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Preservice Teachers' Beliefs about Teaching and Learning Science Through Field Experience

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Abstract

The purpose of this study was to explore two preservice teachers' beliefs and practices about teaching and learning science in the classroom, real teaching contexts. Data were collected through survey, questionnaire, interviews, and class observations with fieldnotes for triangulation. Preservice teachers' belief system consisted of two domains; one was the foundational and very common domain and the other was specific one depending on personal experience and interest. About belief change during field experience, participants did not display critical change during field experience. The relationship between beliefs and practices displayed by participants were consistent and inconsistent depending on teaching context. Finally, mentor teachers' influence on preservice teachers was identified as critical one in preservice teachers' forming beliefs. Implication was possible in teacher education in that preservice teachers are necessary to have opportunities to reflect on their beliefs and practices in the real context of teaching long enough, such as field experience, so that they have enough time to form and structure beliefs about teaching and learning science firmly.

Key words : preservice, belief, practice, field experience, mentor teacher, teacher education

I. Introduction

For decades, the American Association for the Advancement of Science *Benchmarks for Science Literacy* (AAAS, 1993) and the *Standards* (NRC, 1996) has recommended comprehensive changes in science teaching and learning, particularly the teacher's beliefs about teaching. Preparing teachers as change agents begins with an understanding of the beliefs that underlie teacher decisions making (Pajares, 1992; Richardson, 1996). Many researchers also investigated that what affects the instructional decisions that an individual teacher makes, and they found that the individual beliefs of the teacher are powerful indicators of the instructional choices and teaching patterns of the individual (Bandura, 1977; Haney, Czerniak, & Lumpe, 1996).

However, the beliefs of teachers are not consistent with the literature about best practices in teaching (Fang, 1996). Fang (1994) pointed out that contextual factors might make teachers' practices inconsistent with

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their beliefs. Furthermore, Pajares (1992) stated that teachers' beliefs appear to be stable and not amenable to change.

Belief can be defined in a variety of ways. Rokeah (1968) defined belief as any simple proposition, conscious or unconscious inferred from what a person says or does. Rokeah(1968) also defined belief system as having represented within it, in some organized psychological but not necessarily logical form, each and every one of a person's countless beliefs about physical and social reality with three assumptions: Beliefs differ in intensity and power; beliefs vary along a central peripheral dimension; and the more central a belief, the more it will resist change (Pajares, 1992).

For teachers' beliefs, those are personal constructs that can provide an understanding of a teacher's teaching practices, but the nature of this relationship is not well defined (Pajares, 1992; Richardson, 1996). Pajares (1992) supported the notion that beliefs of teachers influence their perceptions, which in turn affects their practices or behaviors in the classroom and implied that beliefs can change, but change is dependent on the duration and formation beliefs. On the other hand, other researchers, for example, Fang (1996), suggested that beliefs may or may not be related to teaching practices. He pointed out that practice can be inconsistent with a teacher's beliefs, and contextual factors may influence behaviors to be inconsistent with beliefs.

Based on these understanding teachers' beliefs, some documents reported that preservice teachers' beliefs play an important role in establishing their own beliefs about teaching in the classroom for lifelong career education. Bryan (1998) studied the complexity of preservice teachers' beliefs and how these beliefs influence learning to teach elementary science. In this study, one preservice teacher displayed certain and firm beliefs as foundational one which might never change and dualistic beliefs that held the capacity for changing, refining, and developing over time. The researcher concluded that these foundational beliefs were the dominant and central belief system driving her practices (Pajares, 1992; Richardson, 1996). Cronin-Jones & Shaw (1992) reported that there were basic differences between the belief structures and concerns of preservice elementary and secondary science teachers. Belief structures of the elementary student-teachers appeared to be more simplistic and secondary student-teachers possessed more complex belief structures regarding teaching and learning by emphasis on some areas which were virtually absent from the belief structures of elementary student-teachers. Brickhouse (1990) studied the difference beliefs about teaching science between inservice and beginning teachers. The experienced inservice teachers demonstrated their teaching from a consistent, self-reinforcing belief system. Their classroom instruction was remarkably consistent from one day to the next, and they expressed personal philosophies that were congruent with their actions in the classroom. However, unlike the experienced teachers, the beginning teacher had not reconciled own conflicting beliefs or the impact of institutional constraints on teaching.

Gess-Newsome & Lederman (1989) explained that microteaching method course offers the preservice teachers chances where they reflect pedagogical knowledge by practicing execution of instructional plans, developing instructional behaviors, viewing one's own teaching on videotape, and receiving systematic feedback prior to the student teaching experience. Dana, McLoughlin, and Freeman (1998) examined the ways in which teacher beliefs and conceptions about learning and teaching science changed during the first level course in science pedagogy by focusing on "teaching science for student understanding" and designed an innovative university and school-based program considering "learning to teach science" as a process of conceptual change. Dramatic paradigm shifts in conceptions and beliefs of prospective science teachers were rare, rather incremental changes in thinking about science teaching and learning occurred with regard to students' learning of science and teaching for student understanding. The researchers concluded that learning to teach science is complex and is complicated by many personal and contextual factors, and it is important to design an introductory secondary science teacher education course

that makes an initial impact on prospective science teachers' concepts and beliefs about teaching for students' learning. It is emphasized the preservice teachers' use of reflection on teaching within their own beliefs and their trials to find conceptual comfort zone by creating dissonance from real interactions with students in the classroom.

