Physical Learning Activities with a Teaching Assistant Robot in Elementary School Music Class

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Abstract— **Very recently, together with ICT (Information Communication and Technology) as teaching aids, the blended-learning combined with off-line education and e-learning has been administered. In the future, however, r-learning based on robots as teaching assistants will be employed to help students enhance their educational motivation and effects. Also, the teachers who have high-qualified capacity of ICT have also assumed robots as their assistants in the various fields such as music and language. Thus, many studies have investigated whether there are significant differences between the use of robots and other educational approaches in the field of education. However, there are few previous studies about whether robots would help music lessons or not in the field of music education. Therefore, the present study investigated whether Tiro, a teaching assistant robot, could help the Korean elementary school 4th-grade students learn six-eight time conduct in the music class. For treatments, teaching scenario for Tiro's experimental lessons was designed. It consists of learning materials and class management services. Also, after the contents for flash-based multimedia robot were designed and developed, the final scenario for teaching assistant robot was created by adding robot action scripts in order to match the contents with robot action template. The contents of the assistant robot for music conduct lesson were downloaded by the wireless, and they were employed for this study. Data collected from Tiro's experimental music lesson and the teacher's assessment and feedback were analyzed and reported.**

Keywords-e-Learning, r-Learning, Teaching Assistant, Music Conduct

I. INTRODUCTION

Many companies in the world have developed various kinds of robots, such as home-robots, silver-robots, and pet-robots, for several purposes. Korea has also promoted and used educational robots for several purposes in the various fields of education. As a result, many researchers have had much more interest in using robots in the field of education, particularly, first or foreign language education, especially, Korean and English education.

Han & Kim [2] interviewed the teachers who have high-qualified capacity of ICT, and found that they have postulated robots as their assistants in the overall rank order of educational effects of several contents as follows: English, Korean, and Music. However, most of these studies have been conducted to investigate the effects of English education in employing robots as teaching assistants, but few have been carried out in music education because music lesson needs smarter (highly technical and expensive) robots as teaching assistants of music lesson due to the extremely complicated features of music. For this reason, most of the studies carried out with educational robots have focused more on language education. To investigate the effects and possibility of using robots in music class, this study used robots as teaching aids in music conduct lesson due to a few limits of robot in using them in very complex educational environments such as music instrument playing.

For this, in Chapter 3, this study designed scenarios for robots' lesson to support the method of music conduct lesson in the Korean 4th-grade elementary school classroom. Next, this study created multimedia contents for teaching assistant robots based on flash. And then, this study devised scenarios for robot lesson in order to match them with robot action template by adding robot action scripts. In Chapter 4, based on lesson scenarios designed, this study suggested the future direction and field implication of music education by conducting experimental field lessons, and data collected from the teachers' and experts' field observation.

II. STUDIES OF USING ROBOTS

Kanda et al. [4] makes it quite clear that using robots, Robovie, had overall effects on improving Japanese 1st-grade and 6th-grade elementary school students' motivation as a result of observing their learning processing for two weeks. NEC designed instrumental PAPERO by using its sensors as touch functions for music body play [7]. Moreover, England has used recycle-robots for recycling or educational event, and robots have been employed for children's health education [6].

Furthermore, Korea has developed and used many kinds of robots as teaching assistants such as iRobi, iRobiQ, and Tiro, especially in the field of language education. In their study carried out to compare the effects of using written texts,

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WBI, and home-robots, in English education to investigate students' learning needs, concentration, and achievement, Han et al. [1] identified that using robots was more effective than other approaches. Kwak et al. [5] examined that there was a significant difference in math education by teaching assistant robots' feedback based on the reinforcement theory or the token reinforcement system. Han & Kim [2] stated that using a prototype robot, Jenny, with these three (English, Korean, and Music) contents, had good effects on students' learning motivation and interest improvement. In contrast, there are a few limits of using robots in music play lessons because of the limited actions of the prototype robot. In addition, in their study conducted to investigate the effects of Korean word lesson between using robots and computers, Hyun et al. [3] found a significant difference between the experimental group, robot-based group, and control group, computer-based group, in English word education for Korean kindergarten students.

