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Examining the Impact of an Experiential Learning Special Education Course on Pre-Service Science Teachers' Perceptions About Inclusive Science Education*

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《 요 약 》

This research introduces an approach to science teacher education programs using experiential learning to educate pre-service science teachers about inclusive science education for special education needs (SEN) students. Utilizing experiential learning and reflective practice as frameworks, we designed a 15-week course to challenge pre-service science teachers' assumptions about SEN learners and their roles as science teachers in inclusive science classrooms. In this paper, we describe features of the course and discuss the need to provide content-specific instruction for teachers about how to effectively meet the needs of SEN students in inclusive classroom settings. We offer important implications about the value of experiential learning for pre-service teachers and we highlight potential areas for transformation in special education, science teacher education, and professional development programs for pre- and in-service teachers in Korea.

Keywords : special education needs (SEN) students, pre-service science teacher education, science equity, experiential learning, inclusive science education

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Ⅰ. INTRODUCTION

In Korea, as in many other countries, teachers are tasked with meeting the needs of diverse learners within the same classroom setting. Special education needs (SEN) students are increasingly being placed in regular education settings as the practice of inclusive education becomes more prevalent. Since the passing of the Special Education Laws for Persons with Disabilities and Others (장애인 등에 대한 특수교육법) in 2002, Korean schools have seen dramatic increases in the percentage of SEN students partially or fully enrolled in classrooms in general education schools (Table 1). From 2004 to 2016, there was a three-fold increase in the number of SEN students in general education schools (Ministry of Education, Science, and Technology, 2008; Ministry of Education, 2016).

〈Table 1〉 Percent population of students in special and general education schools 2004-2016

Year	Special School	General School	Total
2004	23,762 (42.9%)	31,612 (57.1%)	55,374
2008	23,400 (32.7%)	48,084 (67.3%)	71,484
2012	24,720 (29.1%)	58,179 (68.4%)	85,012
2016	25,467 (29.0%)	61.989 (70.1%)	87,950

However, successful inclusive education requires that teachers have not only training about the various characteristics of individual learners, but also clear understanding about general and content-specific instructional strategies that can support SEN students to effectively learn and make adequate educational and social progress. Content-area specialists in math and science, who may face even more challenges in inclusive classrooms, can benefit from more knowledge about how to communicate difficult concepts and teach using specialized vocabulary and materials (Kwon, 2012). Researchers are increasingly advocating that more content from the field of special education should be embedded in content-specific coursework used to prepare future math or science teachers (Villanueva, Taylor, Therrien, & Hand, 2012). Research has shown that providing

experiential activities that connect teachers and SEN students can foster favorable teacher attitudes toward inclusive education and improve teachers' capacity to connect with SEN students on a personal level (Beh-Pajooh, 1992; Shimman, 1990). However, in order for this to happen, teachers need opportunities to engage in authentic teaching experiences that provide expanded opportunities for teachers to develop as practitioners who can enact complex, responsive teaching practices (e.g., Grossman, 2005; Grossman, Hammerness, & McDonald, 2009).

Unfortunately, pre-service teachers in Korea are only required to take a single two-credit special education course designed to introduce basic information about general pedagogical strategies for supporting SEN students. Pre-service teachers also lack sufficient time to engage in practicum teaching experiences and have limited chances to interact with SEN students. This reality is reflected in findings from recent research showing that Korean teachers have limited awareness about how to support SEN students academically or socially (Kim, Park, & Lee, 2015), have limited knowledge about how to effectively implement students' individualized education plans (Kim, Park, & Lee, 2015), and do not know how to develop and support SEN students to set appropriate goals for post-secondary education or employment as part of a students' transition education plan (Martin & Im, 2013). Thus, it is clear that pre- and in-service teachers in Korea could benefit from more course work and professional development about how to teach diverse learners.

Increasingly, researchers are advocating for field-based methods courses and experiential learning activities that can help pre-service teachers more easily connect theory learned from university coursework (Lampert, 2010; Cochran-Smith & Lytle, 2009; Santagata & Yeh, 2014). These approaches are especially successful when teachers are provided opportunities to critically reflect on what can be learned from applying theory to authentic teaching experiences (Siry & Martin, 2014). In this paper, we describe an approach to inclusive science teacher preparation that draws from experiential learning theory (ELT), which asserts that knowledge and understanding are created through experience. ELT emphasizes that experience plays a central role in the learning process and also stresses the need to incorporate constructivist learning opportunities

and reflection so that individual learners can construct knowledge by engaging in and reflecting on deliberate actions (Carver, 1996; Kolb, Boyatzis, & Mainemelis, 2001; Kolb, 2015).