Real contexts, like field experience with students' interactions, are very important factors for preservice teachers' belief formation and change (Beyer & Davis, 2008; Cavallo & Saunders, 2002). Though preservice teachers hold certain beliefs based on their own pedagogical knowledge and experience, these beliefs might be challenged in real contexts by students' understanding and their interaction in the classroom. Teachers claim that most of what they know about teaching came from firsthand experience. In short, they learn to teach by teaching. Experience in the classroom is thought to shape beliefs and practical knowledge. Bradford & Dana (1998) claimed that it is essential that preservice science teachers be treated as learners and be taught according to the best available knowledge on teacher learning. The researchers suggested that reflective coaching from supervisor and cooperating teachers offer preservice teachers valuable insights about their own thinking and teaching, and this coaching process can resolve the seeming inconsistencies in their conception and teaching practice. Field experience gives a chance to reflect on how preservice teachers construct their beliefs and concepts about teaching and learning science in the classroom and this reflection-on-action empowers them to construct new knowledge, take charge of their actions, and initiate change. Preservice teachers need to plan to practice their theory in real context with student interactions, and this first experience in teaching makes them do this (Flores & Day, 2006; Zeichner, 2002). That is, the practical and the theoretical in introductory courses can be brought into closer alignment if students are exposed to large doses of "reality" in the classroom. Consequently, field experience intended to force preservice teachers to rethink their understandings of teaching and learning must confront student teachers' assumptions not separately but as the web they construct (McDonnough & Matkins, 2008; McDiarmid, 1990).

Preservice teachers test their pedagogical knowledge in field experience and try to understand procedural knowledge with students' interaction in real contexts. Every preservice teacher does not feel he or she is successful in teaching as he or she plans. To be functional, workable procedures like field experience must become standardized and reflect an integration of management and instruction (Kagan, 1992). Field experience is where preservice teachers test if their learning theory is workable as they plan for student interactions in the classroom, and where preservice teachers explore their pedagogical knowledge freely. Brown & Rose (1995) and Johnston (1994) support that field experience must be established to help preservice teachers explore their pedagogical knowledge grounded during taking teacher preparation courses with preexisted their beliefs about teaching and learning, adapt, and modify their own instruction strategies for the practical teaching. They learn how to teach by teaching in real context, with every unexpected barrier and with real student interaction. It is called clinical field experience. Bryan (1998) implied that preservice teachers' beliefs are amenable to change after instruction and experience during initial stages of teachers' career. Cronin-Jones & Shaw (1992) added that preservice teachers' beliefs about teaching and learning in the classroom are possible to change though typical preservice teachers' belief structure are not found.

The Standards (NRC, 1996) described that some of the most powerful connections between science teaching and learning are made through thoughtful practice in field experiences, team teaching, collaborative research, or peer coaching. Field experience starts early in the preservice program and continues throughout a teaching career. Whenever possible, the context for learning to teach science should involve actual students, real student work, and outstanding curriculum materials. Trial and error in teaching situations, continual thoughtful reflection, interaction with peers, and much repetition of teaching

science content combine to develop the kind of integrated understanding that characterizes expert teachers of science. Additionally, many researchers described that teaching experiences in the schools are believed to shape teachers' beliefs and understandings about teaching, learning and school contexts. So, to find out the relationship between teachers' beliefs and their teaching practices, it is essential to investigate preservice teachers' beliefs formed through their real teaching in the field experience (Zeichner, 2002; McDonnough & Matkins, 2008; Roehrig & Luft, 2008).

Therefore, the purpose of this investigation, in general, is to describe what kind of preservice teachers' beliefs hold about their teaching and learning science in the classroom (field experience) context with three research questions;

(1) What kinds of belief contribute preservice teachers in choosing the effective teaching methods?
(2) Is there any change in preservice teachers' beliefs about teaching and learning during their field experience?
(3) Is there is any relationship between preservice teachers' beliefs and teaching practices through the field experience?

II. Research Method

1. Participants

First, the researcher asked a director who was in charge of internship to select some preservice teachers who were *on The Professional Teacher Education Licensure Program* for the preparation of science and mathematics teachers for grades 4-10 and 5-12 as a challenging full-time program. Second, the researcher contacted them in one of their taking courses, explained the purpose and procedures of this study, handed out the paper asking if they could participate in or not. Then they were asked to return their responses to the researcher's mail box after the class. The researcher received 30 students' responses and chose only two preservice teachers as participants based on the same or similar background of science to the researcher's. The reason why the researcher chose only two participants was that more participants' involvement was beyond researcher's ability to handle for data collection and its analysis in the qualitative research. The researcher contacted two participants by e-mail first, one is male (Ryan) with chemistry and physics background, and the other is female (Cindy) with integrated science background. They had experience in teaching science camp or other subjects such as writing in informal type of teaching as volunteer for less than one year.

2. Research site and fall practicum program

This study was to investigate preservice teachers' beliefs about teaching and learning science in the classroom at the early stage of fall practicum (campus-based methodology class and real teaching in field experience) for four months. The study covered only fall practicum made up of methodology and microteaching classes and part time real teaching program. First, student teachers had full time experience of assisting mentor teachers during September at the local schools without teaching and part time of assisting mentor teachers for five weeks during November and December. Participants had full teaching during October and part time during November and December. Second, student teachers learned and practiced four kinds of teaching models in the campus during fall practicum, "Introduction & Demo Model", "Inductive Model", "Deductive Model", and "Hands-on/Lab Model" to develop the theoretical background, practical knowledge, and skills essential for successful science teaching. Field experience of teaching happened in the local elementary and secondary schools and methodology class happened in the science and math education department in the university.

3. Data Collection

Tasks in this study attempted to raise and allow participants to think their beliefs about teaching and learning science through field experience and to provide a diversity of perspectives about these beliefs without biasing responses in any particular way. Primary sources of data were verbatim transcripts of two times semi-

structured interviews based on survey with some questions and two observations with fieldnotes.

(1) Survey and Questionnaire (Appendix 1)

The researcher used one survey consisted of Likert Scale by 21 items asking about the general perspectives about teaching and learning, and one questionnaire with five open-ended questions asking about the positive, negative aspect of teaching experience, teaching skill/ strategies effective in teaching science, and teachers' and students' roles in the science classroom. To establish their content validity, two science educators and three doctoral candidates in science education department examined the items and some of the items were modified according to their suggestions after discussion to have agreement to be consistency.

