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Design and Implementation of Teacher-Training Program for Computing Education Using Theme Based Approach Through Co-Teaching: A Case Study for Kindergarten's after School Teacher

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Abstract: The purpose of this study is to investigate the effects of teacher-training program for computing education using theme-based approach through co-teaching on computing teaching self-efficacy of pre-service kindergarten teachers. Computing teacher training program for young children requires cooperation of preschooler specialist and computer specialist, so, cooperative pedagogy can be the most appropriate method for it. The program using theme-based approach is suitable for teaching computational thinking in integrated classroom environments for preschoolers. If teacher-training program is structured using theme-based approach through collaborative teaching, it will have a positive effect on pre-service kindergarten teacher's computing teaching efficacy belief. Therefore, in this study, we designed the computing teachers training program based on theme approach through collaborative teaching and applied it to pre-service teachers who are going to work for the program after kindergarten. As a result, personal computing teaching efficacy belief of pre-service teachers showed a significant difference at the significant level 0.05. In addition, we conducted individual interviews on co-teaching strategy and subject-based approaches. Through these in-depth interviews, we confirmed that the teachers had positive effects by verifying the benefits of the teachers training programs for computing education using theme-based approach through collaborative teaching. The computing teachers training program using theme-based approach through collaborative teaching method can be one of the realistic alternative for the on-the-job training of the pre-service kindergarten teachers.

Key words: Teacher-training program, computing education, co-teaching, theme-centered integrative approach, kindergarten's after school teacher, approaches, realistic

INTRODUCTION

Computational thinking is a discipline that understands human behavior through the basic ideas of computer. When computational thinking is used everywhere, everyone will face computational thinking directly or indirectly (Wing, 2008). Computational thinking must be prepared for young children to live in the future. In order for young children to explore computational thinking and prepare it for future societies, teachers need to be able to teach computing to young children and computing teacher training programs are needed. For computing for all, a program has been published that provides after-school classroom or lunchtime programs for K-12 teachers (Brennan *et al*., 2014), The code.org program which indicates that everyone should have a chance to learn computer science is intended for children from 4 years old and shows teachers how to teach computer science to young children (Code.org., 2017). However, the instructions of planned programs have limitations of explaining all of the series of teaching processes in which interactions with young children occur. In the classroom, actually confronted with young children, the teacher should have a good grasp of the young children's characteristics to educate preschoolers on computational thinking. At the same time, they should know what computational thinking is and be able to establish strategies for how to teach it. And the teacher training program for this purpose should be well harmonized with early childhood education and computer science. Co-teaching can be an effective educational strategy for providing such programs. The study has been done that co-teaching of biology and history led to positive experiences for teachers and students (Flannery and Hendrick, 1999). Professional learning communities have developed thematic and interdisciplinary items of coaching (Graziano and Navarrete, 2012). In addition, several investigations have shown that co-teaching can

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be an adequate teaching pedagogical strategy for learners (Chanmugam and Gerlach, 2013; Cohen and DeLois, 2002; Crow and Smith, 2003, 2005; Gillespie and Israetel, 2008).

There are advantages that teacher educators cooperate to plan curriculum, teach the curriculum together and cooperatively monitor the developed pedagogy (Nevin *et al*., 2009). A program in which early childhood educators and computer education specialists constructs a series of curriculums and teach them together and continually feeds back on them will lead pre-service teachers to provide appropriate computing classes for young children. If co-teaching program is composed of a theme-based approach for organizing it into the young children's integrated environment, both teachers can fuse each other's fields more easily within a common theme. This can be an appropriate approach for organizing programs for co-teaching strategies. Therefore, in this study, we designed the computing teacher training program using theme based approach through co-teaching and it was progressed for pre-service teachers. We investigated the effects of this program on the pre-service teacher's computing teaching efficacy belief. The research questions of this study are as follow.

Whether the teacher-training program for computing education with theme-based approach through co-teaching contributes to improving computing teacher self-efficacy of pre-service teachers who are going to work for the after kindergarten program. How does the teacher-training program for computing education with theme-based approach through co-teaching contribute to improving computing teacher self-efficacy of pre-service teachers who are going to work for the after kindergarten program.