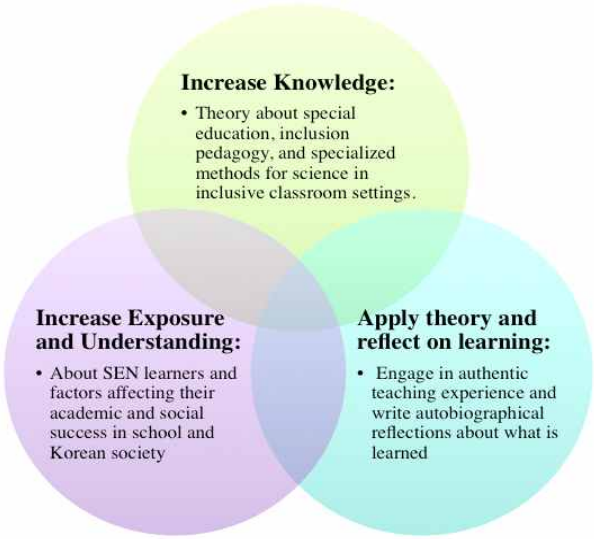
To improve future science teachers' awareness about SEN students, we designed an experiential learning course to support pre-service science teachers (herein, referred to as pre-service science teacher) to engage in activities utilizing inclusive pedagogies in science. We invited pre-service science teachers to participate in a series of activities where they encountered both concrete and abstract representations of new concepts and were then supported to reflect on their experiences to make meaning about inclusive science education for SEN students. In this paper, we report findings to answer the following research questions:

1. How does participation in different aspects of this experiential learning course inform pre-service science teachers' perceptions about inclusive science education?
2. What are the benefits and challenges of implementing experiential learning courses to transform teacher education programs?

Ⅱ. Methodology

1. Context of the experiential learning course

In this paper, we seek to focus attention on how experiential activities influenced pre-service science teachers' perceptions about inclusive science education. Our course engages pre-service teachers in a series of experiential activities designed to increase knowledge about special education theory and inclusion pedagogy, increase exposure to and understanding about how disability limits the academic and social potential of SEN students in Korean schools and society, and provide opportunities to apply what has been learned in authentic science teaching experiences with SEN students (see Figure 1).



<Figure 1> Key components for experiential learning course promoting inclusive education

Specifically, we worked to integrate theory and practice by designing activities to meet these three interconnected goals. A key component necessary for supporting our teachers' to benefit from these experiential learning activities is critical reflection. To support our pre-service teachers to process their experiences and to make meaning of how theory about inclusive pedagogy could be applied to authentic teaching practices, we also engaged the pre-service teachers in our course in critical reflection activities via autobiographical writing and by engaging in dialogue using an online discussion board.

Throughout the course, our teachers were engaged in activities to support them to integrate theory encountered in coursework with the practical work from the experiential-based activities. Experience-based activities included 1) a lecture by a parent of a child with disabilities, 2) a site visit to a special school, and 3) a full-day science fair developed by the pre-service science teachers and implemented with students with hearing impairment and other impairments (students with visual and/or cognitive impairment in addition to hearing impairment). In the section that follows, we provide some details for each of these activities.

1) Lecture by a parent of a child with disabilities

In order to offer pre-service teachers an opportunity to gain a more holistic view of SEN students and their families, we invited a speaker from a parental advocacy group for children with disabilities called 함께가는 서울장애인부모회 (http://www.sebumo.com). This group advocates for the educational rights of SEN students. We invited a lecturer whose child had been diagnosed with a developmental disability. She gave a two-hour talk about the purpose of inclusive education and how schools and teachers could more effectively interact with SEN students and their families in order to improve SEN students' education (See Figure 2). She also shared her personal experiences about the challenges that families with children who have disabilities in Korea face. The parent also shared her child's special interests in learning science and about the joy her child had brought to her life. The goal of this activity was to provide a real voice advocating for the benefits of inclusive education and the need for teacher support for SEN students. The pre-service teachers in our course prepared questions in advance for the lecturer and engaged in a whole-class two-way dialogue after the initial lecture period.

<Figure 2> Parent advocate lecture (left) and special education school site visit (right)

2) Site visit to a special education school

To expand pre-service teachers' understanding about special education in Korea, we made a site visit to a special school serving students with

hearing impairment and other impairments (See Figure 2). The school provided our teachers an opportunity to view well-funded and -developed school facilities and to learn about the school's transition education program that supported students to develop career skills in the field of technology. Pre-service teachers had a chance to meet the high school students who would attend the science fair at the end of the semester and engaged in a dialogue with these students about their interests in science and expectations for the fair. Our pre-service teachers also had a discussion with the principal and a special education teacher from the school about teaching SEN students and about the value of providing science education for all students. In addition, our pre-service teachers received information about careers in special education and employment in special schools.

3) Science fair for students with hearing impairment and other impairments

The pre-service teachers developed and implemented various science-related activities at a full-day science fair for the students they met at the school site visit. Pre-service teachers first developed their science lessons and then worked to apply theories about special education and inclusive pedagogies to modify activities and assessments in their lessons so that they could accommodate nine Grade 11 students for a full day of activities held at our university campus (See Figure 3).