(2) Interviews (Appendix 2)

There were two interviews for each participant. First interview was followed by the initial survey and questionnaire and its purpose was to validate the content of instruments and get more information of two participants' perceptions or beliefs about teaching and learning science in the classroom. The researcher encouraged participants to talk in the area of interest and probes more deeply. To help interview, audio and video recording were used with participants' permission and transcribed for analysis. This interview took half an hour and occurred at the researcher's office room by appointment or another place where participants assessed easily. Second interviews were less structured and more open-ended based on the first observation in the classroom. Interviews built on previous interview aimed at examining possible changes in participants' beliefs about teaching and learning science. The first interview for each participant happened in October, and the second in November.

(3) Classroom observation

Videotaping of two classroom observations of each participant's teaching were used as supporting data for triangulation. The researcher's main role was to observe participants only without students in the classroom, so the participants used microphone to record their voice clearly for transcription. The researcher sat in the back of classroom for taking observation by focusing on participant's behavior and verbal ones to figure out the relationship between their beliefs and their teaching practices. The researcher discussed with the participants in advance about when and what lesson to observe so that the researcher could include participants' recitation and more students' involvement. Two observations for each participant happened in November and in December respectively.

(4) Fieldnotes

There were two types of fieldnotes, one from the interview and the other from the observation. The purpose of fieldnotes was for data triangulation.

4. Data Analysis

Data analysis commenced after collecting data and comprised three phases.

(1) Phase I: Analyzing each data with preliminary list of coding

There were four different data sources (survey and questionnaire, interviews, observations, and field notes) and each data were analyzed separately. First, a survey had 21 items asking general beliefs about teaching and learning with Likert Scale and the researcher divided two participants' responses into 5 groups, *Strong Agree, Agree, Unknown, Disagree, and Strong Disagree*, then repeatedly examined to discover certain words, ways of thinking, similarities, and themes related to the research questions. A questionnaire had five open-ended questions (positive, negative memories in teaching, effective teaching skills/strategies, teachers' role, and students' role) and the researcher also attempted to categorize based on participants' responses. Second, the researcher read over and over carefully transcribed interviews to develop a preliminary list of coding categories related to teaching and learning science and jotted them down in the left margin. For validation, the researcher read the interview transcription over and over until she found agreement (She examined each data at least three times for validity). The researcher developed more preliminary lists of coding than those of survey and questionnaire. Third, the researcher

transcribed the first observation and also developed the preliminary lists of coding. However, the second observation was not transcribed and used for the researcher to jot down her comments as an observant (OC: Observant Comment) based on two preservice teachers' behavior and mottoes. The researcher developed similar lists of coding related to teaching and learning science in the classroom from these two observations. The reason why the researcher did not transcribe the second observation is to have consistency of data sources. The researcher observed two lessons from one participant, but only one lesson from the other participant, instead the researcher got one videotape recorded from that participant for her self-critique. The voice of that participant without microphone was not clear to transcribe, so the researcher decided not to transcribe the second observation from both participants, but used for data triangulation or for observant comments. Fourth, the researcher used fieldnotes from interviews and observations for data triangulation and also developed some lists of coding similar to the other data sources. All codes developed from data sources have quotations as evidences which read, for instances, CI#1-3-18, indicating that a quotation as an evidence is from Cindy's Interview #1, page 3,and line 18. As another example, RS-(4) indicates that this quotation is from Ryan's Survey, number 4. There are two participants, C or R, and five different data indicators, S (Survey), Q (Questionnaire), I (Interview), O (Observation), and F (Fieldnotes).

(2) Phase II: Comparing data sources and developing the common categories with evidences

After developing the preliminary lists of coding from each data source, the researcher compared all sources and developed final common categorizes with evidences. The researcher removed a category found from only one data source and she attempted to generalize list of categorizes, which were found mainly in survey, questionnaire, interview and observation. Two participants showed various their beliefs about teaching and learning and the researcher developed 15 categories from one participant (Cindy) and 20 categories from the other participant (Ryan). Most of categories are common beliefs from two participants but each participant displayed specific beliefs about teaching and learning.

(3) Phase III: Three themes of preservice teachers' beliefs about teaching and learning

Categorizes were divided into three different themes, *Concern about students, Concern about teachers*, and *Concerns about effective teaching methods* from two participants. *Effective teaching methods theme* included two preservice teachers' beliefs about what teaching methods/strategies to use, *Concerns for students* included students' roles and view of learning, and *Concern for teachers* included teachers' roles and view of teaching in the science classroom.

III. Results

1. Concerns about students

Two preservice teachers showed some concerns about students in their beliefs for students' learning, which included *assessment, learner centered/cognitive development, group working/activities*, and *students' roles*. Many quotations from every data source supported this theme. Two participants showed similar beliefs about assessment. They were very concerned about students' understanding during the lesson and used questions for assessing.

Students should be given regular opportunities to think about what they have learned *in the science classroom. (RS-(4))*

I will provide frequent feedback on my work that help students improve their learning(CS-(14)).

I: but your main purpose of using question is to assess.

C: sure(CI#2-6-1).

They also believed that the students must have opportunities through which they can check their learning

and journal writing was suggested as one of the methods for assessing.

Two preservice teachers emphasized the students' own learning by reflecting what they learned through writing journal or questioning with the focus on students' cognitive development. Two participants emphasized students' understanding of 'big ideas' or concepts rather than isolated facts and information with higher thinking and metacognition (CS, RS).

And I didn't expect to make a leap between water and air here, but they did make it. I was worried about going over head and head right on here, and I can't tell because they are responding with not only knowledge level questions which I want them to repeat back but they also making connections to the higher level (RI#2-6-1)

Concerns about student's cognitive development made two participants teach learner-centered lesson where students' roles of responsibility also were emphasized. Cindy mentioned that she prefers to have student learn by discovery rather than being told by teacher (CQ) and Ryan also guided students to make their own knowledge (RI#1-4-14). Cindy also presented active participation, discussion, and questions as the methods that make students experience their own learning.

I: How do you think students can make their learning as a part of them.. I mean..own learning?

C:active participation and discussion, asking questions, if they don't understand, just try to keep questioning to learn about it (CI#2-3-13).