Teacher-training program for computing education using theme based approach through co-teaching

Co-teaching and theme based approach: In a changing society, to prepare teachers, they require knowledge of learners and their developmental status in social situations, knowledge of subject matter and curriculum goals and knowledge of teaching (Darling-Hammond *et al*., 2005). Co-teaching of a veteran teacher with 25 years of experience in early childhood education and computer education major can provide knowledge about the developmental state of the child while providing knowledge of the goals for the computing curriculum.

In addition, early years teaching should be actively engaged and learning opportunities should be provided through diverse ways of painting, writing and making things (Muijs and Reynolds, 2010). By introducing the activities of various domains that can be provided to young children through a theme-based approach, learners can comprehend how computing concepts are applied in various knowledge domains and identify related concepts in a large context. Through it, activities can be conceived and provided to young children.

Logistics

Computational thinking for kindergarten's after school teacher: For computational thinking, students in grade K-3 should be able to; Use technology resources to work out problems of fitting the age 2. Utilize writing and drawing tools to express thoughts and ideas. Understand how to arrange information in effective order without operating computers. Recognize that software has come to control the computer operating system. Show how 0 and 1's are used to express information (ISTE. and CSTA., 2011). Some activities that introduce computer science to all ages include some activities that are consistent with the goal of K-3 (Bell *et al*., 1998) and the programs for the 4 years old young children introduced at Code.org contain some of the K-3's goals at the young children level (Code.org., 2017). Therefore, the two teachers discussed how they could be presented as activities to apply at the preschooler level. Through this, two teachers planned together computing activities that are appropriated for the characteristics and tendencies of young children and conceived ways to effectively teach computing thinking to young children for pre-service teachers.

Selecting theme: The theme is advantageous to teach computing thinking and by choosing a theme to provide a variety of activities for young children, pre-service teachers can be taught meaningfully computational thinking in a variety of activities. The two instructors chose "bee" as a theme that can be combined with various activities such as origami, making, robot movement, singing and rhythm. A bee-bot selected for 'move robot activity' is a bee-shaped and bees are familiar to young children and are good for developing various activities related to computational thinking.

Planning program: Pre-service kindergarten teachers need basic guidance on teaching methods, knowledge of computational thinking and guidance strategies on how to teach it to young children. To this end, the contents of the program are composed of a variety of activities associated the theme "bee" such as understanding algorithms through various activities, solving problems through puzzles, using writing and drawing tools and experiencing basic programming with Code.org. We introduced various activities for young children, then using this, we had pre-service teachers make a teaching plan by themselves and make a mock lesson.

MATERIALS AND METHODS

Participants: The participants of this study were pre-service teachers who applied to kindergarten after-school teacher's course. A total of 15 pre-service teachers had been taking teacher training program which two specialists deigned together for 4 weeks. Participants ranged in ages from 26-56 years with an average age of 37 and all female.

Instruments: The computing teaching efficacy belief of pre-service teachers who are going to work for the after kindergarten was measured by Science Teaching Efficacy Belief Instrument-B developed by Enochs and Riggs (1990). The adaptation by Cheong (2010) was revised and used in accordance with the young children's computing subjects. The Cronbach's alpha coefficient of questions for 15 pre-service teachers was 0.759.

After completing the program, 13 pre-service teachers were individually interviewed using semistructured questions. The purpose of the interviews is to get deeper understanding of the results gathered through quantitative data and to more specifically understand the effects of the program. The questions used in the interviews are as follow:

- What are the advantages of co-teaching?
- What are the disadvantages of co-teaching?
- What are the advantages of the theme based approach?
- What are the disadvantages of the theme based approach Interviews were recorded with audio and analyzed by transcription?

Procedure: The computing teacher training program using theme based approach through co-teaching was conducted over a total of 43 h of instruction for 4 weeks. After training, to figure out the specific results, semistructured interviews of pre-service teacher were recorded individually.

One of two co-teaching instructors was a highly skilled teacher with 25 years of experience in early childhood education. The other was a teacher majoring in computer education. The two researchers planned and studied the teacher training program based on thematic approach in advance. Two instructors cooperated closely in the class for educating pre-service teachers. Two instructors had discussed the program before, during and after the 4 weeks lecture. Table 1 shows the contents and method of the teacher training program for computing education with the theme-based approach through co-teaching.

