Journal of Engineering Science and Technology
Special Issue on AASSEEEC2021, December (2021) 26 - 33

TEACHING COLLOID SYSTEM TO INCREASE THE RESPIRATION OF CHILDREN WITH COMMUNICATION BARRIERS

RILA MUSPITA[1,2], S. SYIHABUDDIN[1], ACHMAD HUFAD[1], ASEP BAYU DANI NANDIYANTO[1,*], TRYASTUTI IRAWATI BELLINY MANULLANG[1], YAYAT SUDARYAT[1], IMAS DIANA APRILIA[1], RENO FERNANDES[2], AMIN AKBAR[2], ZULFITRAH[3]

[1]Universitas Pendidikan Indonesia, Jl. Dr. Setiabudhi no 299, Bandung, 40154, Indonesia
[2]Universitas Negeri Padang, Jl. Prof. Dr. Hamka Air Tawar Padang, Indonesia
[3]Universitas Negeri Makassar, Jl. AP, Pettarani Makassar, Sulawesi Selatan, Indonesia
*Corresponding Author: nandiyanto@upi.edu

Abstract

The goal of this study was to train children's respiration with communication barriers using a colloid system and to educate children on how colloids form. The single group pretest-posttest design method was used in this study. The subjects were four children who experience communication barriers, two children with hearing impairment who use a cochlear implant, and two children with intellectual disabilities. The steps taken were as follows: 1) providing a video on how to make soap foam (colloid), 2) before beginning the activity, subjects were asked several questions about the designed activity to assess the subject's understanding of the material, and 3) following the completion of the soap-making process, the subjects were asked to blow the soap foam to train the respiration and an anemometer was used to determine the speed and strength of the blow, 4) then a posttest was given to assess the subject's comprehension of the material presented. The findings of this study showed that all subjects could participate in the making soap foam activity and understand that when water was added to soap, it produced foam. The foam was blown from a certain distance to assess the subject's respiratory ability. Although the measurement results were quite variable, however, if the activity is repeated regularly, it can improve the subject's respiratory ability.

Keywords: Children with the communication barrier, Colloid, Respiration, Teaching.

1. Introduction

Speaking is a very complex activity. It includes breathing exercises or respiration, which is used as preparation for speaking. There are numerous ways for parents and teachers to train children's breathing such as by blowing balloons or whistles. However, for children who have communication barriers, a multidimensional approach should be taken [1]. Multidimensional approach refers to being able to train speech preparation as children also receive other knowledge to stimulate the brains during the development, and to increase their knowledge, particularly with phenomena around them. One of the daily phenomena children encounters is soap foam [2].

In Indonesia, at least twice a day when children bathe in the morning and the afternoon, children can see, touch, and play with the soap foam. However, children only understand that soap foam or soap is used for bathing. This bathing activity can be used to introduce existing chemical technology into the daily lives of children as early as possible to develop their scientific analysis and also speech development [3]. Speech-language development depends on brain maturation and all aspects of development. Besides, it is also necessary to teach hearing-impaired children about science that they can use in their daily lives, including children who have difficulty communicating in other ways.

In the field of chemistry, the phenomenon of soap foam formation is part of the colloid system. By using the activity of blowing soap bubbles to train children's respiration, communication barriers are broken down while also gaining science experience in everyday life. Because, so far, science learning has been limited to memorization and is rarely used in real-life applications. Furthermore, research on student literacy in the concept of solid and liquid forms requires further investigation [4]. So that children can begin learning science as soon as possible while also improving their respiratory and speaking abilities.

2. Method

This study used a pre-experimental one-group pretest-posttest method which means this study did not have a control group. This study only used a pretest-treatment-posttest design towards four subjects with communication barriers, including two subjects with hearing impairments who used cochlear implants ranging in age from 4 to 7 years, and two subjects with intellectual disabilities (down syndrome) from 10 to 18 years. Subjects were chosen from a group of four people based on classification criteria that subjects could be trained in respiration using colloids. Taking a small number of subjects was also due to their limited presence.