These preservice teachers' interests in students' cognitive development and own learning made their teaching methods more learner-centered. Cindy responded that students must work on problems and projects with other students in a group (CS-(10)) and Ryan just scaffolded students to ask questions and answer themselves (RO#1-5-18, ROF#1-2-1). Learner-centered group working is necessary-sufficient condition with students' social interaction and both participants displayed much interest in social context, through which students can construct their cognitive development.

I will encourage students to work on problems and projects with other students.(CS-(10)): Social interaction

I can get other students to teach each other, because this person gets certain part, and this person gets different part, and this person another one, they combine them together without a teacher and then I will accomplish not only this material but also that they are thinking about how it is learned and how to put things together (RI#2-3-23): Develop students" knowledge through social interaction

Two preservice teachers' interest in students' own learning made their teaching more students' hands-on activity rather than direct lesson from teacher. Cindy believed that activity's safety and activities in pairs or groups are the most important purpose to consider in making groups, while Ryan pointed out the social interaction in groups or pairs as the most important purpose in making groups. The reason why two preservice teachers had groups working or activities in the class was to have students experience their own learning by making abstract concept concrete for easier understanding (RI#2-11-12). Ryan, however, expressed that the lab activity was the most difficult part in his teaching because of students' control during the lab activity (RI#2-13-25).

Two participants showed similar beliefs about students' roles in their learning science. Cindy believed that students must be responsible for own learning by participating in their activities and discussion, and asking questions (CQ-4, CI#2-3-12). Ryan also believed that students themselves must construct their new knowledge by connecting to prior knowledge through journal writing or projects (RS-5-18, RI#2-3-8).

What do you think students' roles are in your teaching in the science classroom?

Students' roles: learn, discover, ask questions, team member, respon-sible for own learning, and being safe.(CQ in question #4 of student's role)

Students' roles: Open and willing to learn, and students must feel responsible for their own learning (RQ in question #4 of student's role)

Concerns about teachers

Two preservice teachers showed some concerns for teachers themselves from their beliefs. They used *text or lesson plan for teaching outline*, used *technology* for their use as teaching tools or resources, described *teachers' roles* as a helper or a facilitator, but sometimes as a director to lower graders, used some *management* in controlling students, and were influenced by *their mentor teachers* in developing their own teaching methods.

Both participants thought that the text is a great resource, not a tool (RI#1-7-17), so they do not depend on the lesson plan or text during the lesson (CI#2-4-7). They also believed that making lesson plans is not related to the quality of teaching.

I: OK, in making lesson plans, you think it is related to your quality of teaching?

R: It is hard to say. In person, I had experienced in teaching a little before this[...]. I cannot follow in detail, but it would be helpful to keep time track in outline. Not much in detail (RI#1-3-3).

She said that lesson plan is not much related to quality of teaching(CIF#1).

Ryan described that the technology is very essential as a teaching tool (Computer, calculator, and projector), and as a great resource (Internet) besides textbook to enhance students' understanding science concepts more clearly in modern times. Cindy, however, thought that the technology is not necessary, but helpful for students' learning and she expressed that traditional ways with paper and pencil are sometimes best way in teaching and learning science.

C: right, sometimes I am using technology in teaching and dealing with the technology to track students what they are doing.. but easily done with the pencil and paper, so sometimes, technology, it is helpful but not necessary(CI#2-1-8).

I will use computer technology in ways that enhance students' ability to learn(RS-(19)).

R: Most of time, I use computer in my teaching, even in my lesson plan, I inserted using of [some]scope in computer, more technical one (RI#1-4-23).

Both participants believed that the teachers must be a facilitator or a helper (CS- (13)) for students' learning, but they agreed that sometimes teachers need to be direct in teaching when they teach lower graders (RO#1-2-18). Actually, Cindy taught science concepts very direct to the 4th graders, even though she mentioned that the main teachers' roles are facilitators, helpers, and guides in students' learning. Ryan explained that the teachers are in the center of students and help them interact one another in getting information. He, however, also taught in a direct way in getting what he expected during the lesson (RI#2-9-5). Besides teachers' roles in teaching, Cindy thought that it is teachers who must play a role to make students good citizens by teaching moral things (CI#2-4-1).

Two preservice teachers were much influenced by their mentor teachers in technology, management, philosophy of teaching, and other teaching methods. Ryan indicated the most positive aspect influenced by mentor teacher was the management in which he dealt students with humor and warning system which his mentor teacher used (RI#1-2-6). Ryan also mentioned that his mentor teachers use technology quite a lot and he imitated his mentor teacher's motto to get along with students at the

beginning period of teaching (RI#1-5-25). Ryan pointed out that observing his mentor teacher at the beginning of field experience was very important to know his teaching styles, methods, and tools (RI#2-13-3). Cindy was also influenced by her mentor teacher, who did not depend on textbook or technology, and she also believed that her teaching philosophy was much similar to her mentor teacher's, for example, students are active learners and teachers teach concepts in different ways with different management (CI#2-6-12).

I used mentor teacher's motto and terms which he used a lot. I blocked everything around me. As times went on, I felt natural in taking questions and trying to do something else. (RI#1-5-25)

That's how I use textbook more than anything else. Two reasons come from how I do and my mentor teacher does in that way, too. He use and has a textbook, but he doesn't do like "OK, let's go to page 33" or something like that (RI#1-7-24).

Only Ryan showed much interest in his management during teaching. His management skills included "waiting time" for students to be quiet before starting the class, walking among students when he asked questions, and calling students' names who were in passive attitude (RO#1-4-6 & 20, RO#1-5-16). Ryan also believed that he is the very person who can teach, who can enjoy teaching, and who was born to teach. He believed that teaching is related to his personality and nature, for example, patience.

I was born to teach. I think it is very natural to teach. I think I have that naturability in teaching. Everybody can teach, but they have to have that naturability. [...] It takes patience and ability to sit down for a long time like "let me think in different way" (RI#1-8-7).

