

## The Effect of Genibo Program Based Robot Learning on a Pre-Schoolers' Emotional Development

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### 로봇학습에 기반한 제니보 프로그램이 유아의 정서발달에 미치는 효과

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**Abstract** The purpose of this study was to identify the effect of Genibo program robot-based learning(R-Learning) on a pre-schooler's mental state. To achieve above study purpose, the subject of this study was selected 46(teacher 2, five years old pre-schooler 44) from pre-school childrens in Kyongki Y city(R-Learning activity participants group 21: boys 10, girls 11. non-participants 25: boys 13, girls 12). R-Learning program is consist of 5 field about 20 contents using Genibo robot, were applied to the experimental group and the pre-post test was conducted using the EQ assessment tool and observations. The data were analyzed by t-test using the SPSS(ver 18.0) program. The results were as follows: First, the exposure of robots to pre-schoolers in practical situation has shown positive influence to the children's emotional well-being. Positive improvements were observed in the four sub categories of the EQ assessment after exposure. Second, the Genibo used for this study, is a biomimetic AI based robot mimicking the behavior of a pet dog. This is related more or less to the specifications of a pre-school education where animals are used as a 'friendly medium' to facilitate the learning process. Third, the robot exposure gave benefit to all the ones in the sample, regardless of sex. Furthermore, It is suggested that promising potential for robots to be utilized as a new educational media plus facilitator, R-Learning is related more or less to the specifications of a pre-school education where animals are used as a 'friendly medium' to facilitate the learning process, and when applying them for education, stereotyping the likes of sex is overrated - instead, the focus should be more on the pre-schoolers' / childrens' individual traits, learning curve differences and alike.

**요약** 본 연구의 목적은 로봇학습에 기반한 제니보 프로그램이 유아의 정서에 미치는 효과를 밝히는 데 있다. 본 연구의 목적을 달성하기 위하여 Y시 소재 유치원 2개 학급(교사 2명, 유아 44명)을 각각 실험집단과 비교집단으로 나눈 후, 실험집단을 대상으로 제니보를 이용하여, 5개의 메인메뉴로 구성된 20개의 하위 콘텐츠를 적용하였다. 두 집단을 대상으로 정서지능 평가검사를 사전·사후로 실시한 후, SPSS 18.0 통계분석프로그램을 이용한 t-검증과 관찰이 이루어졌다. 연구결과 첫째, 제니보는 유아의 정서에 긍정적인 영향을 미친 것으로 나타났다. 정서지능의 4가지 영역(정서인식 및 표현, 사고 촉진, 지식의 활용, 반영적 조절)에서 모두 유의미한 변화를 보였다. 둘째, 생체모방형 로봇은 동물이 수업에 친근하게 사용되는 것과 같이 유아에게 친근하게 다가갈 수 있었다. 셋째, 남아가 여아보다 로봇을 선호하는 경향이 강하다는 기존의 연구들과는 달리 제니보는 남녀유아 모두의 정서에 긍정적인 영향을 미쳤다. 이러한 연구결과는 유아를 위한 새로운 교육방법으로서 로봇의 도입을 긍정적으로 검토를 할 수 있고, 친숙한 동물형태의 생체모방형 로봇이 효과적으로 활용될 수 있으며, 로봇의 활용은 유아의 성별보다 개인적인 성향과 발달수준 등에 의해 고려되어야 함을 시사한다.

**Key Words** : robot based learning, Genibo, mental state

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## 1. Introduction

With mankind reaching a record-high peak growth rate during the 21st century in advancement to IT infrastructure, many countries across the globe began to rapidly evolve into ubiquitous society as a result of converged broadband network through the use of wireless / wired networks, state of the art IT equipments, multimedia data, mutual merges and alike. Recently, blogs based on web 2.0, Facebook, video sharing website Youtube and Twitter which tends to be popular for mobile service users have diversified channels of Social Media, which resulted in a mass-media communication strategic revolution[1]. These phenomena, as forecasted by many scholars, are changing and developing the way of our educational environment and will continue to do so in the years to come.

As such, there are attempts even in pre-schools / kindergartens to apply educational teaching and learning via e-learning, u-learning or alike through the use state of the art technology, and these methods have evolved from just simply conveying information in forms of videos or flash into something more elaborate involving combination of highly advanced computer graphics, virtual reality and games to name a few.

