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UNDERSTANDING COVID-19 PARTICLE CONTAGION THROUGH AEROSOL DROPLETS FOR STUDENTS WITH SPECIAL NEEDS

RINA MARYANTI[1], ACHMAD HUFAD[1], SUNARDI[1], ASEP BAYU DANI NANDIYANTO[2,*], ABDULKAREEM SH. MAHDI AL-OBAIDI[3]
[1]Departemen Pendidikan Khusus, Universitas Pendidikan Indonesia,
Jl. Dr. Setiabudhi no 299, Bandung, 40154, Indonesia
[2]Departemen Kimia, Universitas Pendidikan Indonesia,
Jl. Dr. Setiabudhi no 299, Bandung, 40154, Indonesia
[3]School of Computer Science and Engineering, Taylor's University College,
No. 1 Jalan SS 15/8 47500 Subang Jaya, Selangor DE, Malaysia
*Corresponding Author: nandiyanto@upi.edu

Abstract

The study investigated the perceptions of students with special needs for the contagion of CoViD-19 virus particles through aerosol droplets. Level of student understanding was assessed through a short survey using 35 questions by empowering students' parents. The subjects were 43 students with special needs ranging ages between 7 and 26 old who were taking education in the Special Need School in Kuningan District, Indonesia. This study examined different types of students with special needs (i.e., intellectual disabilities, hearing impairment, visual impairment, physical impairment, and down syndrome). The analysis was supported by the theoretical explanation how the contagion of CoViD-19 virus particles through aerosol droplet. Experimental results showed that most students (62.80%) have understood CoViD-19 virus particles contagion through aerosol droplets, shown by the score achievement of more than 70% correct answer. This study also found that student age did not affect the level of student understanding. The student understanding was supported by their knowledge gained from habituation in learning surrounding environment. Regarding students with low scores, the main problems are their difficulties in focusing on getting knowledge due to their limitations in absorbing complicated and abstract information. This study is important for giving information on how to treat students with special needs for protecting them during contagion problems, especially dealing with CoViD-19 pandemic condition.

Keywords: Aerosol droplets, CoViD-19 virus contagion, Education, Particles, Students with special needs.

1. Introduction

CoViD-19 virus is a type of Corona virus which can infect the human body [1], especially the respiratory tract [2, 3]. CoViD-19 virus has a round shape, surrounded by crown-like nails. The virus has small particles and only can be seen by electron microscope [4]. By the size, these CoViD-19 particles is easily spread and enter to the human body. Detailed information are presented in Figs. 1-4.

CoViD-19 virus requires a medium to make it contagion. This virus can be transmitted through droplets [5]. Droplets are water-containing particles with a diameter of about 5 micrometer in diameter [6] and it can enter the mucosal surface within a certain distance (usually 1 meter).

CoViD-19 contagion through droplets can occur directly or indirectly. The virus is transmitted via droplets that are produced when people with CoViD-19 cough, sneeze, or talk [7]. Then, the droplets containing CoViD-19 particles get inhaled to other people, the virus enters lungs, doing damage in the respiratory system. This is confirmed by the World Health Organization (WHO) statement that a person can be infected with CoViD-19 by inhaling the virus if it is within 1 meter from someone suffering CoViD-19 [8]. CoViD-19 contagion indirectly occurs when there is a hand contact with the contaminated surface (containing the CoViD-19 virus) and the contacted hand touches nose, mouth, or eyes.

CoViD-19 virus is not transmitted through air (or airborne) because the aerosol droplets are too heavy to stay in the air [9]. Although aerosol droplets are solid or liquid components that are held in gaseous phase [10], the droplets quickly fall to the floor or other surfaces. To prevent transmission of the CoViD-19 virus, healthy people must keep distance and wear masks. It is also mandatory that people with CoViD-19 must cover nose and mouth when sneezing or coughing.