<Figure 3> Authentic teaching and learning activities from Science Fair for All Students

The high school students were able to select two activities from the

categories of physics and earth science and one activity from the categories of chemistry or biology. In addition to participating in the science activities for two hours, pre-service teachers also organized a guided tour (with accommodations for students with hearing impairments), a tour of real science laboratories, and a lunch on campus. At the end of the science fair, the high school students received certificates from the university to commemorate their participation in this extra-curricular event. At the close of the fair, the high school students, principal, and science teacher from the school provided critical feedback about the activities to help our pre-service teachers evaluate the quality of their science lessons and the effectiveness of the accommodations they used to increase the accessibility of the content for the SEN students.

2. Participants

The participants in this study included pre-service science teachers who enrolled in our experiential learning course in the spring semester of 2016. To participate in our study, pre-service teachers were required to complete a pre- and post-course survey and participate in one-on-one and group interviews. All pre-service teachers in this 3-credit elective science education course participated in the experiential learning activities, autobiographical writings, and online discussion boards. However only some pre-service teachers (11 of 28) chose to participate in the additional data collection needed to support our evaluation of the course. Most pre-service teachers in the course were seniors and almost all had taken a basic 2-credit special education course during their freshman or sophomore year (see Table 2 for more details about participants).

〈Table 2〉 Pre-Service Science Teacher Participant Demographics

	Gender	Major	Year	Pre-course
1	F	Biology Ed.	4	Y
2	M	Earth Science Ed.	4	Y
3	F	Earth Science Ed.	3	Y
4	M	Earth Science Ed.	4	Y
5	F	Biology Ed.	4	Y
6	M	Earth Science Ed.	4	Y
7	F	Earth Science Ed.	4	Y
8	M	Earth Science Ed.	4	Y
9	M	Biology Ed.	4	N
10	M	Chemistry Ed.	2	N
11	M	Earth Science Ed.	4	Y

To be able to determine the impact this course had on expanding pre-service science teachers' knowledge about special education and inclusive pedagogies and increasing teachers' exposure to and understanding about SEN students and people with disabilities in society, we conducted a pre-course survey to ask our teachers about their prior personal experiences with people with disabilities and any teaching experience with SEN students (See Table 3).

〈Table 3〉 Pre-Service Science Teachers' Prior Experiences with People with Disabilities

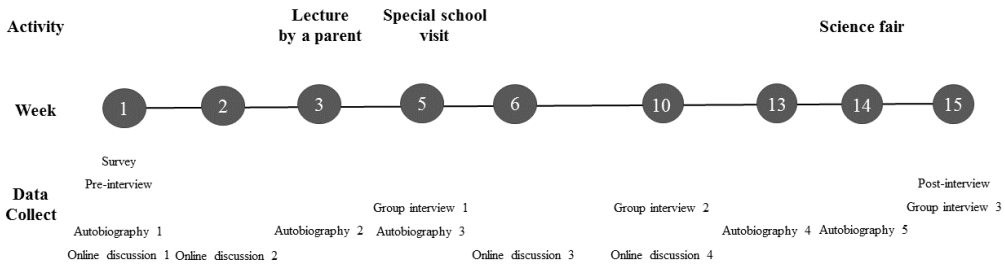
	Experiences with people with disabilities				Teaching experiences
	Inclusive class	Voluntary work	Indirect experience	Acquaintance with disabilities	
1	N	Y	N	N	N
2	Y	Y	Y	Y	N
3	Y	Y	N	N	N
4	N	Y	N	N	N
5	N	Y	N	N	N
6	Y	N	N	Y	Y
7	Y	N	Y	N	N
8	Y	N	Y	N	Y
9	Y	N	Y	N	N
10	Y	N	N	N	N
11	N	N	N	N	N

All but one pre-service science teacher reported they had prior experience or knowledge about inclusion education or people with disabilities. Most pre-service teachers indicated they had either been a peer of an SEN student in an inclusive class in elementary or secondary school (N = 7), had engaged in volunteer activities with organizations for people with disabilities (N = 5), or had heard about these issues from indirect sources such as mass media (N = 4). Notably, two pre-service teachers reported more substantive connections, including a teacher who had a cousin with autism (Pre-service teacher #2) and a teacher whose sister had an intellectual disability (Pre-service teacher #6). Finally, two pre-service teachers reported having had previous opportunities to teach SEN students in an informal learning environment.

3. Data Collection and Analysis

1) Data Collection

During the 15-week semester, we collected data from various sources to support our examination of each component of the experiential learning course to determine the relative effectiveness of the activity and to help us evaluate our overall course design. The data collection process and course outline is depicted in Figure 4 and more details about the process are described below.



<Figure 4> Data collection plan for experiential learning courses

(1) Pre- and Post-interviews

Semi-structured and open interviews were conducted before and after the course to compare participants' perceptions about inclusive education. Analysis of pre- and post- interviews provided evidence of the overall impact of our experiential learning course.

(2) Group Interviews

Group interviews were conducted to examine the impact of each activity in this course on participants' perceptions. Pre-service teachers were divided into two groups and each group participated in an interview, with researchers following each activity to discuss what they learned about special education and inclusive pedagogical theories and how the activity expanded their understanding about SEN students.

