

Two Middle School Science Teachers' Experiences of Teaching Science in the Republic of Korea: A Phenomenological Analysis

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두명의 한국 중학교 과학 교사들의 과학 수업 경험에 대한 현상학적 분석

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Abstract: This study investigated how the unique educational contexts in the Republic of Korea (RK) impacted two science teachers' teaching practices in a public middle school and what the science teaching experience means to them. In particular, we explored how the middle school science teachers decide pedagogical approaches to use in their teaching based on classroom climate, students' attitude toward learning science, school curriculum and classroom culture. Using a phenomenological research approach, we analyzed classroom observation data and interview data to interpret the teachers' science teaching experience. Results of the study showed that the teachers' practice was dominantly affected by two external factors. First, the teachers' teaching practice was affected by the amount of science content knowledge they need to cover within a given class time. Second, the teachers' teaching practice was affected by students' attitudes toward science learning and their science preparedness in private tutoring centers. Implications of the study results are discussed in the paper.

Keywords: teacher beliefs, science teaching practice, phenomenological research

요약: 이 연구는 두명의 중학교 과학 교사의 과학 수업이 어떻게 한국의 독특한 교육 상황에 의해 영향을 받으며, 이러한 수업 경험이 그들에게 가지는 의미가 무엇인지를 알아 보기 위한 현상학적 해석 연구이다. 특히 본 연구는 두 과학 교사가 어떻게 교수 방법을 선정하며 외부적인 상황 즉 교육과정, 학교정책, 환경, 문화, 학생들의 학습동기등이 어떻게 과학 교사들의 교수 방법, 수업 실재에 영향을 미치는지에 중점을 두었다. 이 연구는 두 달간 대도시의 한 중학교에서 시행되었으며, 각 참여 교사에 대한 수업 관찰과 수업 관찰 후 이루어진 인터뷰가 주요 데이터로 사용되었다. 연구 결과는 현상학적 연구 방법에 의해 분석, 기록 되었다. 이 연구의 결과는 첫째, 과학 수업에서 다루어야 할 과중한 교과 내용의 양과 제한된 수업 시간등의 외부적 요인들이 중등학교 과학교사들의 수업에 대한 신념이나 경험에 상관없이 수업의 형태를 결정하는 중요한 요인이라는 것을 보여준다. 둘째, 사교육을 통해 이루어지는 학생들의 과학교과 선

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행학습과 학생들이 수업에 참여할때 나타나는 낮은 학습 동기가 각 교사의 교사의 역할에 대한 인식에 영향을 미치며, 궁극적으로 교사들의 교수 방법 선정에 영향을 미친다는 것을 보여준다.

주요어: 교사 신념, 과학 수업 실제, 현상학적 연구

Introduction

Widely cited as an international benchmark, the Trends in International Mathematics and Science Study (TIMSS) results showed that the Republic of Korea (RK) performed very well in science achievement in TIMSS Studies. For example, in 1995 and 2007, the RK's mean 8th grade science achievement was higher than all of the other participating 47 countries except Singapore, Chinese Taipei and Japan (Gonzales, 2009). However, science teaching in the RK has not been mentioned positively as much as its results in comparative studies. Often science teaching in the RK is characterized as highly content focused rather than real world problem solving or improving critical thinking skills. For example, in a comparative study examining teachers' views on the purpose of science teaching, Swain et. al., (1999) found that Korean science teachers have a view of science teaching that is more content focused such as finding facts, verifying facts and remembering facts, while the United Kingdom science teachers have a view of science teaching that is more process-focused such as solving of real-world problems, critical attitude toward scientific practices and logical reasoning.

The content a science teacher teaches and how that content is taught is more complex than merely what a teacher knows or how he or she was trained (Feiman-Nemser, 2001). The teacher's knowledge of the science topic (subject matter) and of the students, including prior knowledge and alternative conceptions related to the topic play an important role in determining their instructional practices. In addition, science teaching is also a highly personal effort and decision. It is affected by a teacher's personal experience, beliefs, culture, in which they construct their world view. Particularly, science teacher's belief about science teaching provides a tool to understand a

science teacher's instructional decisions because it determines what good science teaching is in the teacher's mind (Nespor, 1987).

In addition, often science teachers' instructional practices are affected by school's environmental and political factors such as school systems, curriculum policies, and school district policies (Knapp & Plecki, 2001). Therefore, science teaching is a process of determining the current concepts and constructing knowledge based on what the teacher knows from his or her experience in a certain teaching context such as the school's environment, culture, policy and so on (Atwater, 1995). Grossman (1990) defines "teacher knowledge of context" as one category of the important teacher knowledge bases that influence practice. Cochran et al. (1993) also add emphasis to the socially constructed aspects of teachers' pedagogical content knowledge (PCK), which interacts with teachers' knowledge of the environmental context and students. They argue that teachers' context knowledge is socially constructed and negotiated through the complex and active process of knowledge transformation using teacher's knowledge of school environmental context and students.