Many studies discussed what the CoViD-19 virus [11], how shape and size of the CoViD-19 virus [12], where the CoViD-19 virus from [13], the spread of CoVID-19 [3, 14], the impact of CoVID-19 virus spread [2], and how the CoViD-19 virus being transmitted [7]. Many reports discussed the CoViD-19 virus contagion through aerosol droplets [15].

Information about contagion of CoViD-19 have been well-distributed, and some journals are published articles focusing on CoViD-19 (showing impacts of this CoViD-19 condition to health, spreading and preventing [14], strategies in taking care of patients and distributing medicine [3], and socio-economic condition [2, 16]). However, research currently relating to socialization and knowledge especially for students with special needs are still limited. In fact, this information is crucial since students with special needs require special treatment and they easily sick compared to normal students. Most children with special needs are very susceptible to be infectious because they are lazy to wash hands and clean their bodies. Students with special needs are the students with development and academic barriers, requiring special services for making them survive [17]. Therefore, this study is focusing on investigating how students with special need understood about CoViD-19 virus particle contagion through aerosol droplets. The assessment was done by making a survey to students with special needs with empowering their parents.

2. Logical Framework

COVID-19 or Corona Virus Disease 2019 is a disease that causes respiratory distress. The disease is caused by Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) infection. This virus comes from animals (known as a zoonotic virus) [11].

CoViD-19 virus has a small size like a particle with crown [4], informing that observing this type of virus requires a special apparatus such as an electron microscope. Some reports explained the size of this virus of between 120 and 160 nanometers [18] with average sizes of 125 nanometers [19]. Since droplets have a diameter about 5 micrometers [20, 21], the number of virus occupied inside one droplet can be 6000 viruses.

Students with special needs have problems to understand abstract concepts, making the teachers to have concrete media to teach them such as an illustration or image. Figure 1 shows the illustration showing to students for the shape and size of CoViD-19 virus particles, as well as how the virus occupies inside the droplet.

Figure 2 presents an illustration of aerosol droplets generated by the respiratory system. People generated aerosol droplets from their mouth and nose. When a patient with CoViD-19 breathes, coughs, or sneezes, the droplets contained CoViD-19 virus particles spread to the environment.

Figure 3 presents how CoViD-19 virus particle contagion through aerosol droplets. The patient with CoViD-19 virus transmits the disease through aerosol droplets containing viruses, when he/she talks, sneezes, and coughs. Aerosol droplets can enter the body of other people through the nose, mouth, and eyes.

The process of CoViD-19 virus entering the body explained in Fig. 4. CoViD-19 viruses in aerosol droplets enters the body through the nose, mouth, and eyes. The virus then travels to the lung organs, causing shortness of breath, pneumonia, and until death.

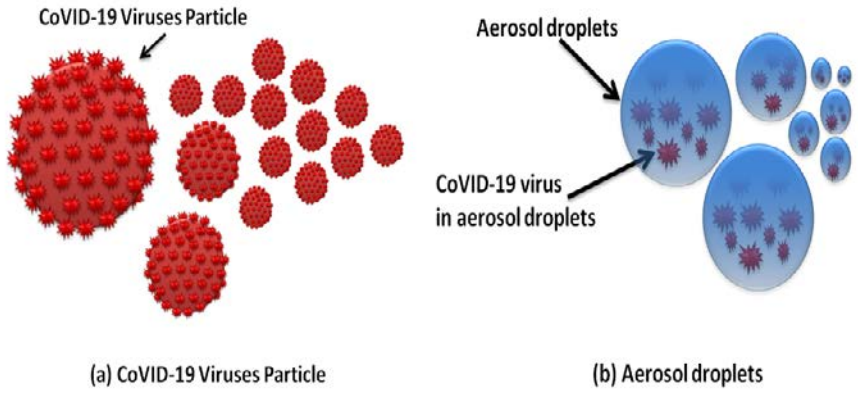

Fig. 1. Illustration CoViD-19 viruses particle and illustration aerosol droplets.