As for music learning, thanks to the invention of web-based multimedia tutor flash, web-based music lessons in the Korean elementary school classroom environment have been administered. Therefore, to achieve the purpose to design curricula for teacher's assistant robots that can make differences between web-based and robot-based music lesson, this study selected music conduct lesson as physical music activity. Besides, this study examined teachers' and students' feedback about experimental lessons through instructional lesson scenarios for six-eight time conduct method in music lessons. Finally, this study will conduct to investigate suitable role, design the scenarios and activities, and develop of prototype contents for teacher's assistant robots in the Korean elementary school classroom settings.

III. Development of Contents for Teacher's Assistant Robot

A. A Teacher's Assistant Robot, Tiro

As seen in Figure 1, Tiro, a teacher's assistant robot, has six basic expressions, shoulder 2 axes, elbow 1 axis, and the 120cm tall [12]. Tiro can automatically move to all directions with two big wheels, and have LCD display output function to send e-learning materials to screen image equipment (PDP, LCD) with sliding cover. Also, it transferred multimedia contents offered in its touch-screen to beam project or projection TV screen in the classroom.

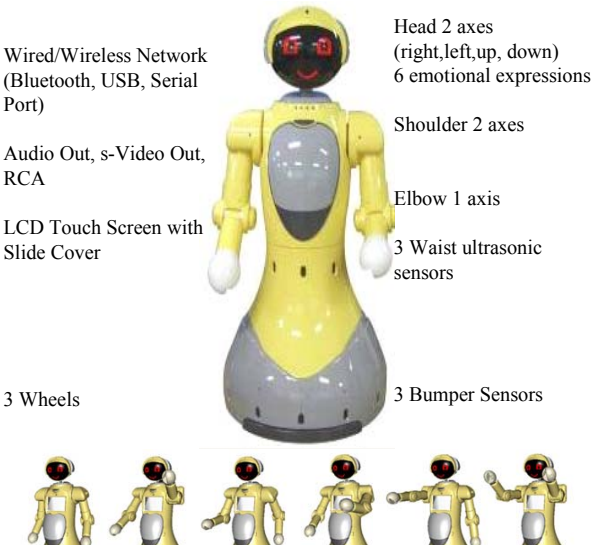


Figure 1. Tiro Specification from [8]

As a teaching assistant, Tiro assisted teacher's lesson beside TV put in front of blackboard. If Tiro fails to recognize voice sound command, the teacher can lead Tiro's action by touching its screen.

B. Design and Development of the Contents of Tiro's Music Conduct

Tiro's music lesson was divided into two compositions: menu related to class management in green box (checking students' attendance, concentration, activity time, and selection of presenters) and learning materials (playing songs, demonstration of music conduct method, and awards from assessment) in Figure 2.

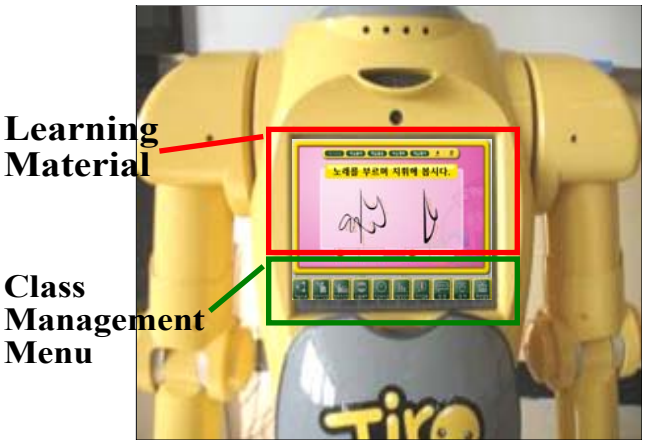


Figure 2. Two Main Compositions of Tiro's Music Lesson

We defined the following procedures for Tiro's lesson assistant scenarios.

- Designing Tiro's assistant lesson scenarios: Lesson plan design in Table 1.
- Designing contents of flash-based Tiro's screen touch:
  - ✓ Lesson management: checking attendance,

activity timer, and choosing presenters (See Figure 3)

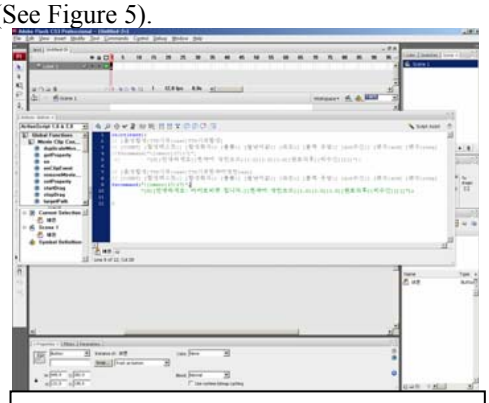
Figure 3. A Student Selected by Tiro

✓ Lesson contents: Lesson question items, lesson contents, summary, and assessment items (See Figure 4)

Figure 4. Contents of Tiro's Music Conduct Lesson

•Developing contents of touch screen, Tiro's action and expressions

•Making out robot action scripts consisting of Tiro's action and expressions: Made out as the type of XML by action pattern protocol of previous definition by a robot company in Korea, Yujinrobotics, using the *fscommand* function of flash (See Figure 5).