This study was conducted following these stages: 1) providing a video on how to make soap foam (colloid), 2) before beginning the activity, subjects were asked several questions about the designed activity to assess the subject's understanding of the material, and 3) following the completion of the soap-making process, the subjects were asked to blow the soap foam to train the respiration and an anemometer was used to determine the speed and strength of the blow, 4) then a posttest was given to assess the subject's comprehension of the material presented.

The data on comprehension and attitudes were collected quantitatively. For the comprehension data, the scoring rubric assessment is 4 when the subject gives the correct answer using verbal words, gets 3 when the subject gives correct cues, gets 2 when the subject gives the wrong answer using verbal words, gets 1 when the

subject gives wrong cues and gets 0 when the subject does not respond. Meanwhile, for the attitude data, a rubric score is applied where 4 is when the subject could pay attention, 3 is when the subject could pay attention with hesitation, 2 is when the subject hesitates, 1 is when the subject cannot pay attention and hesitates and 0 is when the subject cannot pay attention.

The child's respiratory ability is measured using an anemometer, where the number displayed represents the blow's speed and strength produced when the child blows the soap foam. All of the questions given to the subject are adjusted to the subject's ability: (i) What is this? (ii) What happens when the foam is blown?, 3) Where does the foam come from?, (iv) How do we make foam?. Throughout the activity, we observed the children's activities using the following indicators: (i) The child pays attention, (ii) The child can follow instructions, (iii) The child can move his/her mouth forward, (iv) The child can puff the cheek, (v) The child can blow the air from the mouth. In addition, to see the blow speed and strength measured using an anemometer, the distance between the mouth and the foam were varied as follows at 5, 10, 15, and 20 cm.

3. Results and Discussion

3.1. Student's demographic data

This study included four children with communication barriers, including two with hearing impairment who used a cochlear implant and two with intellectual disability (down syndrome). Children with hearing loss who use cochlear implants range in age from 4 to 7 years. Subject A is a 4.5-year-old boy who has a hearing loss of more than 110 decibels (dB) and has been using a cochlear implant for over two years. Subject A has started to comprehend simple command sentences, respond to simple questions, and ask simple questions such as "Please get me some soap!", "What is this?", and "This is soap,". Student A also knows some letters and vocabulary; however, the pronunciation is incorrect.

Subject B is a 7-year-old girl with a hearing loss of 100 dB who has only been using a cochlear implant for about seven months. However, before receiving a cochlear implant, the child used a hearing aid to ensure that she understood the instructions and could speak one or more words.

Both subjects' hearing impairment is severe because it is above 95 dB. Based on the World Health Organization's (WHO) international standards from 2005, which classified hearing loss as mild between 20 and 40 dB moderate between 41 and 55 dB, moderately severe between 56 and 70 dB, severe between 71 and 95 dB, and very severe above 95 dB [5].

Therefore, children with hearing impairments who use cochlear implants must be taught to breathe to improve their articulation when they speak [1]. In general, children with hearing loss exhibit respiratory changes and irregular breathing when speaking [6].

Subject C is also a 14-year-old boy with intellectual disabilities (down syndrome). The subject's vocabulary is still limited, and the pronunciation is not always clear. Subject D is an 18-year-old girl with learning disabilities (down syndrome). Both subjects encountered communication difficulties as a result of their intellectual barriers (down syndrome). Children with Down syndrome frequently struggle with speech and

language [1]. Meanwhile, for children with down syndrome, there is a strong link between cognitive and verbal language development.

3.2. Experiment results

Colloids are heterogeneous mixtures of two or more substances in which particles of one substance with diameters ranging from 1 to 1000 nm are evenly dispersed in the medium of another substance. Colloidal systems can be classified based on their dispersing phase. It is made up of sol (solid dispersed phase), emulsion (liquid dispersed phase), and foam (gas dispersed phase). Meanwhile, it can be divided into eight groups based on the dispersed phase and colloidal dispersion, one of which is the gas dispersed phase and the liquid dispersion phase, and the colloid type is foam. Foam is a colloid composed of gaseous air and a liquid dispersion medium of water. Soap foam is an example of colloidal foam. Hydrolysis reactions, or the reaction of a substance with water, can result in the formation of colloids. Colloidal systems can be created by combining a substance and water. Solute and a colloidal moiety that is molecularly dispersed. Both parts are in a state of hydrolysis equilibrium. [7].