(3) Autobiographies and Online Discussions

Autobiographies were collected at five points: before and after the course and after each of the three main course activities. Participants were asked to reflect on their experiences and write about their perceptions about inclusive science education. Pre-service teachers also participated in four online forum discussions developed to help teachers explicitly make connections between theory, their experiences, and personal perceptions about SEN students and inclusive education.

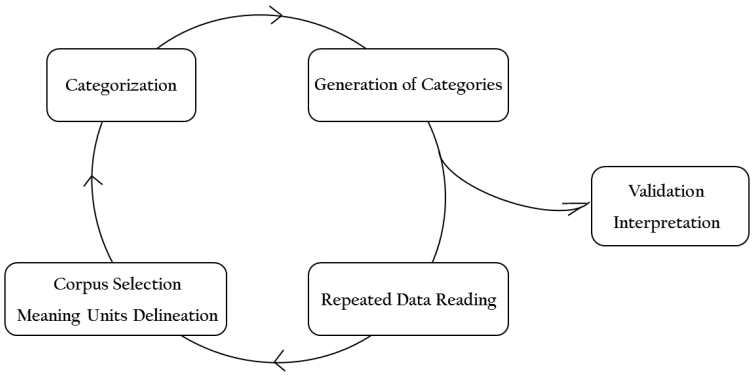
(4) Field Notes and Course Artifacts

Researchers wrote field notes about participants' practices in each activity, on-going questions, and interactions. Course artifacts included all assignments and materials submitted by participants during the course, including lesson plans, assignments, and presentations.

2) Data Analysis

To assess the impact of our course activities on pre-service science teachers' changing perceptions about inclusive science education, we used qualitative research methods (Elliott & Timulak, 2005). During each phase

of the course, we examined the data to identify general patterns and trends —as well as contradictions—among participants' responses to the activities. All interviews were audio recorded and transcribed. The interviews, autobiographies, discussion board threads, assignment artifacts, and field notes were read repeatedly. Through an iterative process, we selected a corpus representing the main ideas related to the purpose of the research. We extracted and delineated meaning units to help us classify and formalize categories of findings from across all data sources. Afterwards, we generalized the categories and examined the relationships between them. We repeated this process for over a period of one year until we reached the point of data saturation, and then we finalized the categories and validated our interpretations through member checking and formal presentations of data and among the researchers (See Figure 5).



<Figure 5> Iterative process for data analysis

Internal reliability and validity of our data analysis was established by triangulating data from different sources (Elliott & Timulak, 2005), engaging in a repetitive process, and engaging in on-going discussion between the researchers. We strengthened the external reliability and validity by inviting feedback via external audit (Lincoln & Guba, 1985) of findings via domestic and international conferences, where we received extensive peer review (Glesne, 2015).

Ⅲ. Findings

To present our findings, we have organized our data to show how the pre-service teachers' participation in each of the three different activities in our course affected the their perceptions about inclusive education. We then share findings about what we learned regarding the relative benefits and challenges of implementing experiential learning courses in a pre-service teacher education program. Following the presentation of our data, we discuss our conclusions about the effectiveness of using this approach in teacher education and we consider the implications for transforming programs that have the potential to improve teaching and learning opportunities for SEN students in inclusive classroom settings.

1. Evaluating the Impact of Each Experiential Activity on Pre-service Science Teachers' Perceptions About Inclusive Science Education

While the pre-service teachers in our study indicated that each component of the experiential learning activities spoke to different issues for each individual, most teachers indicated that the opportunity to teach real SEN learners was the most beneficial for challenging their assumptions about the value and purpose of inclusive education. The pre-service teachers found interacting with the parent and visiting the school site to speak with the high school students, their teachers, and the principal were also effective in providing a broader perspective about the need for appropriate and equitable learning opportunities for SEN students. In the sections that follow, we share data collected from our pre-service teachers, to demonstrate how their participation in these activities influenced their perceptions about inclusion education.

1) Lecture by a parent of a child with disabilities

Engaging in a dialogue with a parent of a child with disabilities was a salient factor in helping pre-service science teachers to reposition

themselves from being a student to being future teacher with real responsibilities to families and children. This experience focused pre-service teachers' attention on the importance of developing effective relationships with parents and family members of SEN students to be better able to serve the needs of the students.

> Problems may occur due to a lack of communication between the teacher, the SEN student and his/her parent. If teachers can meet SEN students to check situations and let parents follow up on how everything is going, many things can be solved. Teachers have to be in the middle of communications. (Pre-service teacher #3, Post-interview, June 2016)

> I think SEN students' and their parents' opinions are important. A teacher has to do the basic duty of asking SEN students' and parents' intentions [for learning], and implement realizable plans. (Pre-service teacher #5, Post-interview, June 2016)

After the parent lecture, teachers reported having an increased understanding of the challenges families with SEN students may face, and pre-service teachers recognized the need for providing appropriate support for learners so they could be successful. Prior to this experience, our teachers confessed they had never really considered inclusive science education from the perspective of families of SEN students. They began to question their roles and responsibilities as advocates with wider perspectives about social issues.