Concerns about effective teaching strategies

Over all, two preservice teachers showed a few of common beliefs about teaching and learning, which included *questions, repetition, rephrase, examples, view of nature of science and science inquiry, and directed lesson*. Ryan, however, held specific beliefs of *inductive teaching method, students' mistakes and motivation in learning, view of science, and importance of teacher's movement*. On the other hand, Cindy held specific beliefs of the importance of *connecting to real world in learning science concepts and use of student's prior knowledge.*

First of all, two participants used questioning to review the last lesson (RO#1-2-12), to assess what students learned (ROF#1-5-9), and to lead the lesson (CO#1-5-8, RO#1-2-23), but they also used questions to manage students (RI#2-7-10). The main reason of using questions was to assess how much students could understand science content, and two participants showed interest in students' cognitive development through their learning (RI#2-6-22, COF#1-1-11). Two participants used questions by calling students' names or by making them raise hands as volunteers, but most of questions were aimed for recalling, which is the most basic area of taxonomy (RI#2-15-1). Both preservice teachers believed that questioning gives students chances to be involved in their active learning (RI#2-14-24).

Another common belief which two preservice teachers displayed during their field experience was that students learn their new concepts through teachers' rephrase, repetition, and examples. Ryan taught the 6th graders and Cindy taught the 4th graders during their field experience. They thought that lower graders need to have repetition as many as possible in getting new knowledge through rephrasing and giving examples until they understand the concepts clearly (CI#2-6-13, RI#1-3-23). Moreover, Ryan emphasized rephrasing students'

answers again for the whole class to understand clearly (RO#1-7-14), and Cindy emphasized giving examples for students to figure out their new concepts by themselves (CQ#1-5).

I: OK, when you see student who looks confused in learning, what do you do?

C: try to rephrase it, and try to step back to take a different perspective on what I trying and give different examples..(CI#2-6-13).

Do you know about any density? Mike? Solid is more dense.. OK, I will give example (CO#1-7-21).

To understand science, students must solve many problems following examples provided (CS-(5)).

My strong point is that repeating, and it helps students understand. I rephrase what students told me. If the thing which one student is not clear, I rephrase it to whole class again (RI#1-3-23).

Ryan nodded when students replied and rephrased student's answer to other students (RO#1-2-10).

Both participants displayed certain beliefs about science inquiry and nature of science through their teaching and students' learning. As one of the examples in nature of science, Ryan and Cindy disagreed that getting the correct answer to a problem in the science classroom is more important than investigating the problem in a scientific manner (RS-2, CS-2). Main beliefs about nature of science from two participants included mainly observation and inferences. Most of their science experiments were based on students' observation and inferences, and two preservice teachers used them in leading their science lesson. As one of the examples in science inquiry, both participants agreed that teachers need to provide opportunities for student to “be” a scientist by posing questions, investigating problems, analyzing data, and developing theories, and they implied that anybody can be a scientist (RS- (18), CS- (18)). Two participants thought that students in the lower graders (4th and 6th) need some guidance so that they can only change variables or redesign with given questions posed by teachers, not really open-ended, since those students do not have much experience in designing science inquiry (CI#2-3-8). Ryan believed that science inquiry is communi-cating and predicting (RO#1-2-16, RI#2-3-29, CO#1-7-28).

Those are important parts in the ear. [.....] Just guess…Go ahead, C. good, first step is that sound waves come to ear. What is next step? It is really light here, you can see well from here? Sounds go through the tunnel and hit the eardrum. (RO#1-2-16): predicting

I can get other students to teach each other, because chances make this person get certain part, and this person get different part, and this person another one, they combine them together without a teacher and then I will accomplish not only this material but also that they are thinking about how it is learned and how to put things together. (RI#2-3-29): communicating

However, the experiments by two participants took place without science inquiry much, but teachers tried to get all students involved in those activities. Cindy described that the 4th graders did not have much background in science and this lead their negative attitude to science.

Both participants believed that it was necessary to use direct-instruction to lower graders for their learning, even though they believed that teacher must act as a facilitator or a helper. Cindy directed the lesson by giving clues for students to get what she expected (CO#1-2-4, CO#2-1-27).

Mike, have you ever heard of it before? What happened up of boiling point? Does any other know the temperature of boiling point? I will give you a clue (CO#1-2-4).

Write the word underneath the box. There is plenty of room for drawing. Andy, do you know another state? Right, gas. So another box, and third box, put "gas", skip in the middle box, and write gas in that box (CO#1-4-23).

I: In your lesson, I catch your phrase "Ok, I will give you a clue." That means you will give students more direction, right?

C: probably. [laughing] (CI#2-5-4).

Ryan also believed that directed instruction is needed to the lower graders. Science can be learned by following the processes, so it is better for the lower graders to follow directed processes first, then to manipulate those processes in applications (RI#2-1-31, RI#2-2-13).

Both participants displayed specific beliefs about teaching and learning science besides common and foundational ones. Ryan, for example, described that inductive teaching method is very effective teaching strategy and he used questions for inductive lesson (RQ, RI#2-6-22). Ryan also expressed that studnets are allowed to make mistakes in their learning (RI#2-1-13). Moreover, he pointed out that students' motivation is important and he believed that every student can feel motivation in learning in a different way, so it is a teacher who makes student feel motivated in her/his learning (RI#2-5-4, RI#2-11-20)

I have some students who don't do task well, yet they really did well on their projects. So in that case, give them chances to understand materials in a different way. But also give them chances to keep their grades in a balanced portion, cause if a student doesn't do task well, he can do well through project and give good motivation to keep doing (RI#2-5-3).

On the other hand, Cindy held specific beliefs about students' prior knowledge and its connection to the real world through their experience (CI#2-1-31). She sometimes checked students' prior knowledge before introducing new concepts how much they knew and used their ideas to lead the lesson (CO#1-5-29).

C: I think by applying their own life, link and connect concepts with new concepts and go back to their experience and tie to previous learned…

I: you mean apply to their real world from experience..

