A Case Study on Integrating Soundbeam Technology and Music Activities to Enhance a Child with Disabilities Development of Motor Skills and Attention Span

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Abstract

Soundbeam has had dramatic effects in the field of disability and special education. Even children with significant impairments are, with the most minimal movements, able to create exciting and beautiful sounds. The purpose of the study is to examine the use of Soundbeam Technology in enhancing young children with disabilities motor skills. The methodology of the study used a quantitative analysis to measure validity based on assessment scales used in the observation forms by four observers and a qualitative study using interviews with parents and researcher’s teaching log. A 4 year-old participant with Williams Syndrome was selected by purposive sampling to participate in the research. The duration was 20 weeks with 30-minute instructional sessions twice per week. Both qualitative and quantitative methods were used to obtain the results. The results showed the efficacy of using Soundbeam and music activities to develop the young child’s motor skills. Especially while using visual software and Soundbeam equipment together, the participant became more interested in movements. Furthermore, the young child’s attention span was also
improved through the assessment of music activities.

Keywords: Soundbeam, Music Activities, Williams Syndromes, Motor Skills, Attention Span
INTRODUCTION

Background
Using technology in the practice and research of music therapy provides a window into the specific advantages for music education. This assists in the training and development of new tools for educators and therapists (Crowe & Rio, 2004). Soundbeam has had dramatic effects in the field of disability and special education. Even children with significant impairments are, with the most minimal movements, able to create exciting and beautiful sounds.

The Motivation of the Study
Soundbeam technology is a brand new avenue for educators in the field of special education and therapy in Taiwan. At an International Society for Music Education conference in 2006, the researcher learned of Soundbeam from a conference presenter, Professor Philip Ellis who is a pioneer in the field of sound therapy. After learning the technology with Professor Ellis at the University of Sunderland, the researcher set up a Soundbeam room and implemented a pilot study of using Soundbeam to enhance mainstream children’s creativity. The study showed positive results for young children; therefore, the participant group was expanded and this technology was applied to children with disabilities.

The Purpose of the Study
1. Integrating Soundbeam technology and music activities to assist a young child with Williams Syndrome development of motor skills.
2. Integrating Soundbeam technology and music activities to enhance a young child with Williams Syndrome attention span.

Research Questions: the specific research questions would be involved in the study:
1. Could Soundbeam technology and music activities assist a young child with Williams Syndrome development of motor skills?
2. Could Soundbeam technology and music activities enhance a young child with Williams Syndrome attention span?
RELATIVE LITERATURE REVIEW

Sound Therapy

Sound Therapy was developed in the early 1990s by Professor Philip Ellis, at a school for children with learning difficulties and mental disabilities. It was also tried at facility for the elderly (Ellis, 1997). Technology and aesthetic response are combined to create sound therapy, which can help interaction and communication skills development in a non-interventionist method (Ellis, 1995). Sound therapy has become vibroacoustic sound therapy (VAST), which has been tested on the elderly (Ellis, 2004a, b). This uses a device to reinforce Soundbeam-created sounds, as well as relaxing the user. Ellis’ work at the iMUSE (interactive Multi-Sensory Environment) research center at Sunderland University is focused on the elderly and also produces graphical feedback. This multi-sensory approach has been shown to bring delight and pleasure to children with cerebral palsy (Ellis, 2006). Linking sound with physical movement has increased understanding of cause and effect for many, including children with profound and multiple learning difficulties (PMLD) (Ellis, 2006).

Soundbeam Technology

Soundbeam is shown to help in the instruction of children with disabilities. It can help expression through music and sound, and encourages participation in activities (Swingler, 2003; Ellis, 2006). Most musical instruments require precise physical movement that is difficult for the severely disabled (Jacobs, 1997). Soundbeam lets the user create sound and music without touch (Soundbeam Project, 2003). The use of Soundbeam has helped to develop practical movement and expressive movement capabilities, as well as allowing children to create improvised music (Ellis, 1996).

Ellis (Ellis, 1994, 1995, 1996) has conducted the first systematic, long-range study of the potential of Soundbeam for disabled adults and children (Soundbeam Project, 2003). When a child moves, a sound emanates, spurring continued movement and therefore improved posture, trunk control and balance. It also creates an atmosphere of achievement and fun, and the therapeutic aspect is not important to the child. Soundbeam is drawing in those who had no access to music or music.
therapy, and is also benefiting therapists through the quantitative data it produces (Hunt, Kirt, & Abbotson, 2000).