> I recognized that not only parental effort but also systemic social supports should be established for the formation of a healthy family. This would help parents and families to be psychologically stable, be better able to educate SEN students, and mutually cooperate with teachers. (Pre-service teacher #7, Online discussion 2, March 2016)

> I found that society has shifted the full responsibility of welfare for SEN students to parents. I felt ashamed that I had perceived this issue to be so simple and easy. It would definitely be an unmanageable burden for parents to teach and protect SEN students by themselves. (Pre-service teacher #11, Autobiography 2, March 2016)

2) Site visit to a special education school

Pre-service teacher found the site visit to a special school was valuable because it provided an opportunity to see a positive and inviting educational setting. Inclusive education is still very new in Korea, and, until recently, nearly 30% of SEN students were still educated in separate schools. As a result, our teachers have had limited experience with SEN students and no understanding about special schools, special education teachers, SEN students, or the curriculum and resources available to support SEN students. Before visiting the school, many pre-service teachers were nervous and unsure about what they would find.

> The most effective component in this course [for me] was the site visit to the special education school. I learned about the current situation of special education schools and realized many things from learning about the programs and facilities available for SEN students. I hadn't considered these things or seen anything like it before. (Pre-service teacher #1, Autobiography 5 and Post-interview, June 2016)

However, after touring the school and being introduced to the learning facilities (student garden, art space, and technology-related career center), pre-service teachers found the school was very similar to regular education settings. In addition, they had a chance to observe SEN students engaged in "regular teaching and learning" activities, and they found that SEN students had a range of abilities and were being instructed in various subjects at different levels. Many pre-service teachers admitted they were surprised to learn this.

> The school visit was the highlight of this course. I learned many things about the school facilities and was impressed to see consideration for small things [that students need]. The school was very enterprising and the teachers were not controlling [of the students]; instead they were responsible for and proud of teaching SEN students. (Pre-service teacher #3, Autobiography, June 2016)

> I was moved while seeing the conversations between teachers and

> students. I thought the teachers in the special education school were awesome because I could not imagine being so patient during conversations like the ones they were with students. (Pre-service teacher #5, Autobiography 3, April 2016)

During the site visit, our pre-service teachers had a chance to interview a special education teacher and the principal of the school. As shown above, our pre-service teachers were very moved and impressed by the passion these teachers had for working with SEN students. They reported that this experience encouraged them to begin to think more deeply about the purpose of science education for SEN students and to consider the debate about the relative merits of educating SEN students in special schools versus inclusive classrooms in mainstream settings.

3) Science fair for students with hearing impairment and other impairments

Most special education coursework is general in nature and does not provide content-specific instruction for pre-service teachers. During the science fair, pre-service science teachers reported that having the opportunity to design and implement lessons allowed them to more fully appreciate their future roles as science teachers for all students.

> Even though things did not always go smoothly [during the activities], I felt responsible for helping the students to enjoy and learn something by my teaching. I also learned so much. Seeing students react and learn, I took on the role of a teacher for the first time. I learned I should be careful about content, teaching strategies, and terminology. I had not previously considered safely when [doing] lab experiments; however, I now know that it may be more important when doing experiments with SEN students. (Pre-service teacher #10, Group interview 3, June 2016)

> This science fair allowed us to try to communicate with SEN students. We learned how to draw out students' expressions and ideas and what students are interested in, and we learned about the levels that [different] students could understand. This experience is necessary for future teachers since there are SEN students in classrooms. If we face them in the future,

this opportunity will be more helpful than having had no exposure. (Pre-service teacher #6, Group interview, June 2016)

These comments show that preparing for and teaching SEN students in the science fair provided pre-service teachers not only with an opportunity to put curriculum development and inclusive pedagogical theories into practice, but also provided content-specific opportunities to consider the intersections between special education and science education. The science fair also helped pre-service science teachers think about the need for cooperating with special education teachers.

> While preparing for the science activities, I got continuous feedback from teachers at the special school. They asked us to be considerate about language use, which I had never thought about before. I expected students would need me to use easier content and shorten words, but I had not considered [how to communicate] with language. When we designed our activity by ourselves, we could not think about many things, such as using captions. It was very important to get feedbacks from the [special education] teachers (Pre-service teacher #1, Group interview 3, June 2016).

> When we modified our teaching materials, we were able to apply a lot of advice from the course instructors. If we had only used an assessment rubric, we would have lost track of important things [that we needed to consider] due to our lack of teaching experiences with SEN students. However, the continuous feedback from the special education teachers at the school and our course instructors about the students' characteristics really helped us to develop our activity. (Pre-service teacher #9, Autobiography 4, May 2016)

By sharing their lesson plans and materials with the special education teachers at the school, our teachers were able to get some specific feedback about how to effectively accommodate students by modifying the content level, instructional strategies, and assessment tools. In addition, our pre-service teachers were required to do a full rehearsal of the science fair activities so they could get feedback from their peer teachers and from

us as the instructors of the course. Reflecting on these practices allowed our teachers to perceive the importance of engaging in a collaborative process that allowed them to develop strong science content lessons with appropriate inclusive education strategies embedded in the activities.