Table 1: Computing teacher training program

Days	Duration (h)	Contents
1	2	Orientation for young children computing education Introduction to young children computing education program
2	2	Current status and necessity of young children computing education
3	3	Early childhood education theory
	2	Young children computing education concepts and goals
4	5	Content of young children computing education, understanding of algorithms through various activities based on bee theme
5	5	Content of young children computing education, problem solving with a bee-themed puzzle
6	5	Content of young children computing education using writing and drawing tools through bee-themed painting activities
7	5	Content of young children computing education, bee theme based basic programming experience
8	5	Bee theme based computing lesson planning and mock lessons
9	5	Bee theme based computing lesson planning and mock lessons
10	4	Discussion and evaluation of bee theme based teaching aids used for mock lessons

RESULTS AND DISCUSSION

To investigate the effects of the computing teacher training program using theme-based approach through co-teaching, kindergarten computing teaching efficacy belief test were conducted as pretest and posttest. Paired sample t-test analysis was performed. A results in Table 2 showed significant mean differences between pre and post test scores of personal computing teaching efficacy belief ($p<0.05$). However, there was no significant mean difference in outcome expectancy. As a result, there was a significant mean difference between pretest and posttest of kindergarten computing teaching efficacy belief ($p<0.05$).

In the pre-test of personal computing teaching efficacy belief, the mean was 3.41 and the standard deviation was 0.44. In post-test, the mean was 3.76 and the standard deviation was 0.43. The distribution on picture on Fig. 1 was shown to increase overall. In the pre-test of outcome expectancy, the mean was 3.36 and the standard deviation was 0.44. In the post-test, the mean was 3.40 and standard deviation was 0.28 as .shown in Fig. 1, the mean rose up but the highest scores decreased and the overall distribution narrowed in posttest compared with pretest.

When we interviewed pre-service teachers using semistructured questions, all 13 students answered positively to the question about the advantages of co-teaching. When asked the question about the disadvantages of co-teaching, 12 pre-service teachers answered that 'I could not find the disadvantage or I could not bring to mind the disadvantage. When they are

Table 2: Results of t-test

Variables	Time	N	M	SD	t-values	p-values
Personal computing	Pre	15	3.41	0.44	-2.670	0.018
teaching efficacy belief	Post	15	3.76	0.43		
Computing teaching	Pre	15	3.36	0.44	-0.450	0.660
outcome expectancy	Post	15	3.40	0.28		
Computing teaching	Pre	15	3.38	0.32	-2.181	0.047
self-efficacy	Post	15	3.61	0.27		