In short, science teaching is a complex process affected not only by teachers' knowledge of student and subject matter but also by various contextual factors such as school and district policy, national curriculum, school climate and culture, and beliefs about science teaching. The Republic of Korea has a unique context in terms of a history of development of national curriculum and educational systems and a history of industrial development that has shaped the educational system. These contextual factors could affect the RK science teachers' practice, which is often referred to as being more science content focused than other countries. However, in most studies about science teachers' practice in the RK, the

contextual effects on science teaching are not considered enough. Beyond the statistical evidence of students' science achievement or general statements of differences, we need to closely examine cultural or political aspects of science teachers' teaching practices in the RK science classrooms. Using a phenomenological approach, this study attempts to understand how the unique educational contexts in the RK shaped two science teachers teaching experience in a middle school and what the science teaching experience in the school means to the two science teachers.

Methodology

In this study, we explored two middle school science teachers' teaching practice. Particularly, we were interested in exploring how the Korean middle school science teachers decide pedagogical approach based on the external factors such as school policy, school environment, classroom climate and culture these factors. We utilize a phenomenological research approach to interpret the teachers' practices.

In phenomenological research, the lived experience is the source of data (Van Manen, 1997) and it is important that we explore our own experiences, backgrounds, and beliefs. Both authors of this study are former 5-8th grade science teachers and have spent several years in public schools in the RK. Our experiences have given us a particular understanding of the participants, Young (a male teacher), and Jin (a female teacher), that the teachers want to be doing their best for teaching science in their school's context. The specific methods of investigating the lived experience including gathering data (the selection of participants, observations of classroom, interviews), reflection of the lived experience (text analysis), and writing is described in detail in the following sections.

Context

This study was conducted in a large city in the RK during June and July 2011. Due to the location and population of the city, complex educational characteristics appear in the city. For example, there

are some variations in students' science achievement depending on the school locations. The school in which we conducted this study was a middle school located in an urban area in the city. Because of the accessibility to the main facilities and community resources of the city, the school location is considered one of the best locations in the city. However, the students' achievement level and socio-economic status (SES) are about average of the city's.

Participants

Two science teachers were selected purposefully for two reasons: 1) they were teaching the same science topic (weather) at the time of the study; 2) they have more than three years' of science teaching experience in the school. Both of the teachers were teaching 8th grade general science. One teacher (Young) is a male teacher with biology background. He has been teaching science for five years at the middle school where this study was conducted. The other teacher, Jin is a female teacher. She has physics background with thirteen years of science teaching experience. Jin taught science at two different middle schools before she came to the school. Jin is also a very active and enthusiastic science teacher in terms of improving her professional teaching skills. She has a master degree in physics and keeps taking professional development programs for teaching science for talented and gifted students.

Data Source

Teacher Interview: Each teacher participated in four semi-structured interviews designed to elicit teachers' understandings about the cultural and political environmental aspects of teaching science as well as their beliefs on science teaching. During the interviews we wished to find the essence of the teachers' experience and used several follow-up questions. We also looked for the deeper meaning of their experience and encouraged interviewees to recall specific moments in their teaching and to interpret those moments. Particularly, to investigate the teachers' beliefs of science teaching, we modified Luft and Roehrig's

(2007) Teachers' Beliefs Interview (TBI) protocol. Each interview lasted approximately one hour and was held either after first or second classroom observation, or after their fifth or six classroom observation to get vivid reflections about the participant teacher's science teaching. In addition, the teachers provided information about their educational background and science teaching experiences. The interviews were recorded and transcribed verbatim.

Classroom Observation: We observed each participant's classroom six times with at least one week interval between observations to get consistent classroom data. Detailed written descriptions were made to get a complete picture of the participant teacher's teaching practices. To make a comfortable atmosphere during the classroom observation, participant teachers introduced the researchers to the students and explained the purpose of the research.