2. Benefits and Challenges of an Experiential Learning Course

In this section, we consider the benefits and challenges of implementing experiential learning courses and we consider the possibility for such approaches to help transform traditional teacher preparation programs to be more responsive to the necessity for teachers to learn about inclusive education. In this section, we first discuss the benefits we identified and then we share some challenges that also emerged. We also describe the necessity of integrating on-going reflective practice as part of pre-service teacher' meaning making when processing what they learned by engaging in the different experiences provided in our course.

1) Benefits of Implementing an Experiential Learning Course

Pre-service science teachers reported that this experiential learning course offered an abundance of field-based activities that invited them to consider issues about inclusive education that they had previously not thought about. The connection between introducing theory, engaging in activity, and then reflecting on the two helped our pre-service teachers to see some coherence between theory and practice and supported them to focus on specific issues related to inclusive science education.

> This course was really helpful for understanding the characteristics of SEN students and it was also quite practical. I learned a lot of realistic things from activities such as the site visit and the parental lecture. It was powerful to listen to and experience the real field beyond an ideal situation or statistics from a textbook. (Pre-service teacher #1, Post-interview, June 2016)

> This course offered a number of opportunities to be involved in SEN

> students' lives. I personally like taking a course with many activities because studying from a textbook and taking an exam can be done on my own. Participating in diverse field experiences through a course is more important. It was good to gain field experience through various activities rather than only theoretical knowledge. (Pre-service teacher #9, Autobiography 5, June 2016)

This experiential learning course also helped pre-service science teachers to link their knowledge about inclusive education with their knowledge about science. Many pre-service teachers mentioned their prior mandatory course, Introduction to Special Education (특수교육학개론), which covered general special education theory and the characteristics of disabilities. Compared with that course, our course provided more information about inclusive education in the context of teaching and learning science.

> This course might be the first and last to cover science education for SEN students. Introduction to Special Education does not consider lessons for SEN students or help teachers to understand students or what they are like. It does not handle education, special education, or inclusive education in my opinion. It just lists information and knowledge about special education. However, [in this course] I could think about it practically. (Pre-service teacher #6, Post-interview, June 2016)

Pre-service teachers noted that this course helped prepare them to recognize and teach SEN students in inclusive classrooms in the future.

> Compared with Introduction to Special Education, which focuses on introducing SEN students and understanding their characteristics, this course concentrated on developing pre-service teachers' competencies in teaching SEN students in future classrooms. (Pre-service teacher #2, Post-interview, June 2016)

> Teaching SEN students allowed me to apply my best effort towards improving my teaching strategies. It is far better than having no experience. I now can think comprehensively in some ways and specifically

in other ways [about inclusive science education]. (Pre-service teacher #8, post-interview, June 2016)

Pre-service science teachers were also able to gain awareness of their own personal biases and recognize SEN students' learning abilities. They also reported that this course was an approach to inclusive science education from the perspective of a science teacher. We think that this was the most significant benefit for our pre-service teachers, and we think this has the potential to be expanded to other teacher preparation coursework for other content areas, such as mathematics. We believe our pre-service teachers would not have been able to gain awareness of their personal biases without engaging in autobiographical writing and online discussions with their peers. Through these personal written reflections and online dialogues, our pre-service teachers generated content about special education/inclusive science teaching strategies, SEN students, and information about disability rights and human rights. These reflections supported pre-service teachers to critically reflect on the role teachers should play in inclusive science classrooms.

In science education, autobiography has been used to understand coming to know science across difference (Barton, 2000; Roth, 2000; Martin, 2005). Used in this way, autobiographical writings can become a tool for helping teachers to understand difference and to productively address how differences in perceptions, values, goals, and experiences shape teachers' practices, students' learning, and the expectations of families, communities, and societies for science teaching and learning. Online discussion boards offered our teachers a virtual space to mutually share ideas and resources to improve their understanding of the topics we were discussing in class (Revere & Kovach, 2011). We believe that teacher education programs seeking to integrate experiential learning components as a part of teacher coursework and practicums must integrate systematic methods for engaging teachers in individual reflection about personal experience. At the same time, they must also engage teachers in collective reflection with peers about the responsibilities these pre-service teachers will face as beginning teachers in inclusive classrooms in the future.

2) Challenges

In preparing and implementing this course, we anticipated some challenges, but we also encountered some issues we did not expect. We anticipated that engaging in authentic learning activities would support our teachers to make meaningful changes in perceptions about inclusive education. However, we also found that as our pre-service teachers learned more about what was needed to support SEN learners, some of them became overwhelmed. Coming to understand the realistic situation made some teachers more apprehensive about their ability to be successful in an inclusive science classroom.

> I had not agonized seriously in the pre-interview about this issue, but I do today. I've now been able to consider many things. There is kind of an internal conflict of my values. I already know what I need to do or not do, but now it is hard to keep my balance because as I learn more, I also have more concerns. I believe I should help SEN students; however, I'm concerned about whether I will have enough ability to support them and whether I really want to do it [because it is so difficult]. But I will try to consider this being concerned a positive thing. (Pre-service teacher #5, Post-interview, June 2016)

Pre-service teachers learned about theory needed to implement inclusive science education, including teaching strategies, information about assistive technologies, and specific ways to scaffold learning for different kinds of learners.