C: right…water cycle..water unit. Talk about the plant, just water cycle again (CI#2-1-31)

Two preservice teachers described that teacher must act as a facilitator, students need to feel responsible for their learning, and the lessons need to be guided in open-ended situation. However, they taught their lesson sometimes in a directed way as a giver or a teller and students just acted in a passive way. Cindy sometimes led the groups of students to go to the right direction not to get lost in doing their experiment, and believed that she needed to direct lesson when she had to explain the difficult concepts to the lower graders. This explains that there is inconsistency between their beliefs and teaching practices in the classroom and provides the answers to the second research question of if there is any relationship between them.

When two participants were asked how much their beliefs were changed during the fall practicum, particularly field experience, they answered that there was no change in their beliefs about teaching and learning in general.

I: Do you have any change in your teaching though the field experience since teaching? Is there anything to add or comment about that point?

C: Not really (CI#2-7-4).

However, Ryan mentioned that the lab activity was getting more difficult to do with the students than he expected before entering the field experience and it might be said that there was incremental belief change about lab activity.

IV. Discussion And Implication

Several issues emerged through this study regarding preservice teachers' beliefs about teaching and learning, and these issues are discussed based on the main findings of the study and research questions, compared to previous research. The discussion follows (a) Preservice teachers' belief system and change, (b) Their beliefs and practices in the classroom, (c) Their personal experience and teacher preparation program before field experience, and (d) Mentor teachers' influences and other context factors on their beliefs.

1. Preservice teachers' beliefs system and its change

Two preservice teachers showed two systems of beliefs about teaching and learning science; the foundational beliefs and the specific beliefs. These preservice teachers showed the foundational beliefs about effective teaching methods, which were questions, repetition, rephrase, examples, and some directed instruction with the view of nature of science and science inquiry. As the specific beliefs, Ryan, one of the participants, showed that mistaking is the essential factor in students' learning, and preferred to using the inductive instruction. On the other hand, Cindy, the other of the participants, displayed that it is very important to connect the science content to the real world and use the students' prior knowledge.

They also held concerns about students and teachers, most of which were foundational ones. The foundational beliefs about students included assessment, learner-centered with cognitive development, groups working through activities, and active students' role in learning. The foundational beliefs about teachers included text/lesson plan, mentor teachers' influence, and teachers' roles as a facilitator or a helper, but sometimes as a director. Two participants also displayed these two concerns in a different way, but not as the specific one. For example, Ryan believed that technology is essential one for his teaching, however, Cindy showed her beliefs that technology can be helpful but not necessary. Both participants had different view about technology for teaching, but those beliefs can not be defined as the specific ones, which come

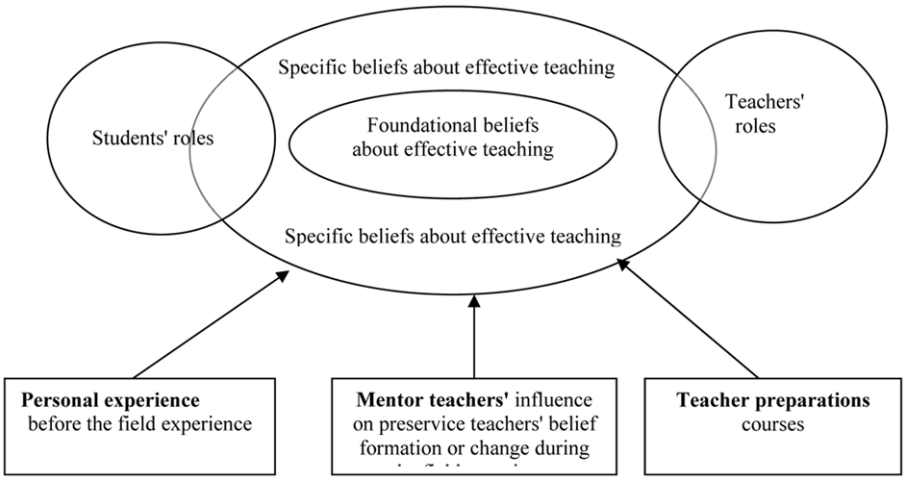

Fig 1. Preservice teachers' beliefs about teaching in the field experience.

from their personal experience or interest.

Two participants' beliefs system consists of two domains, one is the foundational and very common domain and seems to be located in the center in belief system, and the other thing is the specific one very depending on participant's experience and their interests. For example, teaching style is determined by teachers' personality. Ryan believed that he is the very person for teaching, which requires patience. Murray *et al* (1990, cited in Patrick & Smart (1998)) reported that suitability of the teacher's personality to a given course is an excellent indicator of that teacher's effectiveness rating.

Two participants responded that there was not change in their beliefs during the field experience, but one participant, Ryan, mentioned that he was getting more difficulty in doing lab activities with students as times went on, specifically in controlling students for their learning. This can be regar

2. The relationship between beliefs and practices by preservice teachers

The relationship between preservice teachers' beliefs and teaching practices showed both consistency and inconsistency. As one of the consistent evidences, two participants responded that they prefer questioning as a main teaching method or give examples for students' understanding and they really used both of them in their real teaching. However, as one of the inconsistent evidences, participants believed that a student must be an active learner and a teacher must be a facilitator or a helper, they were observed to deliver the knowledge from his/her head to a student's head. Students in the classroom did not have many chances to be involved in, so they were passive in their learning, though both participants believed that students must be active learners. Preservice teachers led the lesson by direct-instruction, though they used questioning and examples for students' understanding. They also exaggerated science inquiry skills in the science lesson; they did not demonstrate the inquiry lesson such as collecting data or communicating.

3. Preservice teachers' personal experience and preparations

Two preservice teachers' beliefs were already formed through their personal experiences and teacher preparation courses before entering the real teaching, field experience. Ryan, for example, described that using technology is essential for his teaching and got his ideas of lab activities from the Internet sources. On the other hand, Cindy did not prefer using technology, and she believed that using technology might be helpful, but not necessary for her teaching and students' learning. Furthermore, she believed that the safety during the lab is the most important thing and it is her job to make students good citizen through learning moral things. These two participants entered their fall practicum with their rich personal experiences, which already affected on his/her beliefs about teaching in the classroom. Richardson (1996) pointed out that three categories of experience are described as influencing the development of beliefs and knowledge about teaching, which begin at different stages of the individual's educational career. They are personal experience, experience with schooling and instruction, and experience with formal knowledge.

