-based teaching;
- Providing a friendly atmosphere for increasing their reflection in order to reduce the problems about SSI-based teaching;
- Motivating them to share ideas with their cooperative teacher or experienced teacher about SSI-based teaching; and
- Continually following their progress in SSI-based teaching.

Using social networking as the channel for providing feedback could eliminate my pre-service science teachers' lack of understanding about SSI, especially when such a lack of understanding could lead to feelings of fear, anger and distrust towards the scientific community (Hodson, 2008). So my pre-service science teachers felt more confident in both their classroom action research and their SSI-based teaching. This result confirmed that social networks can be used as an educational channel for students and teachers to communicate, reflect, share, or learn their ideas from and to each other (Goldfarb *et al.,* 2011; Schlenkrich & Sewry, 2012). I also confirmed that e-mentoring is best suited to short specific questions, and more complex or personal questions require face to face mentoring (Stokes, 2001). In order to increase their understanding and practice of SSI-based teaching and classroom action research, I also provided them an empirical example for their holistic views of SSI-based teaching related to Magnusson*et al.* (1999), which indicated that

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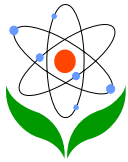
effective teachers require an array of teacher resources, subject-matter knowledge, and pedagogical content knowledge. SSI-rich instructional contexts may well provide a productive context that promotes their integration of knowledge structures, including pedagogical content knowledge (Zeidler *et al.*, 2005). The changing process can occur when pre-service teachers are confident about the outcomes of teaching strategies (Bell, 1998). It also occurs when they recognize a need, make plans to improve, engage in improvements, and allow for time to evaluate the effectiveness of new practices (Boling & Martin, 2005).

When I provided a friendly atmosphere, my pre-service science teachers increased their efforts to reduce the problems with SSI-based teaching. Starcevich (2004) noted that the good mentor should provide advice, share knowledge and experiences, and teach using a low-pressure, self-discovery approach. Moreover, I learned that not only could I promote my pre-service science teachers understanding and practices of SSI-based teaching or doing classroom action research but cooperative teachers and expert teachers could also do so in their schools as facilitators and scaffolders (Bell, 1993). Similarly, Korthagen & Kessels (1999) indicated that teachers may learn a lot of teaching methods and strategies for many types of situations from professional development experiences but typically do not know how to apply these to specific situations occurring in everyday teaching. In addition, professional development should have sufficient time and on-going professional support (Radford, 1998). For continually following their progress in SSI-based teaching, my pre-service science teachers progressed faster than before. I believe that changes in knowledge and belief take time and persistence (Loucks-Horseley *et al.*, 2003). Therefore, a good mentor should help students stay on track and successfully progress through their work (Michigan Virtual University, 2014).

Implications and Recommendations

From the findings of this study, most pre-service science teachers including William and Nancy had good perceptions about using social media for professional development, and their perceptions might affect my practice of using social media to promote SSI-based teaching. Moreover, the processes of action research made me develop my practice and understand my pre-service science teachers more than before. Although they completed their work and their degrees, I still continue to use social media to:

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- provide my advisees with feedback;
- provide an empirical example for their holistic views of SSI-based teaching;
- provide a friendly atmosphere for increasing their reflection in order to reduce the problems about SSI-based teaching;
- motivate them to share ideas with cooperative teacher or experience teacher about SSI-based teaching; and
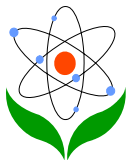- continually follow their progress in SSI-based teaching.

In order to support the sustainability of changing their practices in line with SSI-based teaching, I suggest that these strategies can be applied to designing an online mentoring program for pre-service science teachers' teaching practice according to SSI-based teaching.

University teachers should consider the context of their practice. The strategies that I used for advising them how to do classroom action research related to using SSI-based teaching in their classrooms might work well or not depending on that context. This study also points out some interesting issues for further studies. Based on the finding that cooperative teachers did not have much knowledge about SSI-based teaching, as a science educator, I still have questions about what strategies I can use to promote that might be beneficial to my advisees who are interested in SSI-based teaching.
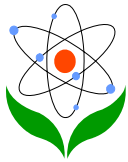
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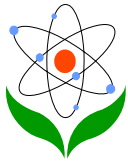based teaching

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Appendix

Professional Development about SSI-Based teaching and Using Social Media Questionnaire

Directions: The aim of this questionnaire is to explore current pre-service science teachers' perspectives on professional development about SSI-based teaching and using social media for promoting SSI-based teaching. This questionnaire has two parts. Please fill your information in the blank as follows:

Part I: Personal Data

1. Gender ………………….........……………
2. Age ....………………
3. Major fields ………………….........…………………….......
4. 4. Grade point average (GPA) …………………….........…………………….....
5. 5. SSI-based teaching experience……………………….........…………………

Part II: Perceptions about Professional Development and Using Social Media for Promoting SSI-Based teaching

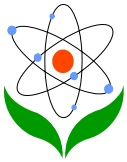1. Do you need professional development about SSI-based teaching? If yes, tell me your reasons.
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2. What is the appropriate strategy for professional development about SSI-based teaching?
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3. What do you think about using mentoring as a professional development strategy for SSI-based teaching?
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4. What do you think about using social media as a professional development strategy for SSI-based teaching?

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