3.3. Teaching process

During the teaching process, there are five aspects to consider when implementing the activity of making soap foam in training children's respiration. The results of the observations can be seen in Fig. 1. On the first aspect, all subjects got 4 which means that all subjects can pay attention. The media used and the activities carried out were quite appealing to the subject. The use of media to attract children's attention is a common approach [8]. For the second aspect, subjects A and B obtained 4 because they could follow the instructions, while subjects C and D followed hesitantly. Subjects A and B got 4 in the third aspect, while subjects C and D obtained 3 because they could do it but hesitated.

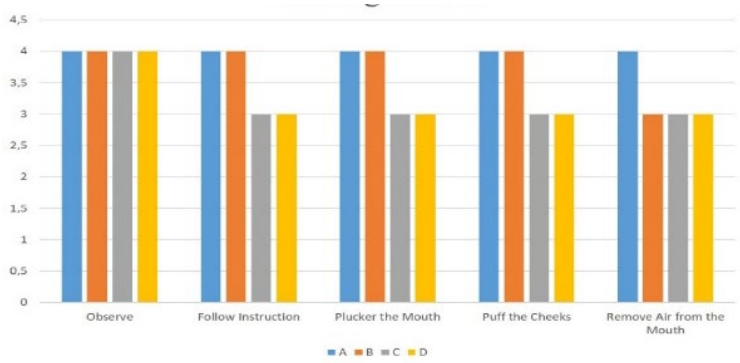

Fig. 1. Subject's Attitude during the teaching process.

Subjects A and B got 4 in the third aspect, while subjects C and D obtained 3 because they could do it but hesitated. Furthermore, subjects A and B got 4 in the fourth aspect, while subjects C and D obtained 3. Subject A got 4 in the fifth aspect, but when blowing, the subject was salivated. This happened because the subject's articulation part was stiff. Furthermore, congenital factors cause children

to salivate when blowing [2]. Subjects B, C, and D obtained 3 because they could do it but hesitated.

3.4. Colloid system taught to subjects

Table 1 compares children's understanding of colloids before and after the activity. Subject A got 0 because, when asked, “What is this?”, the subject was silent and did not respond. Similarly, to the other four questions, subject A got 0 because the subject did not respond. The subject was then asked again after the activity of making soap foam was completed.

Subject A got 2 on the first question because the child answered but not correctly. When asked, “What exactly is this?”, the subject repeated the question and then mentioned the objects used "spoon," "water," and "soap." Furthermore, the subject obtained 2 on the second question because the subject did not respond. In the third question, the subject got 3 because the subject pointed to the soap, indicating that the subject understood where the foam was from. Furthermore, the subject got 3 for the fourth question because when asked, "How do we make foam?", the subject shoved soapy water until it was foamy, at which point the subject said "this." It can thus be interpreted that the subject comprehends the foaming process. Subject A has used expressive language, albeit nonverbally, because subject A is still in the process of transitioning to verbal expressive language and has started using one or two verbalized words, such as saying "this." As stated, hearing loss causes a delay in expressive verbal communication [9]. Subject A, on the other hand, has progressed to the stage of core communication ability, which requires the ability to listen to others, reflect, and then act on what has been observed.

Subject B obtained 2 on the first question because the subject made a sound but answered incorrectly. The subject got 0 in the second question because when asked a question, the subject did not respond. The subject got 3 on the third question and the fourth question. The subject got 4 after completing the activity of making foam for the first question because the subject answered the question. The subject used the term "bubble," which was new to the subject's vocabulary. In the second question, the subject obtained 3 for answering with a smile while making the flying sign. Then, the subject got 4 for the third question, in which the subject stated aloud that foam was made of soap. For the fourth question, the subject obtained 4 on how to make soap. "Make bubbles with soap," the subject stated.