**Music Therapy for Children with Disabilities**

Music has been an important part of health care for some time. Communication skills were enhanced among a group of children with disabilities through the application of music therapy (Edgerton, 1994). Children with developmental delays improved their coordination, speaking and listening abilities, etc. through creative music therapy (Aldridge et al., 1996). Visually impaired children explored their environment, interacted with their peers and increased social awareness via music therapy (Gourgey, 1998). School children have developed social skills and levels of participation through music therapy (Camilleri, 2000). Children diagnosed with Rett Syndrome improved the duration and frequency of hand grasp, as well as language and socialization skills (Yasuhara & Sugiyama, 2001). Music therapy spurred a significantly higher level of engagement than other activities in a hospital setting. Unlike other therapies, there are no sensory, cognitive or physical requirements to participate in music. But, most music therapy uses acoustic instruments, which precludes participation of some children with physical issues (Robb, 2000).

The relationship between Soundbeam technology, music therapy and music activities for young special needs children is shown in figure 1. Music plays a crucial role for human life since every culture has its own music. Through music activities, young children enjoy playing and learning. Music therapy is a great way for most young children with disabilities to improve their non-musical development. Music technology is a new way of improving young children with disability development; therefore, combining three aspects of learning tools to help the young child will have positive effects.

Through previous study (Lee, 2008a, b, c; Lee, 2007 a, b; Lee, 2006 a, b, c) and instruction, the researcher has seen positive effects from children with developmental challenge being given the opportunity to interact and experiment with musical instruments. The positive effects included improving attention span and language abilities and
enhancing social and behavioural changes for young special needs children with disabilities.

**METHODOLOGY**

The methodology of the study was both quantitative analysis and qualitative reports. The former was based on assessment scales used in the pre-test and post-test by a physical therapist and observation forms by four observers. And the latter included interviews with parents, observation reports from four observers and researcher’s teaching log. All observations of the participant undertaken during all sessions were recorded on videotape.

**Participant**

The subject was a 4 year-old girl who had received a clinical diagnosis of Williams Syndrome and had physical movement disabilities. The child was enrolled in a regular private kindergarten in Taichung, Taiwan, and was selected by purposive sampling to participate in the study.

**Duration**

This was a 20-week study, with half-hour sessions twice per week. The total intervention was 40 sessions.

**Curriculum Design**

**Free exploration stage**

At this stage, the children explore the sound freely through physical movement. Through the sound exploration, the sounds motivate the subject’s attention and curiosity in order to increase learning motivation.

**Instructional learning stage**

**Guidance with target sounds**

The researcher used Soundbeam for target sounds that the participant imitated in order to reach the target objectives.

**Guidance with sounds and visual images**

The researcher used Soundbeam target sounds and target visual images from Arkaos software of VJ3.61FC1 to have the subject imitated in order to reach the target objectives.

**Purposive guidance**
In order to evaluate the subject’s learning efficiency, the researcher used purposive guidance, including Soundbeam activities, visual image activities and musical storytelling time.

Data Analysis

The results were interpreted based on data collected via a semi-structured musical activities observation form, interviews with parents, musical activities feedback form, and researcher’s activity log. Cross-comparison was conducted on the quantified data and related original documents to increase the objectivity and reliability of the research results.

Assessment

The assessment included pre-test and post-test forms completed by a physical therapist at a local hospital, semi-structured observation forms to gather data on motor skills and attention span from four observers who were trained graduate students, interview reports from the parents at home and teaching logs from the researcher. All intervention sessions were recorded on video and these were viewed and scored by four observers. At the end of the study, three social reliability assessment reports were completed by the parents and an observer.