> I found that resources such as teaching strategies and textbooks are deficient. Compared to SEN students' willingness to learn, there is not enough support prepared for them. (Pre-service teacher #1, Post-interview, June 2016)

> I would feel bad if I need to include an SEN student in my class with the support available in the current situation. Even for the science fair, we needed so much effort and consideration. If teachers are asked to have SEN students in their classes, other support such as small size, increased

budget or salary, and assistant teachers should be provided. (Pre-service teacher #2, Post-interview, June 2016)

These remarks show that as pre-service teachers became aware of what was needed in an inclusive science class, they began to feel more hesitant and concerned. As a result of their experiences, pre-service teachers became aware of the lack of resources that exist in real classroom settings. For some pre-service teachers, having less knowledge about inclusive science education had allowed them to have more positive expectations for their success. The more some of our teachers learned, the less confident they were that they could really be successful. Nevertheless, most pre-service teachers remained positive about having SEN students in their science classes and reported that they would do their best to support students. However, they were still worried about working in an educational system that lacked so many resources. This concern became intensified after pre-service teachers learned more about how in-service teachers viewed inclusive education. As a part of our experiential learning course, pre-service teachers interviewed in-service science teachers about their perceptions about inclusive science education.

Far from my expectation, in-service teachers' perspectives about the value of science education for SEN students were quite negative. I partially admit it is understandable in the real situation. However, I still think science education for SEN student is necessary and a curriculum for them needs to be developed. (Pre-service teacher #6, Autobiography 5, June 2016)

My perceptions about science education for SEN students changed twice while taking this course. At first I was skeptical, but I began to think about science education for SEN students more positively after the parental lecture and site visit. However, I kept wondering about the need for science education for SEN students and finally, after learning about in-service teachers' negative perceptions, I became more skeptical again. (Pre-service teacher #11, Autobiography 5, June 2016)

Based on interviews, our teachers found that in-service teachers showed extremely negative views about implementing academic inclusion in

science in regular classroom settings. While we think it is important for our teachers to have gained these insights, such comments negatively influenced our pre-service teachers by having them more clearly consider the gap between their experience in our course and real school situations.

Ⅳ. Discussion and Conclusion

Our emergent findings suggest there is potential for experiential courses to help pre-service science teachers' develop more positive perceptions about inclusive science education. The experiential activities in this study allowed pre-service teachers to gain practical experience and, through a supported reflective process, to consider how the challenges and benefits of applying theory to real-world teaching practice. The lecture by a parent of a child with disabilities was essential for helping pre-service science teachers become more aware of the important roles that teachers play in helping make inclusive education successful and positive for children and families. Hearing from a real voice encouraged pre-service teachers to recognize the importance of building relationships with parents of SEN students. Moreover, our teachers became more aware that there is a need for more systemic societal support for families with SEN students. Narrowing the gap between science teachers, SEN students, and their parents about expectations for education (Kwon, 2012) can improve the real practice of inclusive science education.

The site visit to a special school allowed pre-service science teachers to see the possibilities of for dynamic teaching and learning with attention and adequate resources to support SEN students. Our pre-service teachers saw real classrooms, which helped them to prepare for their science fair and to imagine a future where they might enact similar inclusive teaching practices. Visiting a well-managed special education institution helped pre-service teachers to broaden their views and establish positive perceptions about SEN students and the value of educating special needs learners (Lee & Kwon, 2010). We recognize that the special school is not

the same as an inclusive school setting, but at this time we have no adequate sites that can be used as a substitute to help pre-service teachers envision a positive learning environment. Visiting the special school showed what was possible if given the tools, but it also made clear that the SEN students were isolated from their non-disabled peers—academically, physically, and socially. This isolation has important consequences for the futures of SEN students who fail to make social networks that could benefit their transition to the workforce, and it also means general education peers in regular schools miss the opportunity to learn to be more inclusive and appreciative of difference. Both of these have the potential to have a negative impact on schools and society.

Developing and implementing a science fair offered pre-service science teachers an opportunity to practice real science teaching with SEN students. It also positioned these pre-service teachers as real science teachers where they were better able to consider the importance of teaching in inclusive settings and collaborating with special education teachers. Research shows that science teachers are not likely to work with special education teachers (Kim, 2014; Lee & Park, 2009), so the course helped offer our pre-service teachers an experience that can benefit their professional practice in the future.

Our examination of the impact of each experiential activity on pre-service science teachers showed that pre-service teachers were able to develop more positive perceptions of inclusive science education and gain important practical experience. By challenging their biases and making links between theory and practice, pre-service teachers shifted their views about the value of inclusive education and the role they might each play in expanding learning opportunities for SEN students in the future. These findings are well aligned to other studies (Campbell, Gilmore, & Cuskelly, 2003; Forlin, Loreman, Sharma, & Earle, 2009: Lee & Kwon, 2010; Seo, 2010; Shippen, Crites, Houchins, Ramsey, & Simon, 2005) showing that direct experiences with people with disabilities and authentic opportunities for engaging in activities with students who have disabilities promotes positive attitudes about inclusive education.