Data Analysis

We chose Van Manen's hermeneutic phenomenological reflection as our analysis method. Van Manen (1997) said phenomenological themes are not objective or generalizations; they are more like knots in the webs of our experiences, around which certain lived experiences are spun and thus lived through as meaningful wholes. We used thematic analysis in hermeneutic phenomenological reflection to find the themes as the essential structures of experience. To conduct a thematic analysis, first we read the interview transcripts and the written descriptions of the classroom observation several times. We agree with Dahlberg's (2001) position that the importance of this initial reading should not be underestimated, especially if the data are extensive like in the case of interviews or classroom observation. Thus, we used the selective or highlighting approach, which is one of the three approaches to uncover thematic aspects of a phenomenon in Van Manen's (1997) position. First, we individually read through the data to uncover emerging themes. Then we created a table for recording these initial themes. Then, together, we re-

read the data to find the patterns of consistency and agreement in our emerging themes. Based on this work we were able to identify recurrent themes which addressed each of our research questions.

In phenomenological human science, writing is not merely a final step of the research process but the objective of the research process, as "writing is closely fused into the research activity and reflection itself" (Van Manen, 1997). However, writing is "difficult sometimes to persist with a theme and systematically explore its meaningful aspect" because it is different from the description of the research results which we found but still a creative and detective process for finding the meaning of lived experience in hermeneutic phenomenological research (Van Manen, 1997). We used a thematic structure for writing using the thematic analysis of text results.

Findings: two science teachers' lived experiences of teaching science in the RK

I know that this is not an ideal way of teaching science but this is what I can do: Teacher beliefs

In middle schools in the RK, quality of science teacher is often judged by the level of students' science achievement on national standardized tests scores. This situation is true at the school in which this study was conducted. Both of the participant teachers knew this situation well. Thus for both of them, the most important purpose of teaching science was to increase their students' science achievement. However, increasing student's science achievement was not an easy task for them. Both of the teachers were concerned that the amount of science content knowledge they should cover during the class was too much for the given class time. In the educational context in the RK, science content is fixed by national curriculum and standards and the teachers were pressed to cover all of the content knowledge due to different external factors such as parents, school policy, district's climate, national standards and government policy. In other words, there is not much

freedom for individual teachers to choose science content knowledge. Thus increasing students' achievement means that most of the students should learn and gain a certain level of science knowledge about all the science content in the text book. In the following quote, Jin shared her experience about this issue:

I think half of what I have in the text book is enough for my 8th grade students. Actually a year ago, I skipped a text book chapter at the end of the semester because I thought it was better to focus on one of other chapters and spent more time on that. But I found that my students struggled in high school when they learned the science concepts I skipped. Even if it was because of a good reason like...focusing on a more important chapter or concept, in my opinion, I realized that I cannot skip any chapter in the text book because eventually the students should learn it to take the college entrance exam at highschool.

In this situation where the science teachers should cover most of the science content in the text book despite them thinking they do not have enough time, there is not much freedom for the teachers to choose science teaching methods, or instructional approaches. In other words, even if Young and Jin has certain beliefs about what a desirable way of teaching science would be, they would not have enough time to implement it in their science classes. As Jin mentioned, "Good science teaching is helping students to think critically about real world problems but I often skip good teaching materials I prepared due to the lack of time to cover science content that is already scheduled for that time." Both of the teachers regret that they did not have enough time to address how real science and scientists work including nature of science. The following quote demonstrates how the teachers address this concern:

I wanted to be a scientist and I really like what I studied, physics. For my science teaching, my experiences of scientific experiments in physics laboratory are useless because my science curriculum does not allow enough time to experience what and how real scientists are doing. I regret that my science teaching schedule does not have enough room to do science experiments and

hands on activities. I know that science experiments would really help my students to understand what science is, nature of science. Real science is not memorizing scientific facts but doing problem solving and improving critical thinking skills through trial and error. My current teaching method is very teacher-centered and makes my students are very passive learners. I think there is a huge gap between the amount of content knowledge recommended by the national science curriculum and what science teachers can cover in real science classrooms (Jin).

Furthermore, Young noted:

I want to spend more time for science experiments for my 8th grade students instead of delivering science knowledge and concepts. But I need more time to prepare science experiments. The number of students in one class is too big so I need to pay attention for lab safety and classroom management. I know that the students would be more interested in doing science experiments and I believe science experiments would help them to learn science better. However, there is also too much science content in the text book that I should cover at the same time (Young).

As the above quote demonstrates, Jin concerned that her students would not learn what science is or the nature of science from her science lesson. Young also concerned that what his students learned from his class would not help them to be more scientifically literate people for their future life as he said, "Teaching science is teaching how nature works as well as how human society is working but I regret that I cannot address the importance of science in my students' life fully during the class". Both of them also agreed that they need more time to prepare science experiments for their students.