RESULTS

Analysis of the Participant’s Motor Skills

**The changes of the subject’s gross motor skills**

The figure 1 shows the changes of the subject’s gross motor skills based on the pre-test and post-test. After attending 10 weeks of research teaching, the subject’s gross motor skills progressed, including: running more with stability at greater speeds and changing direction. It was also able to hop on one foot; to roll a ball while sitting on the floor; to catch the ball from 3 meters. Therefore, the research teaching had a positive effectiveness for the subject’s gross motor skills.
The changes of the subject’s fine motor skills

The figure 2 shows the changes of the subject’s fine motor skills based on the pre-test and post-test. After attending 10 sessions, the participant’s fine motor skills progressed, including: using 5 blocks to build objects in three-dimensions and use of an eraser without damaging pieces of paper. Therefore, the sessions had a positive effectiveness for the subject’s fine motor skills.
The change process of the subject’s motor skills

The following description is the change process of the subject’s motor skills based on the observation forms from four observers, interviews with the parents and researcher’s teaching log.

Figure 3: the observers’ measurement of the subject’s motor skills

Week 1 to week 3
At the beginning of the research the subject could not catch balls and hop on one foot with stability. After three weeks, the subject’s fine motor skills were still unstable, but her gross motor skills obviously made progress the ability to perform increasingly varied movements.

Week 4 to week 7
Soundbeam equipment was used to encourage the subject’s interest and motivation for each lesson. Through movement, the participant could hear many different sounds. When there was no sound, the subject would ask “How come no sounds?” and stop her movements. At the fourth week, after the subject heard the sounds she disliked, she asked for her mother. At the fifth week, the subject was ill and medicated and had no desire to do the movements. It affected her performance and made the scores went down.

After four weeks of lessons, the subject’s motor skills had progressed. From the parental interview, the parent said the subject was able to hop on one foot and could peel an orange. The teacher also
shared the subject’s progress with the parent by saying the subject was able to use scissors better.

*She made a lot of progress on her motor skills. Before she would need a long time to walk on the sidewalk or stairs, especially the first step, but now she had overcome and made is more balanced. At home, she could peel an orange by herself. I feel that she make a lot of progress in both gross and fine motor skills.*

At this stage, the subject was able to use her fingers individually and pretend to play the piano in front of the sensor. She also was able to push balls and use a single hand to play with balls and could roll, throw and tap on the balls. With the instructor’s assistance, she could hop on one foot five times. At the sixth week, the subject was able to hop on one foot for 30 seconds and jump on a straight line for 2 meters with assistance. At the seventh week, the subject could hop on one foot four times by herself.

**Week 8 to week 10**

At the 8th Week, the subject did the movements as instructed, but at 9th week, the subject was sick and there was a visitor in the teaching room, so she did not perform well. At the last week, the subject was no longer ill, so her learning improved. She did well on the movements from the instructor’s direction, such as: threw and caught balls independently; hopped on one foot 5 times on her right foot and 6 times on her left foot. The parent indicated the subject practiced hopping on one foot all the time and tried to stand on one foot. The subject made progress in gross motor skills and fine motor skills.

*The subject was able to use her five fingers separately to play on the instructor’s palm with the piano sounds from the Soundbeam.*

From the information above, the subject’s gross and fine motor skills both had progressed by the end of the ten sessions. The participant made progress on her gross motor skills by running, hopping, throwing and catching. Her fine motor skills also progressed, as shown by her using her fingers to “play the piano.” According to the parent and the teacher, the subject both at home and school could do better at peeling oranges and using scissors for art work.

**Analysis of the Participant’s Attention Span**

The figure 4 shows the changes of the participant’s attention span
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based on four observers’ observation forms.

![Figure 4: the observers’ measurement of the subject’s attention span](image)

**The changes of the subject’s fine motor skills**

The following description is the change process of the subject’s motor skills based on the observation forms from four observers, interview with the parent and researcher’s teaching log.

From a 10-week curriculum including a Hello Song, Activity One, Activity Two, Musical Storytelling, Relaxation Time and Goodbye Song, the participant’s scores of attention span from the beginning of 1.125 to the end of 3.75. The subject made clear progress from week one to week two. At week four, the subject disliked the sounds from the Soundbeam, so her attention was distracted. Therefore, the scores went down. At week 5, even when ill, the subject’s attention span did not decrease, especially while listening to a story. Except at week 9, due to illness and a stranger’s interruption, the subject’s attention span decreased, from week 5 to week 8, the subject’s scores went up stably. By the end of the sessions, the participant reached the highest scores.