However, computer and web based learning methods such as e-learning or u-learning have limited interface to facilitate for the pre-schoolers' level of lingual and cognitive abilities, which, in turn, limits the degree of emotional and communication exchange with the pre-schooler. As such, in reality, it would be fair to say that the application of such method in pre-schools are that much more difficult.

More recently, cases of educational effectiveness achieved by the application of AI based educational services robots[2], has proven a promising potential for network integrated AI based robots as the new black for the future's appropriate mode of educational media.

Robots have recently been actively dispatched to pre-schools for educational purposes, however, there is

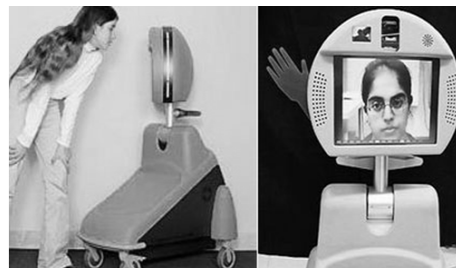
neither concrete definition nor classifications to these robots, not to mention the lack of research on the standards of educational contents, types and required elements that should be equipped on these robots[3].

As such, this study aims to study the impact of robot-based learning activities on a pre-schoolers' mental state.

## 2. R-Learning Research Status

### 2-1. International

In Canada, a robot has been used in primary schools for 12 years as a facilitator to health education. Remote attendance robot, by the name of PEBBLES has been commercialized for the needs of students that could not attend school for prolonged periods of time due to long-term hospitalization and alike. PEBBLES allows the victim student to attend classes remotely, thereby minimizing academic stress for the victim student even after delayed hospital discharge.



[Fig. 1] PEBBLES - Canada

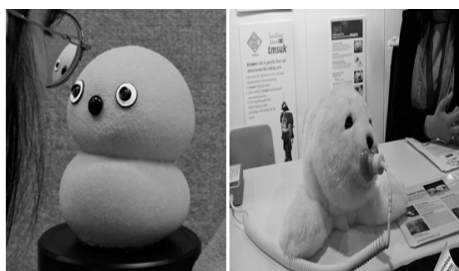
In the case of England, robots are used to facilitate improving symptoms as well as to teach special-education students (autism in particular). The robot Recycler (England) is used for educating primary school students about the importance of recycling, namely the 3R's(Reduce, Reuse, Recycle). Robot KASPAR is used for pre-schoolers with autism to help them develop social and communication skills via their interactions with KASPAR.



[Fig. 2] KASPAR - England

As for the US, there has been a case study supporting the success of using robots as a facilitator to teaching. A controlled robot-facilitated teaching session for over 6 months in primary, secondary and tertiary institutions have reported success, for the students' mathematics classes. In addition to the above, US is continuously researching to develop a state-of-the-art robot that incorporate a human's emotions and psychological aspects into its AI via the use and study of MIT's robot Kismet and alike.

In Japan, NEC developed Papero, initially designed to function as a talking buddy for elderly or as assistant plus pet. Nowadays, childcare support service function has been added to the Papero. Furthermore, a robot taking the appearance of a seal by the name of Paro has been developed by Dr Shibata's team, designed to provide emotional treatment for the elderly and autism patients through stimulating the sense of touch. Other robot development cases also include Robovie, a primary school English teaching-aide as well as Keepon, a robot designed to help autistic pre-schoolers to interact.



[Fig. 3] Papero and Keepon - JAPAN

Japan has also developed ASIMO (Honda), a robot used as a case study for science classes for grade 1 to 9. ASIMO is an AI based robot which is capable of expressing feelings, greetings as well as handing over objects. It can also recognise a person's face as well as reacting to voice commands accordingly.

## 2-2. National

In Korea, IROBIQ, a robot equipped with voice recognition and pre school education contents went into commercialization as of December 2008 to be used around pre-schools as teacher aide robots. IROBIQ is an URC concept robot, capable of security, communication, play and education functions all achieved via wireless network connection. It is capable of expressing emotion via LED facial expression, simple commands, voice recognition and self-mobility.