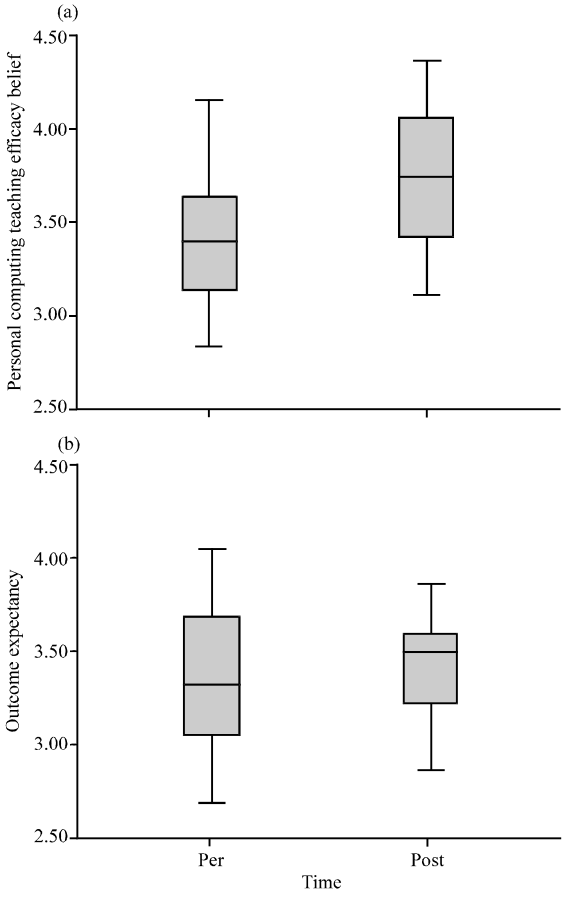

Fig. 1: Comparing Pro and post test scores

asked about the advantages of co-teaching, teacher 1 said, 'It was good to make it possible to complement each other' and teacher 2 'In cooperative relationship, two instructors can supplement each other's works in other words, while kindergarten instructor provided special knowledge for educationist children, computing instructor offered knowledge about computational thinking, so that, brought effect to combine them'. In addition, teacher 3 said, 'I think that the teaching in classes is harmonious because of the good coordination between them and teacher 4 said, 'The two teachers had different specialties. So, we could get the specialized skill from them. It makes us to better understand each part. I think that was a good point' and teacher 5 said 'The teacher could be the mutually beneficial compensators to each other. The teacher with computer major could teach computing education well and the advanced skills kindergarten teacher could provide teaching methods. So, they could cooperate with each other very well. When it comes to the disadvantages, teacher 6 said as the two teachers ran class together and talked with each other, it was hard to catch up every moment due to the progress.

The pre-service teachers responded that theme based approach was easy to understand. They replied that they learned the necessary concepts through the bee-play and much useful knowledge to teach children was melted in the content of class. Teacher 7 said 'I did not know that what I see in everyday life is related to computational thinking. I have come to think in connection with computational thinking in everyday thinking. It was new and fresh'. Teacher 8 answered, 'I do not think that classes using theme based approach was difficult, because it had a common theme. The class had one common theme to deal with'. When asked about the disadvantages of the theme based approach, teacher 9 wanted instructors to introduce various themes rather than just one theme as boys like insects like bees and girls could like flowers and other things. There was an opinion that it would be good to add various other activities. And there was another opinion that it felt like an introductory process.

Co-teaching, in which two or more teachers teach the same students with each of the teacher's expertise can be an effective method for teacher education. The theme of the bee became a medium that led to the integration of the fields of the two teachers. Through the theme of bees, it is possible to introduce the educational contents that stimulates the curiosity of young children and suitable for young children's stage of development. The theme of bees make it easier for children to learn from algorithms by knowing that there are natural series of sequences such as eggs, caterpillars, pupae and adults to programing of bee-bot. Because of this, the pre-service teachers can understand what the computational thinking is and how to approach it to the young children. The two instructors guided pre-service teachers to make well-organized classroom instructions and had pre-service teachers fulfill their instructions in class. It can give the pre-service teachers confidence that they can do the computing class with children successfully. The theme based approach helps pre-service teachers to get to know what they need to learn in an easy and friendly way and allows them to know how to approach computing classes through co-teaching.

CONCLUSION

Therefore, in this study, we investigated how the teacher training program for computing education using theme-based approach through co-teaching affects the teacher self-efficacy of pre-service teachers in kindergarten. As a result of the pretest, there was a significant mean difference in kindergarten computing teaching efficacy belief of pre-service teachers ($p<0.05$).When examining two areas of computing teaching self-efficacy, computing teaching efficacy showed a significant mean difference ($p<0.05$) between the pre-test and post-test of personal computing teaching efficacy belief but there was no significant mean difference between the pre-test and post-test of outcome expectancy. Concerning the co-teaching 12 pre-service teachers showed positive opinions and there were opinions of disadvantage that the two instructors had a fast progress and learners missed some part. When it comes to theme-based approach, it is easy to understand the common theme but there was a desire to deal with more diverse activities and in-depth content. It was easy to understand how to approach a theme based approach to a common theme but there was a desire to deal with more diverse activities and in-depth content. Therefore, in the theme based approach, it is necessary to deal with more diverse and profound contents. For more effective co-teaching, two instructor's coordination about their course should be preceded and also mediation between two instructors is necessary in the course progress. Therefore, in the theme based approach, it is necessary to deal with more diverse and profound contents. In order for the co-teaching to be effective, coordination of the two teachers should be preceded and coordination is also necessary in the course progress.

RECOMMENDATIONS

Co-teaching is effective in integrating the two areas and the theme based approach facilitates this integration. However, there are a wide variety of choices about the ways of integration and themes. Therefore, it is necessary to support a lot of researches in various fields and it is necessary to study the ways of approaching various theme, not one theme, also, the coordination methods for more efficient teaching of two teachers are demanded to study.

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