Week 1 to week 2

At the first week, the subject was distracted by many things, such
as: new environment, Soundbeam equipment, teaching assistants and musical instruments. She asked “Who are you?” and “What is this?” often. Therefore, she could not concentrate on the lesson and needed the instructor’s direction often. At week 2, she was more familiar with the teaching environment and the equipment, so her attention more focused.

The participant had not seen the Sound Box before, so for the first time, she was very curious and asked the instructor questions while sitting in the box. The subject showed more anxiety than concentration.

At the first week, due to curiosity, the subject could not concentrate on the activities, but was looking around and asking questions. At the second week, she paid more attention to the instructor. While singing the Goodbye song, the subject asked for it to be repeated and was able to sing part of the song.

Week 3 to week 5

At the third week, the subject’s attention was improved, but she still would look around during the lesson and needed the instructor’s direction. Through week four and five, the participant’s attention improved stably. The participant liked to listen to the story, so was very focused on the story time. She liked the musical story time. She could echo the instructor’s repeated words of the story and interacted with the instructor by imitating the movements and saying the words sometimes.

The parent indicated after the research teaching, the participant’s attention span had changed. She could focus on her work more and disturbed others less at school. (PI-12032007-2)

Week 6 to week 7

When visual images were added to Soundbeam effects at week 6 and 7, the participant showed interest. She would look at the instruments on the screen and did the motion of playing them. Therefore, she paid a lot of attention to the image and the sounds, especially when she found out the image moved and sounds came out as she did the movements. She also focused on the storytelling time and interacted with the instructor most of the time. During the relaxation
time, the participant only sometimes paid attention quietly.

From the parental interview, the parent indicated the participant’s attention was distracted by things easily. Her attention span lasted longer after participating in the lesson.

Week 8 to week 10

At this stage, the participant showed improvement in her attention span. The reason the participant’s scores went down at week 9 was due to her illness and a visitor observing the lesson. At week ten she demonstrated increased attention span. The parent indicated the participant had previous difficulty falling asleep, but while listening to the music from the class, she would fall deeply asleep in 5 minutes.

From the analysis above, after 10 weeks of music teaching, the subject’s attention had made a remarkable improvement in both her reading and school work, such as: reading stories at home, work on art work at school, etc. This was verified by the parents and her school teacher.

Observers’ Internal Consistency Reliability

In order to determine that the data was objective, there were 4 observers to assess the subject. As showed in the figure 6, the score of four observers’ internal consistency reliability for the subject’s motor skills is .8; therefore, this study is reliable.
As showed in the figure 7, the score of four observers’ internal consistency reliability for the subject’s attention span is .876; therefore, this study is reliable.

Figure 6. The scores of internal consistency reliability for the participant’s attention span

**Social Validity**

In order to support the validity of the study, a feedback form was used by the parents and an observer. The reliability for the study of coefficient of internal consistency is .804.
Figure 7. The score of the social validity

All respondents gave positive support for the study, and scored various aspects on a 1-5 scale. A score of 1 for questions in the goals section indicate that the respondent strongly disagreed with whether a goal of the study had been met; a score of 5 showed that they strongly agreed that a goal had been met. There were 6 scores of 5 (strongly agreed), 9 scores of 4 (agreed), no no comments, no disagreed and no strongly disagreed scores.

A score of 1 for questions in the development of motor skills and attention span section indicate that the respondent agreed the subject regressed a lot; a score of 5 showed that they agreed that the subject progressed a lot. There were 5 scores of 5 (progressed a lot), 10 scores of 4 (progressed), 0 no comments, no disagreed and no strongly disagreed scores.
### Table 1. Social Validity