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fscommand("{[cmncc|17|17]","[8][Attention
, please.] [Korean] [1.0] [1.0] [Finish] ");
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Figure 6. Robot Actionscripts

•Loading Tiro's teaching assistant contents from the LMS (Learning Management System) by the wireless internet when the teacher queries.

C. *Design for Music Conduct Instruction*

Students have already contacted a Tiro's prototype, and they have taken lessons with Tiro one year ago. On the whole, because students have been familiar to Tiro, we did not need to describe Tiro to them. In this present study, the teacher with instructional lesson plan led Tiro as a teaching assistant to doing music conduct lesson demonstration, six-eight time, with a song, Mother's Benefit, in the 4th grade elementary school students' classroom in Table 1. On the contrary, Tiro could not adapt about six-eight time conduct because of the mechanical problems of arms and shoulders. As a result, Tiro's conduct lesson demonstration was replaced to three-four time conduct, and the teacher induced the motivation that students practiced the six-eight time conduct rapidly. Then, the teacher asked students to teach Tiro that could not conduct six-eight time conduct.

Table 1. Lesson Plan for Music Conduct Lesson

Grade	4th grade students on a Korean elementary school
Unit	Mother's Benefit
The Purpose of the Lesson	Students can sing a song and operate six-eight Time conduct of the song
Treatment Time	40 minutes
Procedures of Experimental Lesson	
Introduction (5 minutes)	
•Calling Attention - Greeting: The teacher and Tiro greet to students. - Checking the attendance: Tiro checks the student's attendance showing the student's photos and calling the students' name. •Describing the Purpose of Study - Teacher asks to Tiro about the object of study, and then Tiro answers like 'we can sing with six-eight time music conduct.' •Drawing the motivation Teacher induces the motivation that students can teach Tiro because Tiro cannot do six-eight time music conduct well.	
Progression (30 minutes)	
•Watching Music Conduct Example - The teacher's explanation and example about the six-eights time music conduct - Tiro's example of three-four time conduct Music Conduct Practice - Tiro takes the practice time, 5 minutes, and students practice the six-eight music conduct. - Tiro announces the 5-minute time limits, takes the time on background, provides an accompaniment, and repeats to show the example of the three-four time music conduct. - Teacher goes around the classroom, and students have individual lesson demonstration.	
Arranging, Assessment, and Presentation (5 minutes)	
•Reorganizing the contents of the study - Can students perform six-eight time music conduct on a song? - Selecting the students: Tiro uses the selection program, and Tiro randomly chooses the students who will perform the conduct - Selected students go forward to the class and do the conduct with the Tiro's accompaniment	

IV. FIELD APPLICATION

A. Lesson to Display an Example

The 4th-grade 33 Korean elementary school students had an example lesson demonstration with Tiro that loaded developing robot contents. The teacher guided one lesson demonstration, and four teachers observed and evaluated the lesson. Researchers intensively interviewed the students and teachers after finishing all experimental lessons using a teaching assistant robot.

A teaching assistant robot 'Tiro' was prepared to move in terms of robot contents scenarios that already had the proper time depending on the teacher's direction language and remote control. When the lesson began, the teacher asked Tiro to check the attendance, and Tiro showed students' photos and called students' names. When Tiro called the students' name, they were surprised about the Tiro's intelligence, and felt more familiar to Tiro. After checking the attendance, Tiro presented the object of lesson, and contents of lesson about six-eight time music conduct. Therefore, both the teacher and Tiro performed all activities progressed or supported all experimental lessons.