However, we also unexpectedly found that participation in our course also limited some pre-service science teachers' willingness to try to enact

inclusive science education practices because they became overwhelmed with the many challenges they would face in the future. Our teachers regarded the inclusion of SEN students in regular classroom as a burden that would have negative consequences for teachers and learners. In-service science teachers' negative attitudes about inclusive education had a negative impact on our teachers' perceptions about what is really possible. Other studies (Kim, 2014; Kwon, 2012; Park, 2010) have shown that in-service science teachers find it very challenging to teach SEN students due to a lack of resources. Several researchers have found consistent requests from in-service teachers to develop a support system in the area of science specifically (Kim, 2002; Park, 2010; Yoo, 2006). This continues to be an important issue that must be addressed systematically within the school system.

Ⅴ. Implications

Findings from this research can help science teacher educators and special education educators to more effectively design curriculum that supports teachers to be effective science instructors for SEN students. This study has shown us that pre-service science teachers can become more open to inclusive education and more positive about the need for SEN students to learn science as a result of their experiences in this course. However, in order for new science teachers to really be able to effectively implement inclusive education in their future classrooms, there is a need for far more support and resources in teacher preparation programs and in schools and for professional development for in-service teachers. There is a need for more special education and content-integrated course work, more teaching and learning resources developed for Korean contexts, and more student teaching practicums with confident and successful teaching professionals working in inclusive classrooms.

The activities in this course were really powerful for our pre-service teachers. We advocate for more experiential courses to be designed and

implemented in teacher preparation and professional development programs, both in Korea and internationally. It is essential to improve pre-service teachers' personal perceptions about the importance of educating SEN learners if we are going to make inclusive classrooms a reality in the future. Teachers need to be able to acknowledge that equal is not equitable. Being inclusive means helping students be in the position to do what they each can do, not asking that all students do the same thing. Challenging this mindset in the Korean education system is difficult, and teachers will face many barriers when trying to do so, but the positive benefits can improve not only the lives of individual SEN students but also their regular education peers who may develop more open mindsets about people with disabilities.

In the future, it is anticipated that inclusive classrooms will become increasingly more abundant in general education settings due to Korea's steadily declining student population as a result of well-documented low-fertility issues. One result of the shrinking student population is smaller class sizes and the need to down-size schools to account for smaller student populations. The overall decrease in students, coupled with a rapidly aging society, will mean there are fewer economic resources available to support separate special schools. Thus, it is anticipated, future teachers will benefit from coursework and practicum experiences designed to prepare educators to be effective in inclusive classrooms.

It is important to remember that these challenges are not unique to Korea. There are also many challenges in other countries with even longer and more established histories of legislating rights for people with disabilities and developing special education programs. In addition, throughout the Asia-Pacific region, many countries are experiencing a decline in student populations that may warrant the expansion of inclusive education practices. These changes would also necessitate changes in teacher preparation and professional development for countries in the region. We believe Korean scholars can lead the way in these initiatives by providing more resources to support research and development in the fields of special education and on the topic of inclusive pedagogy. We believe additional research is needed to maximize the benefits of learning when engaging special education and content-area teachers in cross-curriculum

coursework and co-teaching practicums. We encourage additional research in this area and improved development of resources and policies for supporting content-area and special education teachers to effectively collaborate and support SEN learners in inclusive school settings.

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경험학습 강좌가 통합교육 환경의 과학교육에 대한 예비 과학교사들의 인식에 미치는 영향 탐구

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<국문초록>

본 연구에서는 경험학습 이론을 접목하여 예비 과학교사들이 장애학생을 위한 통합교육 환경의 과학교육에 대해 학습할 수 있도록 고안 된 과학 교사 교육 프로그램을 소개하였다. 연구자들은 성찰을 통한 실천에 중점을 둔 경험학습 이론을 기반으로 15주차 프로그램을 개발하고, 예비 과학교사들이 프로그램에 참여하면서 장애학생들에 대한 인식 및 통합교육 환경의 과학교육에 있어 과학교사의 역할을 성찰할 수 있도록 하였다. 본 연구에서는 강좌에서 수행된 활동들의 내용과 의도를 자세히 기술하고, 각각이 예비 과학교사들의 통합교육 환경의 과학교육에 대한 인식에 어떠한 작용을 하였는지 규명하였다. 또한 수행된 경험학습 강좌 전반에 대해 평가함으로써, 교과 교수법 중심의 교사교육이 통합교육 환경의 과학교육의 달성에 필요함을 논의하였다. 이를 통해, 예비 교사교육에 있어 경험학습의 중요성을 역설하고 한국의 특수교육 및 과학교사교육, 교사들의 전문성 향상에 있어서 변화의 필요성을 제언하였다.

키워드 : 장애학생, 예비 과학교사교육, 과학 평등성, 경험학습, 통합교육 환경의 과학교육

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