Furthermore, subject C got 1 on the first question before doing the activity, where the subject answered with a cue, but the answer provided was incorrect. The subject's second question got 1 as well because the subject still answered with a cue, but it was incorrect. In the next question, the subject got 2 because the subject answered with a voice, but the answer is incorrect. While the subject's fourth question got 1, the subject was still using cues and gave incorrect answers. However, after the activity, subject C's score was nearly perfect, as, in the first question, the subject got 4 with the answer "foam." The subject responded "fly" to the second question about what happens when the foam is blown. The subject responded "from soap" to the third question about where the foam comes from. However, the subject obtained 2 for the fourth question because the subject answered but was incorrect. The subject responded with the words; "soap" and "fly into the sky" when asked how to make soap foam. This could be affected by

the fact that children with down syndrome have a limited understanding of concepts, so the subject only answered what the subject knew. However, because children say whatever they want, it can be difficult for us to determine exactly what they are saying.

Subject D got 2 on the first question before the activity because the subject answered but it was incorrect. In the second question, the subject obtained 1 because the subject only responded by puffing the cheeks. The subject got 0 on the third question because the subject simply shook their head. The fourth question got 0 because the child refused to answer and covered the face with a scarf. The score after the treatment on the first question was 4, the subject answered "foam." The subject got 3 for answering the second question using a "flying" sign. The third question got 4 for mentioning "soap" and the fourth question obtained 2 because the subject answered but it was incorrect.

Table 1. Comparison of Subject.

No	Question	Subject							
		A		B		C		D	
		Wo	W	Wo	W	Wo	W	Wo	W
1	What is it?	0	2	2	4	1	4	2	4
2	What happens when the foam is blown?	0	0	1	3	1	4	1	3
3	Where does the foam come from?	0	3	2	4	2	4	0	4
4	How do we make foam?	0	3	2	4	1	2	0	2

3.5. Respiration ability

Table 2 describes each subject's respiratory conditions when asked to blow soap foam to train the subject's respiration. An anemometer was used to measure respiration to obtain measurable data including the blow speed, strength, or pressure. Subjects A, B, C, and D were measured with distances of 5, 10, 15, and 20 cm, respectively, based on the outcomes of each subject's ability. As for subject A with a distance of 5 cm, the speed was 1 m/s, and the strength was 7.7 m/s. For the distance of 10 cm got 6 m/s for the speed and 6.2 m/s for the strength, then at a distance of 15 cm got 5 m/s for the speed, and 8 m/s for the strength, and while a distance of 20 cm 2 m/s for the speed and 7 m/s for the strength. Meanwhile, for subject B at a distance of 5 cm, the speed was 1 m/s, and the strength was 4.5 m/s, while at a distance of 10 cm, the speed was 3 m/s, and the strength was 4.5. Furthermore, at a distance of 15 cm, the speed was 2 m/s, and the strength was 3.5 m/s and at a distance of 20 cm the speed was only 0 m/s, but the strength was 7.8 m/s. According to the numbers that appear at strengths above 2 m/s, even though the blow speed on one subject was 0 m/s, the blowing strength reached 7.8 m/s. This has a significant impact on children's speech accuracy acquisition. Speech production problems in children with hearing loss are frequently reported, and overall control of speech processes may involve the respiratory or respiratory systems [10]. Breathing or respiration exercises by blowing, inhaling, inhaling, and exhaling through the nose are one type of speech therapy for children with hearing impairment [9].

Furthermore, Subject C at a distance of 5 cm with a speed of 0 m/s and a strength of 0 m/s. Meanwhile, with a distance of 10 cm, the speed was 0 m/s, and the strength was 0.6 m/s. And then with a distance of 15 cm, the speed was 0 m/s, and the strength was also 0 m/s. Meanwhile, with a distance of 20 cm, the speed was 2 m/s and the strength was 2.6 cm. Followed by the ability of subject D where at a distance of 5 cm the speed was 7 m/s and the strength was 6.6 cm, a distance of 10 cm had a speed of 3 m/s and the strength of 3.2, and at a distance of 15 cm the speed was 5 m/s and the strength was 5.2 m/s, while at a distance of 20 cm, the speed was 0 m/s and the strength was 0 m/s. In addition to cognitive issues, children with down syndrome have articulation issues. Speech disorders in children with down syndrome reveal a variety of articulation issues [1].

Table 2. Subject's Respiration Ability.