Figure 6. Scene of the Lesson

Figure 6 shows that Tiro is doing a lesson demonstration of music conduct with the teacher according to a song 'Mother's Benefit' after introducing the aim of lesson. After the teacher explained and did experimental conduct lessons, A variety of functions such as the selection of students and small group for experimental conduct lesson, the timer function for students' autonomous conduct practice, and the alarm function for preventing students' making-noise and improving concentration, had been applied. Namely, after the teacher described the method of music conduct, Tiro made students do conduct demonstration turn by turn as it automatically replayed and conducted, and chose students who displayed conduct demonstration lesson as shown in Figure 7.

As shown in Figure 7, students themselves practiced conduct in their seats with music, and then once Tiro randomly chose one of them, he or she did cooperative conduct with Tiro with great pleasure. As all lesson demonstrations have been well done automatically by Tiro, the teacher could guide and lead students' conduct activity and task individually. In consequence, more students could be directed by the teacher about six-eight time conduct method thanks to Tiro's cooperation.

Figure 7. A Student Performing Conduct Task with Tiro

B. Discussion

This study proposes a few limitations and suggestions based on experimental lessons, and suggests teachers' opinions and feedback about the roles and expectations of using robots as teaching assistants in the Korean elementary school music class. First, the advantages that the teacher had investigated during the experimental lessons from using robots are as follows.

•The more effective and successful achievement of lessons through teacher's self-controlling and self-managing robot and cooperation with the teacher and teaching assistant robot

•The student's more repeated practice opportunities through the management of the self-controlling robot

•The children's more intensive concentration with curiosity, the novelty effects on robot and overall achievement effects on music conduct lessons in music class

•The facilities of the robot's support function about the simple but repeated class activities such as attendance, and cooperation with robot

•The more lesson demonstration opportunities fairly offered to children through robot's random and right participant selection

The disadvantages investigated are as follows:

•The difficulties in using the remote control when robot fails to recognize the children's voice sound because it was far away from the teacher

•The necessity for developing the curriculum, lesson plan, scenarios, and contents able to maximize the overall lesson effects when using robot, comparing to the traditional CD player or the flashy 'singing-room' contents

•There were some of the participants who ignored the teacher because they preferred to robot. Thus, more education should be needed for reducing the children's temporary bias and distortion about robot preference to the teacher, while this problem may soon disappear through the reduction of novelty effects about the robot.

Some of the differences found between computer-based contents and this study were as follows: Figure 8 shows that three male students who were selected by Tiro and finished their task appeared their affection to Tiro before coming back to their seats. They expressed their thanks to Tiro because it selected them, and helped do their task.

Figure 8. Children Expressing Their Affection to Tiro

In particular, unlikely the results of the previous studies carried out in the same field, this study recommends that male students showed more intensive attention, affection, and passion to Tiro than female ones, and they also participated on the music lesson more actively, positively, and dynamically than female students.

Consequently, Tiro was recognized by children not only as a teaching assistant robot but also as a children's friend. For this reason, the future study will need to examine how to use teaching assistant robots as peer tutors effectively, and how to balance good relationship between the teacher and the teaching assistant robot for effective education.

V. CONCLUSION

The purpose of this study was to investigate field trial on employing a teaching assistant robot, Tiro, in a Korean elementary school music class. First, this study selected six-eight time music conduct lesson available for low-price robots, and divided instructional programs into two tasks: class management and class procedure assistance.

Also, based on the lesson demonstration scenarios and contents designed, this study defined robot's action template for assisting the teacher, and inserted robot action scripts into multimedia robot contents used for touch screen. Developed robot contents were loaded to LMS, and they were used in experimental lessons by the teacher through wireless download. In the lesson demonstration, the teacher explained to the children that the cost of the robot development was the one core reason why the robot had difficulties doing the same six-eight time music conduct as human beings, so three-four time conduct had to be performed. Accordingly, at the end of overall lesson demonstrations, the teacher gave students the opportunities that they could teach six-eight time music conduct to robot and assess it. As a result of this, both the teacher and observers conclude that the students' satisfaction and concentration were much higher than before. More importantly, students recognized Tiro as their friend rather than as teaching assistant, and they tried to have some good opportunities to help Tiro as a peer tutor that had difficulties performing six-eight time music conduct. Also, because music lesson is more practical, it acquires more teachers' own personal guidance to each student in spite of the more highly improved quality of lesson in terms of the teacher's cooperation with Tiro than before. Equally importantly, more future studies will need to overcome some problems shown in this study: Tiro's low-recognition rate in noisy classroom settings, difficulties of using long-distance remote control, problems of using Tiro in the play of complicated instruments such as records and drums, and interaction problems between the teacher and Tiro.

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