We also found that a lack of time and pressure to cover all of the content knowledge in the text book in a limited time affected the teachers' teaching practices. First, it limits teachers' choice of instructional approach. For example the teachers preferred to choose a teacher-centered lecture approach to reduce classroom management issues. In this teacher-centered approach, students' behavior and the classroom

climate would be very important factors for effective science teaching. Thus, for both of the teachers, getting their students' attention on the teaching was the biggest issue during their science teaching. Because they need to cover a lot of content in a limited amount of time, the teachers need to keep moving forward to teach science content even if they thought most of their students would not be interested in learning the science content. For most of the class time, the teachers tried to get students attention using different techniques. For example, Jin called students' names or used extra points as an incentive to get the students' attention. The length of class time that teachers spent for classroom management and for getting students' attention was almost one third of the class time. Both of the teachers shared student worksheets for science lesson. For both of them, using student worksheets was one of the main methods for teaching science because it could cover a large amount of science content in a short period of time.

Second, the lack of time does not only limit the teaching approach but also makes the teachers to simplify or distort important scientific ideas during class. Sometime the teachers skipped what they had prepared because of the tight class time. For example, Young said that sometimes he should simplify or distort the meaning of the nature of science. He said, "I don't mention the nature of science in my science class. Sometime I make my students assume that science laws and theories are immutable because the idea of exceptions in science are too much to deal with in my class". The fact that science is not a complete set of knowledge but subject to change is an important idea to understand nature of science. However, in Young's class, he did not want to explain this because he thought this could make his student confused about the definition of scientific knowledge, laws and theories. Jin also addressed this issue in the following quote:

I tried to use some of the materials and topics, examples from their everyday lives but I don't have time to fully integrate it into my teaching because students

easily can be distracted by the example I prepared and I don't want to waste time to get their attention back to the science topic.

More importantly, the lack of time and pressure of covering all the science content in the textbook pressed the teachers to focus more on the students' behavior or classroom management than their learning of science knowledge. The following quotes from Jin and Young show how managing the classroom and controlling student behavior during the science lesson is a huge concern for teaching science.

My objective for this year is not teaching science content but changing their attitude to learn science. Their textbook and notebook should be ready before the class starts. The energy I spend for making my students ready to learn or to engage them in learning science is too much. I ask students to write scientific terms related to the science topic I covered during class ten times as their homework and then I check if they did their homework before I start the science lesson. (Jin)

Young said:

I first try to present science topics using fun examples to get students' attention. If this approach is not working, I say that the science concept will appear on a quiz or final test. I almost oppress my students to focus on learning the science concepts. Science experiments are not an alternative way of redirecting student attention to learning science. Sometimes science experiments make them more distracted from learning the science topic.

As above quotes address, lack of time to prepare science experiments as well as lack of class time to teach science concept through scientific inquiry or science experiments were important factors that affect the teachers' teaching practices that are more focused on classroom management than effective instruction to engage students in learning science concept. We address another important factor that makes the teachers consider more about students' behavior or classroom management during their science teaching in the following section in regards to teacher identity.

What is my role as a science teacher?: Teacher identities

The teachers mentioned that their role as a science teacher is to get their students to be more interested in learning science. But they were not positive that they were on the right track.

The limited time and pressure to cover a huge amount of science content affects the teachers' identity as a good science teacher. Jin reflected on her feelings at a moment when she was thinking about her teaching:

To get my students' attention, I always say this, "It is a very important concept because I'm going to use this for the next quiz or unit test" but at the same time, I say to myself "Is this really important for them, for their life?" I'm very sad that I should say "This is important because it will appear on your test". I believe the purpose of teaching science in our country is to help students find answers quickly on school tests.

The most important factor that makes the teachers regret how they are doing their job was related to the teachers' identity and their perceptions of their role as a science teacher. This issue was directly related to the students' behavior and response during the class as the following quote addresses:

During a test season, most of my students do not even answer my questions in class because they already know what I'm going to teach from private tutoring centers, or they are physically tired to pay attention on my teaching or even sit in class because they spent most of their afterschool time by attending private tutoring centers. I do not think that I have authority as a science teacher because they do not want to learn science in my science class (Jin)

Young stated:

I am not sure how much my teaching would help my students' learning because they already learned science in private tutoring centers. Some of my students' parents were arguing about the amount of science homework because they didn't want their kids are distracted by my homework while they study science at a private tutoring centers. The parents seem to trust private tutors more than me. I believe that many other public school

teachers would feel the same way I do.