Another source where two participants held some beliefs about teaching and learning was the teacher preparation courses which participants had already taken before entering field experience. Two participants practiced how to make and when to use lesson plans through the methodology class, then they became to believe that making lesson plan is not related to the quality of teaching. Ryan, furthermore, used inductive instruction what he thought was the most effective instruction strategy. These all beliefs were formed while participants were taking preservice teachers preparation courses.

Two participants entered field experience with

foundational beliefs and specific beliefs from their personal experiences and teacher preparation courses. They brought some foundational beliefs about teaching and learning before entering field experience and in turn these beliefs had influence choosing teaching strategies in the classroom. Furthermore, studies of the origins of teachers' beliefs indicate that many different life experiences contribute to the formation of strong and enduring beliefs about teaching and learning. Within a constructivist learning and teaching framework, these beliefs should be surfaced and acknowledge during the teacher education program if the program is to make a difference in the deep structure of knowledge and beliefs held by the students (Richardson, 1996).

4. Mentor teachers' influence on preservice teachers' beliefs

The one of the most outstanding categories is mentor teachers' influence on preservice teachers' beliefs during the fall practicum. Two preservice teachers spent the whole one-month in assisting the mentor teachers and observing their teaching and preservice teachers' beliefs seemed to have been influenced by mentor teacher at this time. Ryan, one of the participants, mentioned that observing other teachers' teaching for one month was good experience to get ideas and compare his teaching methods with the others. He imitated the mottoes used by mentor teacher to get used to the environment where his mentor and his students had been so far. Ryan used technology a lot for his teaching and his mentor used technology a lot. Cindy, however, did not like to use technology and preferred traditional pencil-paper teaching method. Coincidentally, her mentor teacher did not use technology much, either. Cindy also mentioned that her philosophy was similar to mentor teacher's and that there was not a problem in teaching her students in the same environment where her mentor teacher and students had developed. Two participants seemed to have good relationship with mentors like friends by observing mentors' teaching, imitating their mottoes for management, and sharing ideas each other when working. The roles of mentor teachers are described as important factors for preservice teachers to form their beliefs through the field experience through guidance, mutual learning, and friendship (Fairbanks, Freedom, & Kahn, 2000). The researchers described that one purpose of mentoring relationship is to assist new teachers in the development of their professional identities. Preservice teachers bring multiple experiences and understandings to their practice teaching: personal experiences in school, first-hand awareness of classroom roles and rituals, influences of popular culture, and other interactions in school settings (Freedman, in press, cited in Fairbanks, Freedom, & Kahn, 2000). These perceptions often conflict with the reality of school and the pedagogical knowledge they acquire during preservice education, and learning to teach is a social process where preservice teachers must negotiate the contradictions between their previous conceptions of teaching and their present attempts to construct a provisional teaching identity. Therefore, it is important for mentor teachers to help preservice teachers negotiate their contradiction in real teaching.

Over all, it is complicated to figure out what kind of beliefs about teaching and learning science preservice teachers display through the field experience. There seemed to be conflict between their beliefs, which had been acquired through their pedagogical knowledge and personal experience, and their practices. Many factors might influence on the form of preservice teachers' beliefs structure, but there are common foundational and specific beliefs from preservice teachers' personal experience and their knowledge acquired through teacher preparation courses before field experience, and mentor teachers' influence of their teaching methods or philosophy during field experience.

Significance of this study

Teacher Preparation Program at Universities

Field experience in the classroom is the first career in teaching science for preservice teachers after preparation in the university. Preservice teachers applied everything that they learned in the preparation program to become effective teachers for students' most learning. This study displayed the problem which preservice teachers have during field experience so that educators can develop more effective programs to help preservice teachers explore their own pedagogical knowledge in the real context. Actually, present teacher-preparation courses and inservice activities in methods of teaching science frequently emphasize technical skills rather than decision making, theory, and reasoning. This study will serve to further improve the quality of field-based components of science teacher education and also provide significant insights into the development of the preservice science teachers' instructional behaviors, concerns, perceptions of teaching, and decision-making skills.

Science Teaching Implication

The most important concern in the classroom is to make students' meaningful learning. Preservice teachers might know what teaching skills and techniques to use and when to use for better students' accomplishments based on science inquiry. Skilled teachers guide students to understand the purpose for their own learning and to formulate self-assessment strategies (NRC, 1996). Preservice teachers experience what kind of different effective teaching methods to use in various context of the classroom, and this can make techniques of science teaching more effective and fruitful for students' achievement in learning. By real experience in teaching for the first time, preservice teachers' beliefs about teaching and learning might change to understand and respond to individual student's interest, strengths, experiences, and needs. Preservice teachers in this study recognized what teaching method to use in real context to be skilled teachers as a guide, a facilitator, or a leader as they concerned students' most outcomes.

References

American Association for the Advancement of Science, 1993, Benchmarks for
science literacy, New York, Oxford: Oxford University Press.

Bandura, A., 1977, Self-efficacy: Toward a unifying theory of behavioral change, Psychological Review, 84 (2), 191-215.

Bradford, C. S., & Dana, T. M., 1998, Changes in prospective science teachers' conceptions and practices during field experiences, Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Diego, CA. Beyer, C. J., & Davis, E. A., 2008, Supporting preservice elementary teachers' critique and adaptation of science curriculum materials using two types of educative supports, Paper presented at the annual meeting of the National Association for Research in Science Teaching, Baltimore, MD.

Brickhouse, N. W., 1990, Teachers' beliefs about the nature of science and their relationship to classroom practice, Journal of Teacher Education, 41(3), 53-62.

Brown, D. F., & Rose, T. D., 1995, Self-reported classroom impact of teachers' theories about learning and obstacles to implementation, Action in Teacher Education, 17(1), 20-29.

Bryan, L. A., 1998), Learning to teach elementary science: A case study of teacher belief about science teaching and learning, Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Diego, CA.