[Fig. 4] iROBIQ - Republic of Korea

A primary school teacher-aide AI robot TRIO is capable of variety of uses as its' functions can differ depending on the software equipped on it. It is designed to facilitate academic work in the classroom as well as assisting the teacher's administrative work. Its' entertainment functions allow for both effective and fun learning, and administrative functions assist the teacher with things such as notifications and tidying up class. TRIO was also put on trial for primary school English classes.



[Fig. 5] TIRO - Republic of Korea

VANI, is a tele-presence based robot equipped with an online learning program on an upper-half monitor, designed to teach English in listening, talking, reading and writing. The native teacher from overseas can also monitor the progress via wireless LAN to teach the English classes real-time.



[Fig. 6] The Korean VANI (VANI)

The summary of robot development cases, national and world-wide are as below.

[Table 1] National and international Robot developments

| Country | Robot name | Primary role     | Applied in               |
|---------|------------|------------------|--------------------------|
| Canada  | PEBBLES    | A double         | Remote attendance        |
| England | Recycler   | Teacher-aide     | Primary school education |
|         | KASPAR     | Friend           | Special education        |
| USA     | RUBI       | Friend, Pet      | Pre-school education     |
|         | GiraFFe    | Parent, A double | Childcare support        |
|         | Papero     | Friend, Pet      | Childcare support        |
| Japan   | Paro       | Pet              | Special education        |
|         | Robovie    | Friend           | Teaching English         |
|         | Keepon     | Friend           | Special education        |
| Korea   | iROBIQ     | Teacher-aide     | Pre-school education     |
|         | TIRO       | Teacher-aide     | Primary school education |
|         | VANI       | Native teacher   | Teaching English         |
|         | Genibo     | Friend           | Pre-school education     |

### 3. Methodology

#### 3-1. Pre-school sample for this research

Participants for this research were 44 pre-schoolers in total, 20 from class A and 24 from class B. Two teachers as well as the home room teacher of the classes also participated in the research. The number of boys to girls were 24 to 20 and were all five years old, with none of them having prior exposure to robot-facilitated learning.

#### 3-2. AI based pre-school educational robot



[Fig. 7] The Genibo edu

The robot used for this research is 'Genibo Edu', developed by A Corporation, Republic of Korea. Sized at 192mm×334mm×300mm, weighing 1.6kg. It is a biomimetic AI based robot, designed to reflect the behaviours of a dog through the state-of-the-art technology. Its merit is that it can mimic the behaviours of pets, that are, in reality hard to raise within a pre-school environment.

#### 3-3. Learning contents

Learning contents that can be utilized in Genibo Edu are divided into five main menus: 'learning-aide contents'; 'day-to-day assistance contents'; 'self-learning assistance contents'; 'administration and events assistance contents' and 'emotion-developing oriented contents'. There are twenty sub menus that fall under these main five as well.

[Table 2] The contents in Genibo

| Main function                        | Robot sub-menu           | Details / Description  |
|--------------------------------------|--------------------------|--|
| Learning-aid                         | Korean folk songs        | Folk song contents where the pre-schoolers can sing and dance with Genibo.         |
|                                      | Korean folklores         | Genibo tells Korean folklores.   |
|                                      | Fairytale session        | Genibo tells fairytales and the pre-schoolers commit to related activities after.  |
|                                      | Poetry session           | Genibo recites poems and the story is re-created.                                  |
|                                      | Games                    | Genibo's motions and actions can be remotely controlled.                           |
|                                      | Lingual development      | Genibo supports lingual development via activities.                                |
|                                      | P.E                      | Exercise time with Genibo.   |
| Day-to-Day assistance                | Daily assessment         | Assess the day's activities by viewing photos taken during the day.                |
|                                      | Activities guide         | Guides the day's activities and sessions.  |
| Self-learning assistance             | Photo taking             | Take photos to use in various ways.  |
|                                      | Recording                | Record voice or music for various purposes.  |
|                                      | Recognition              | Voice, touch or all-motion recognition.  |
| Administration and events assistance | Events notification      | Introduces the school's environment as well as notifying events.                   |
|                                      | Conversations            | Many Genibos share onversations.   |
|                                      | Schedule                 | Sets the schedule and guides the day.  |
|                                      | Roll call                | Roll call the students (pre-schoolers) by their assigned numbers.                  |
|                                      | Group roll call          | Roll call the students (pre-schoolers) by their assorted pairs / groups.           |
|                                      | Greetings / Farewell     | Greetings and fairwell for the pre-schoolers up on arrival and departure.          |
|                                      | Transition / Meal time   | Conversation contents for students (pre-schoolers) during transition / meal times. |
| Emotion-developing                   | Take good care of Genibo | Emotional-developing modules for the pre-schoolers via interations with Genibo.    |