<table>
<thead>
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<th>Items</th>
<th>Feedback Questions</th>
<th>Strongly Agreed (5)</th>
<th>Agreed (4)</th>
<th>No comments (3)</th>
<th>Disagreed (2)</th>
<th>Strongly Disagreed (1)</th>
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<tr>
<td>Part I Goals</td>
<td>1. The research teaching has a crucial meaning for the participant.</td>
<td>1</td>
<td>2</td>
<td></td>
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<td></td>
<td>2. The research goals fit in the needs of the participant.</td>
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<td>2</td>
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<td></td>
<td>3. Soundbeam and music activities have the positive effects on the participant.</td>
<td>2</td>
<td>1</td>
<td></td>
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<td></td>
<td>4. Soundbeam and music activities are safe, not dangerous learning methods and good for the participant.</td>
<td>1</td>
<td>2</td>
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<td></td>
<td>5. You accept the use of Soundbeam and music activities to teach the participant.</td>
<td>1</td>
<td>2</td>
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<th>Progressed (4)</th>
<th>No progress (3)</th>
<th>Regressed (2)</th>
<th>Regressed a lot (1)</th>
</tr>
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<tbody>
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<td>Part II The development of Motor Skills &amp; Attention Span</td>
<td>1. After taking ten sessions, the subject’s gross motors are</td>
<td>1</td>
<td>2</td>
<td></td>
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<td></td>
<td>2. After taking ten sessions, the subject’s fine motors are</td>
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<td>2</td>
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<td></td>
<td>3. After taking ten sessions, the subject’s attention span is</td>
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<td>2</td>
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<td>4. After taking ten sessions, the subject’s attention span on listening (including speaking with people, listening to stories and music) is</td>
<td>1</td>
<td>2</td>
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<td></td>
<td>5. After taking ten sessions, the subject’s participation in group and class activities is</td>
<td>1</td>
<td>2</td>
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</table>
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If you have other thoughts or opinions other than the description above, please include them here:

**CONCLUSION AND SUGGESTIONS**

According to the research purposes, the conclusions were made through the observation forms, researcher’s log and interviews with parents and supported by the social validity from parents and an observer.

**Conclusion**

The new technology of Soundbeam and its related equipment have positive effects on enhancing the participant’s physical movements. Through the sensor, the Soundbeam and its related equipment transformed the subject’s movements into sounds and images. It gave the subject more motivation for doing movements. Therefore, throughout the ten sessions, the subject’s gross motor skills for running, jumping, hopping were more stable and her fine motor skills for catching, throwing, pushing and peeling were also positively improved.

The new technology and music activities have positive effects on improving the young special child’s attention span.

The sounds from Soundbeam strongly focused the participant’s attention. When adding images into sound games, the participant’s attention increased. Other music activities also played a crucial role for the subject’s learning, such as, different movement directions from the *Hello Song* and musical storytelling.

Many different disciplines interweave; music, visual art, computer science, psychology, special education and physiotherapy. Due to this interdisciplinary environment a high degree of collaboration is required amongst experts from very different areas who generally talk in different technical languages. Thus, there is a need for a tool that allows us to assess the results and obtain conclusions.
Suggestions for the Further Study

Extend duration of the study

The duration of the study was three months. Young children with disabilities need longer duration of learning sessions. More sessions would increase data collection for more valid results.

Parental involvement

Parental involvement plays a crucial role for special needs child’s learning. It helps if the parents are involved in learning activities with children review activities at home.

Expand the ages, disabilities and numbers of subjects

Combining Soundbeam technology and music into the therapeutic setting is still a new avenue; therefore, there is a need to expand the age, disabilities and numbers of subjects in order to build a larger sample in the future.
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References


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World Conference. Bologna, Italy.


Soundbeam Project (2003.) Soundbeam 2®. Web link: www.soundbeam.co.uk/


整合聲音光束科技和音樂活動促進一位特殊幼兒肢體動作與注意力之個案研究

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中文摘要

聲音光束在特殊教育領域具有極其引人注目的效果，即使是僅具有最低肢體動作能力，相當重度之幼兒，也能創造出令人興奮與美麗的聲音。本研究之目的在檢驗聲音光束科技對於促進特殊幼兒肢體動作與專注力之功效。本研究主要採質性研究之「個案研究法」，資料蒐集方式以參與觀察與訪談為主，除了以質性方式蒐集與分析資料之外，再以量化數據為輔，量化數據由四位受過專業訓練之研究生根據量表評分，質性則以家長與幼稚園教師訪談紀錄和研究者教學日誌為資料來源。研究對象以立意取樣，選取一位四歲患有威廉氏症之幼兒參與研究教學。研究期限為 20 週，每週兩次，一次為 30 分鐘。根據質與量之資料分析結果。結論顯示聲音光束與音樂活動對特殊幼兒肢體發展具有正向效果，尤其是當加入視覺軟體於聲音光束音樂活動中，研究對象之學習動機不僅加強，對於其專注力亦有加強之功效。

關鍵字：聲音光束、音樂活動、威廉氏症、肢體動作、專注力