Cavallo, A. M., Miller, R. B., & Saunders, G., 2002, Motivation and affect toward learning science among preservice elementary school teachers: Implications for classroom teaching, Journal of Elementary Science Education, 14 (2), 25-38.

Cronin-Jones, L., 1992, The influence of methods instruction on the beliefs of preservice elementary and secondary science teachers: Preliminary com-parative analysis, School Science and Mathematics, 92(1), 14-22.

Dana, T. M., McLoughlin, A. S., & Freeman, T. B., 1998, Creating dissonance in prospective teachers' conceptions of teaching and learning science, Paper presented at the annual meeting of the National Association for Research in Science Teaching, San Diego, CA.

Fairbanks, C. M., Freedom, D., & Kahn, C., 2000, The role of effective mentors in learning to teach, Journal of

Teacher Education, 51(2), 102-112.
Fang, Z., 1996, A review of research on teacher beliefs and practice, Educational Researcher, 38, 47-65.
Flores M. A,m & Day. C., 2006, Context which shape and reshape new teachers' identities: A multi-perspective study, Teaching and Teacher Education, 22, 219-232.
Gess-Newsome, J., & Lederman, N. G., 1990, The preservice microteaching course and science teachers' instructional decisions: A qualitative analysis, Journal of Research in Science Education, 27(8), 717-726.
Haney, J. J., Czerniak, C. M., & Lumpe, A. T., 1996, Teacher beliefs and intentions regarding the implementation of science education reform strands, Journal of Researcher in Science Teaching, 33(9), 971-993.
Johnston, S., 1994, Experience is the best teachers; Or is it?: An analysis of the role of experience in learning to teach, Journal of Teacher Education, 45(3), 199-208.
Kagan, D. M., 1992, Professional growth among preservice and beginning teachers, Review of Education Research, 62(2), 129-169.
Khalid, T., & Girardeau, C., 2008, Teachers' attitude and behavior and student science learning, Paper presented at the annual meeting of the National Association for Research in Science Teaching, Baltimore, MD.
Khalid, T., 2003, Pre-service high school teachers' perceptions of three environmental phenomena, Environmental Education Research, 9(1), 35-50.
McDiarmid, G. W., 1990, Challenging prospective teachers' beliefs during early field experience: A quixotic undertaking?, Journal of Teacher Education, 41(3), 12-20.
National Science Foundation, 1996, National science education standards, Washington, DC: National Academy Press.
Pajares, M. F., 1992, Teachers' belief and edu-cational research: Cleaning up a messy construct, Review of Educational Research, 62(3), 307-332.
Patrick, J., & Smart, R. M., 1998, An empirical evaluation of teacher effectiveness: The emergence of three critical factors. Assessment & Evaluation in Higher Education, 23(2), 165-179.
Richardson, V., 1996, The role of attitudes and beliefs in learning to teach. Handbook of research on teacher education (2nd ed.), New York: Macmillan Library Reference USA.
Rokeach, M., 1968, Beliefs, attitudes and values: A theory of organization and change. San Francisco: Jossey-Bass.
Roehrig. G. H., & Luft, J. A., 2008, Exploring the first year of teaching in secondary science classrooms, Paper presented at the annual meeting of the National Association for Research in Science Teaching, Baltimore, MD.
Supervisor Guide, 1999, Preparing science and mathematics teachers professional teacher education licensure program, Science & Mathematics Education, Oregon State University.
Zeichner, K., 2002, Beyond traditional structures of student teaching, Teacher Education Quarterly, 29(2), 59-64.

Appendix 1

View of science teaching: Survey

This survey is to know what beliefs you have on teaching and learning science in the classroom.

SD: Strong disagree
D: Disagree
U: Undecided, or Unknown
A: Agree
SA: Strong Agree

1. Using technologies (e.g., calculators, computer, etc.) in science lesson will improve students' understanding of science.
2. Getting the correct answer to a problem in the science classroom is more important than investigate the problem in a scientific manner.
3. In grades K-9, truly understanding science in the science classroom requires special abilities that only some people posses.
4. Students should be given regular opportunities to think about what they have learned in the science classroom.
5. To understand science, students must solve many problems following examples provided.
6. The use of technologies in science is an aid primarily for slow learners.
7. Students should have opportunities to experience manipulating materials in the science classroom before teachers introduce scientific vocabulary.
8. Calculators should always be available for students in science classes.
9. Small group activities should be a regular part of the science classroom.

I will

10. Encourage students to work on problems and projects with other students.
11. Use a variety of approaches to help students

learn (group work, lecture, field-based work, hands-on labs and demonstrations, etc.).

12. Provide a variety of ways for students to demonstrate what they learned.
13. Help students to make connections between the course material and the "real world".
14. Provide frequent feedback on my work that helped students improve their learning.
15. Make learning goals very clear
16. Emphasize students understanding of "big ideas" or concepts rather than isolated facts and information.
17. Express the belief that students can learn and be successful in their classes.
18. Provide opportunities for students to "be" a scientist (posing questions, investigating problems, analyzing data, developing theories)
19. Use computer technology in ways that enhance students' ability to learn.
20. Require students to reflect on their learning through writing, journalizing, etc.
21. Share with the class reasons for choosing my teaching strategies.

Questionnaire

1. What was most memorable during your fall practicum of September and October?

- Positive aspect which might help your teaching
- Negative aspect which might hinder your teaching

2. Teachers' role in the science classroom
3. Students' role in the classroom.
4. Important teaching skills and instructional strategies in the science classroom

Appendix 2

Interview protocol

1. Think back on any science course where you feel you really learned. What was it related to this experience, which worked so well for you in your field experience?

2. Now think back on science course experience where your learning was hindered in some way. What was it that hindered your learning in your field experience?

3. What relationship, if any, exists between your ability to plan and the quality of your teaching?

4. What teaching skills/techniques do you believe to be of the most importance for you?

5. What role is your lesson- planning for teaching?

6. Based on what have you learned, which will be of significant help to your success in teaching students?