Concretely five main menus is that :

Pre-schoolers showed positive response and interest to robots & relative programs, also they were much more active than the teachers in attempting to interact and form bounds with it.

This behavior was similar observed in previous studies. Pre-schoolers or children, recognize robots as

their friend or alike counterparts, whereas their parents see them as just machines. The degree of interest to robots were high without distinction of sex. In other words, children recognize robots more or less one of their own and such mind set allows them to interact more actively as opposed to their teachers, the adults.

### 3-4. Research apparatus

To measure the impact of robot-based learning on a pre-schoolers' mental state, a corrected, improved version of the survey was created based on the EQ assessment tool [4] improvements on the survey were done via previous research analysis, participant observations as well as validity analysis.

The survey contains a total of 114 questions, 6 of which are based on the pre-schoolers' basic backgrounds while 108 are based on EQ assessment. The summary of the EQ assessment tool / survey are as follows.

[Table 3] EQ assessment tool's contents & questions

| Area                      | Contents   | # of Questions |
|---------------------------|--|----------------|
| Pre-schoolers' background | Institution, age, robot type, time of exposure to robot-facilitated learning | 6              |
| EQ assessment tool        | Recognizing emotions and its expressions                                     | 33             |
|                           | Accelerated cogitation brought on by emotional development                   | 25             |
|                           | Use of emotional-intellect   | 27             |
|                           | Controlling reflective emotions  | 23             |

The EQ assessment tool was constructed with the pre-school's daily session as a focus, specifically divided into sections - attendance; dismissal; play sessions and conversation time; group activities; clean up time; situations where mistakes occur; conflict situations; free activities time; tea and lunch time and outdoor activities.

### 3-5. Data analysis

To measure the changes brought to the pre-schoolers' mental state through the application of

robot-facilitated learning, the differences of each variables values with respect to the pre-schoolers EQ score prior to robot facilitated learning and after were calculated and a two-dependant sample t-validation was conducted against the increase of average scores. SPSS / WIN 18.0 was utilized in the process.

## 4. Results

### 4-1. EQ score comparison prior to robot facilitated learning and after

#### 4-1-1. Total score comparis

As indicated by the above, the pre-schooler's average EQ score increased from 303.34 to 326.74, after being exposed to robot facilitated learning (to be noted as exposure from this point onwards). This is a significant difference in statistical terms ( $t=22.10$ ,  $p<.05$ ).

It is that given to pleasure for children. Concretely, through the Korean folk songs contents which the pre-schoolers can sing and dance with Genibo were improved for their sociality. Also Genibo program is very helpful to the interaction between the pre-schooler and the external condotions in environment to which he can react.

[Table 4] total score comparison

| Situation | N  | M      | SD    | df  | t       |
|-----------|----|--------|-------|-----|---------|
| Before    | 44 | 303.34 | 31.58 | 427 | 22.10** |
| After     |    | 326.74 | 33.47 |     |         |

\*\* $p <.05$

#### 4-1-2. Sub-category score comparisons

As observed by the above, the pre-schoolers' average EQ score in the 1st category increased from 94.89 to 101.91 after exposure, and this is statistically meaningful ( $t=17.70$ ,  $p<.05$ ). As for the 2nd category, the pre-schoolers' mean EQ score increased from 70.14 to 76.16 after exposure and also demonstrates statistical significance ( $t=21.86$ ,  $p<.05$ ).