Subject	Respiration Measurement Results Using Anemometer							
	5 cm	10 cm	15 cm	20 cm	5 cm	10 cm	15 cm	20 cm
	Speed	Strength	Speed	Strength	Speed	Strength	Speed	Strength
A	1 m/s	7.7 m/s	6 m/s	6.2 m/s	5 m/s	8 m/s	2 m/s	7 m/s
B	1 m/s	4.5 m/s	3 m/s	4.5 m/s	2 m/s	3.5 m/s	0 m/s	7.8 m/s
C	0 m/s	0 m/s	0 m/s	0.6 m/s	0 m/s	0 m/s	2 m/s	2.6 m/s
D	7 m/s	6.6 m/s	3 m/s	3.2 m/s	5 m/s	5.1 m/s	0 m/s	0 m/s

4. Conclusion

As a result, it is possible to conclude that the material about the simplified colloidal system applied chemical technology to children who have communication barriers, both hearing barriers and intellectual barriers. Furthermore, the use of chemical technology not only broadens the child's knowledge but can also improve the child's respiratory capacity. If it is performed regularly, the child's respiration will improve, which will aid in the process of practicing language and speaking. However, since this research was conducted during the pandemic, it was difficult to stay close to the subject as researchers had to stay at a safe distance, and because the activity was related to releasing air, droplets would come out. It is hoped that more research on other types of colloids could be conducted on children with communication barriers and that they would also improve children's language and speech.

Acknowledgments

We would like to acknowledge Sekolah Pasca Sarjana Universitas Pendidikan Indonesia, World Class University Universitas Pendidikan Indonesia, Universitas Negeri Padang, and Gerakan Minang Mendengar (GEMA) Sumatera Barat.

References

1. Che, W.C.; Wang, Y.T.; Lu, H.J.; and Green, J.R. (2011). Respiratory changes during reading in Mandarin-speaking adolescents with prelingual hearing impairment. *Folia Phoniatrica et Logopaedica*, 63(6), 275-280.
2. Chen, Y.; Lu, Y.; Kuyaxi, P.; Cheng, J.; Zhao, J.; Zhao, Q.; and Yuan, H. (2018). Identification of pathogenic genes of nonsyndromic hearing loss in Uyghur families using massively parallel DNA sequencing technique. *Disease Markers*, 2018, 1-9.

3. Hernawati, T. (2007). Pengembangan kemampuan berbahasa dan berbicara anak tunarungu. *Jurnal JASSI_Anakku*, 7(1), 101-110.
4. Hobbs, R. (2006). Non-optimal uses of video in the classroom. *Learning, Media and Technology*, 31(1), 35-50.
5. Lawrence, A.S.C. (2002). Soap films and colloidal behavior. *The Journal of Physical Chemistry*, 34(2), 263-272.
6. Maryanti, R.; Nandiyanto, A.B.D.; Hufad, A.; and Sunardi, S. (2021). Science education for students with special needs in Indonesia: From definition, systematic review, education system, to curriculum. *Indonesian Journal of Community and Special Needs Education*, 1(1), 1-8.
7. Metz, D.E.; and Schiavetti, N. (1995). Speech breathing processes of deaf and hearing-impaired persons. *Producing Speech: Contemporary Issues*, 187-198.
8. Muspita, R.; Syihabuddin, A.H.; Nandiyanto, A.B.D.; Fernandes, R.; Akbar, A.; and Manullang, T.I.B. (2021). Teaching making dishwashing liquid to introduce chemical technology to the deaf community. *Journal of Engineering Science and Technology*, 16(2), 1311-1318.
9. Muspita, R.; Syihabuddin, A.H.; Nandiyanto, A.B.D.; Manullang, T.I.B.; Efrina, E.; and Yulistian, L. (2020). Application of sound wave theory as an alternative to teach sound detection for students with hearing impairments using cochlear implants. *Journal of Psychosocial Rehabilitation*, 24(1), 3624-3639.
10. Setyaningsih, F.; and Andajani, S.J. (2019). Analisis literasi sains pada siswa tunarungu terhadap konsep IPA. *Jurnal Pendidikan Khusus*, 12(3), 1-9.