According to the teachers, about ten percent of students already know what they are going to learn from school by private tutoring. More than half of the students take science classes at private tutoring centers. Thus more than half of the students sat in a science class are not learning but reviewing science content that they have learned from outside of the school. The teachers said that they are often confused by their role as a science teacher. They said that they knew what ideal science teaching looks like and how they could motivate students to engage in science lessons and help them to be better critical thinkers but in reality, the students were bored by learning the same science content. As Jin mentioned, "The important purposes of teaching and learning science is addressed in national science standards. They are fancy but not realistic. Science achievement, getting high scores on standardized tests is the most important purpose of teaching science in reality. I hate this situation".

As addressed in the prior section, the lack of time to prepare science experiments as well as to teach science concept through scientific inquiry or science experiments were important factors that affect the teachers' identity negatively because the teachers could not teach science in a desirable way that they believe a good science teacher should do. However, as addressed above, students' attitude and motivation to learn science were even more important factors that affect the teacher's identity and their perceptions of the role of science teacher in the science classroom. Both of the teachers were not satisfied with their science teaching context or even being a science teacher for the students who already know most of the science concept they should learn in the classroom and who are not interested in learning science. More importantly, they felt that they could not control this situation for making learning science more meaningful for their students.

The findings of this study delineate that the two teachers' experiences of teaching science, specifically, the meanings of teaching science in the school context

have been shaped by various external and social factors such as the situations of students' private tutoring, the amount of science content the teachers should cover during a science class, and parents' expectations about school science teaching. As the subtitles of the finding section show, the teachers' experiences of teaching science in the school context can be described as two sentences; *I know that this is not an ideal way of teaching science but this is what I can do* and *What is my role as a science teacher?*. The first sentence implies that the teachers' practices of teaching science are not reflecting the desirable ways of teaching science that the teachers believe. The second sentence implies that the teachers regret the situation that their role as a science teacher in science classrooms are not engaging students in science inquiry process or in learning nature of science but reviewing or delivering science content knowledge for only science knowledge gain.

Discussion and Implications

The purpose of the study is to explore two middle school science teachers' experience of teaching science in a public middle school context in the RK. As the findings show, there is a gap between the teachers' practices of teaching science and the desirable ways of teaching science that the teachers believe. In addition, the teachers are not satisfied by their role as a science teacher in the school context. We found that there are two important external factors that dominantly affect the teachers' meaning of science teaching experience in the RK middle school context regardless of their beliefs of science teaching or understandings of their students: 1) amount of science content knowledge and limited class time, and 2) the level of students preparation and private tutoring that affects the students' attitude toward science learning and motivation to learn science in school science classes.

There is no one simple answer about what good science teaching is because teaching is a dynamic process that is affected by different and complex

contextual factors. In different contexts, the definition of good science teaching could be defined differently. Sometimes, students' science achievement is considered the most important factor to judge the effectiveness and the quality of science teaching. In this case, how the science achievement is measured is also important to understand the quality of science teaching. Unfortunately in the public school context in the RK, science achievement is mostly measured by science test scores. This situation makes many students heavily rely on private tutoring because of the huge amount of science content they should learn. School teachers do not have enough time to use scientific inquiry approach for teaching science, which often includes hands-on activities and science experiments and considered as effective teaching strategies for engaging students in learning science and make students more interested in learning science. Due to limitations on class time and the amount of science content necessary to cover during a school year, teachers often emphasize more on classroom management for controlling students behavior for effective lecture. This approach of teaching science make the students more passive to learn science and consequently they are not prepared as scientifically literate future citizen and further they are not properly trained to enter scientific fields.

The purpose of this study was not to suggest a solution for a better educational environment for teaching science but to reveal how this educational situation affects teachers' identity and their perceptions of their role as a science teacher. Because teaching is one of most fundamental social interactions in our society, we cannot neglect how teachers feel and interpret their experience of teaching. The results of this study are not positive in terms of how the teachers feel about their teaching career and experiences of teaching in a public middle school.

We believe this study has two implications for general teacher education research. First, while we agree that the teaching practice is a complex process and affected by many factors, this study shows that certain factors could be more dominant than other

factors. In this study, teachers' practice was dominantly affected by the amount of science content they are required to cover and the limited time they have to cover it. There is not enough time for them to cover all of the science content knowledge addressed in the text book. Thus we need to consider this situation for better educational policy development and developing national science curriculum. Second, the social context that many of the students and parents do not rely on the public school education to learn science was a problem. This was a big issue because it directly affects a teacher's identity as a science teacher and consequently it affects their teaching practice. The teachers' practice and their instructional approach is often based on their beliefs of science teaching. However, in the situation that the teachers know that their students want to review what they already learned from private tutoring centers, the teachers easily lose motivation to be a better science teacher. Thus teacher educators should consider this social and educational situation in the RK when they teach teachers in professional development programs or teacher preparation programs.

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