[Table 5] Sub-category score comparisons

| Sub-categories  | Before (n=24) |       | After (n=24) |       | t       |
|---|---------------|-------|--------------|-------|---------|
|   | M             | SD    | M            | SD    |         |
| 1. Recognizing emotions and its expressions                   | 94.89(2.87)   | 11.30 | 101.91(3.08) | 11.48 | 17.70** |
| 2. Accelerated cogitation brought on by emotional development | 70.14(2.80)   | 7.94  | 76.16(3.04)  | 8.57  | 21.86** |
| 3. Use of emotional-intellect                                 | 75.93(2.81)   | 8.58  | 82.51(3.05)  | 9.60  | 19.73** |
| 4. Controlling reflective emotions                            | 62.37(2.71)   | 7.61  | 66.14(2.87)  | 7.84  | 17.98** |
| Total   | 303.34(2.80)  | 31.58 | 326.74(3.02) | 33.47 | 22.10** |

\*\* $p <.05$

For the 3rd category, the mean score fluctuated from 75.93 to 82.51 after exposure and likewise, holds statistical significance ( $t=19.73$ ,  $p<.05$ ).

Finally, for the 4th category, the pre-schoolers' average EQ score has shown improvement from 62.37 to 66.14 after exposure, also conclusively showing statistical significance ( $t=17.98$ ,  $p<.05$ ).

Genibo program is useful that teacher is making explanation and that most of pre-schooler is much interested in the their problem and is following the explanation mentally, seeing the connrctions that are made and taking from his own experience certain illustrations as the teacher goes along with the explonation.

### 4-2. Difference in scores by sex

As indicated by the above table, the boys' EQ scores improved from 303.07 to 326.12 after exposure and this holds statistical significance( $t=16.21$ ,  $p<.05$ ).

Similar case was observed for the girls, as reflected by the above table ( $t=15.07$ ,  $p<.05$ ).

The differences in the scores between the two different sexes were boys' with an average increase of 23.05 while for the girls it was 23.86. This has been deemed as no statistical significance ( $t=0.37$ ,  $p>.05$ ), meaning that the exposure does not have significantly differing impact depending on the sexes.

**[Table 6]** Difference in scores by sex

| Male/Female | Before |       | After  |       | Increase |       | t       |
|-------------|--------|-------|--------|-------|----------|-------|---------|
|             | M      | SD    | M      | SD    | M        | SD    |         |
| Boy (n=24)  | 303.07 | 32.07 | 326.12 | 33.59 | 23.05    | 22.39 | 16.21** |
| Girl (n=20) | 303.72 | 30.97 | 327.58 | 33.37 | 23.86    | 21.23 | 15.07** |
| t           |        |       |        |       |          |       | -0.37   |

\*\**p* < .05

## 5. Conclusion and recommendation

The conclusion for this study is as follows.

Firstly, the exposure of robots to pre-schoolers in practical situation has shown positive influence to the children's emotional well-being. Positive improvements were observed in the four sub categories of the EQ assessment after exposure and this shows promising potential for robots to be utilized as a new educational media plus facilitator[5]. However, there is a need to cautiously approach this matter, not to exclude the possibility of this change merely being brought upon by the students'/pre-schoolers' fascination alone[6].

In addition to this, a systematic research and assessment should be put in place to measure the system's consistency as well as its' long-term effects[7].

Secondly, the Genibo robot used for this study, is a biomimetic AI based robot mimicking the behavior of a pet dog. This is related more or less to the specifications of a pre-school education where animals are used as a 'friendly medium' to facilitate the learning process. In other words, robots that are in forms that the children are more used to being with (i.e. pets such as dogs), are bound to be more effective for learning and engaging[8].

As such, various forms of biomimetic robots befitting differing situations will need to be developed so as to widen the mode of optimal choice.

Finally, the robot exposure gave benefit to all the ones in the sample, regardless of sex. The hypothesis was that the boys would tend to prefer the robot more and hence would show drastic change in EQ scores,

but the reality was that it was more or less similar for both sexes.

Important changes in pre-schooler's behavior are not produced overnight. No single learning experience like a Genibo program has a very profound influence upon the pre-schoolers. Changes in ways of thinking, in fundamental habits, in major operating concepts, in attitudes, in abiding interests and the like, develop slowly. But As observed by the results, It is useful program to improving in preschool's mental state.

This suggests that when developing robots or applying them for education, stereotyping the likes of sex is overrated - instead, the focus should be more on the pre-schoolers' / childrens' individual traits, learning curve differences and alike.

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