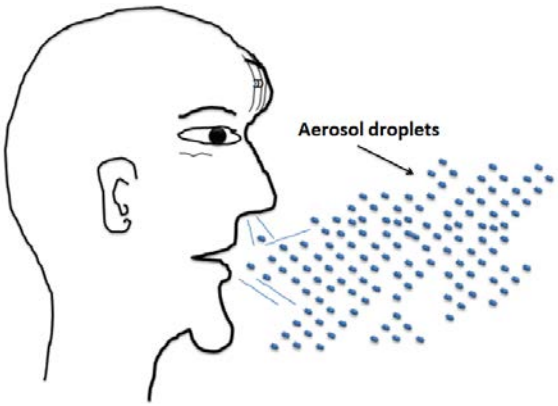

Fig. 2. Illustration of a droplet from respiratory.

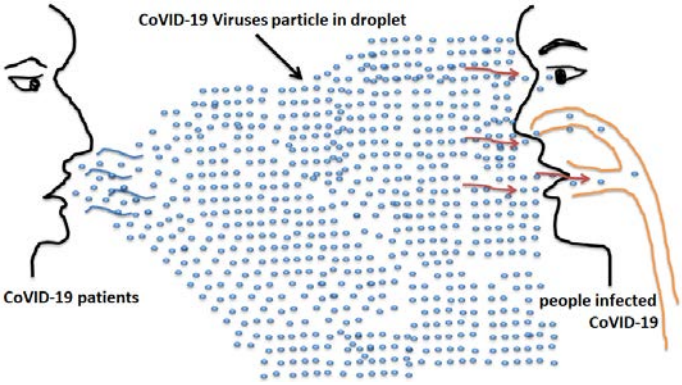

Fig. 3. Illustration of CoViD-19 virus particles contagion through aerosol droplets.

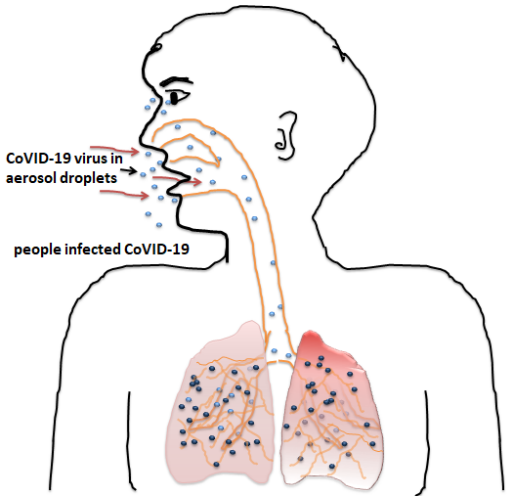

Fig. 4. Illustration aerosol droplets and illustration CoViD-19 viruses particle is enter to the human body.

3. Experimental Procedure

This study was focused on limited research subjects (i.e., understanding of CoViD-19 particles contagion through aerosol droplets for students with special needs). Research participants were 43 students with special needs from a Special Need School in Kuningan District, Indonesia. This school is only for students with special needs. This study examined different types of students with special needs (i.e., intellectual disabilities, hearing impairment, visual impairment, physical impairment, and down syndrome).

The study assessed students by asking 35 short answer-question multiple choice (Table 1), in which all tests were done online. This study asked helps students' parents. Parents asked questions orally, students answered objectively, and parents put the results into the online form. The tests were done to keep students not feeling in tension. The analysis score for answering yes is 1, while no is 0. The total correct score is 100 (if students answered all questions by yes, the maximum score will be 100). The equation for calculating the score is

$$\frac{n \times 100}{35} = Nt \tag{1}$$

where n is the score (for answering yes) and Nt is the students' final score. In addition, to ensure that the students answer correctly (not making random answer), we asked parents to put "no" followed by "yes" when asking the students.

After the test, parents explained illustration (see Figs. 1, 2, and 3) to students. This purpused to make students understand what phenomena happening during CoViD-19 contagion, in which this is important to give this information. Indeed, this will help the students to protect themselves from the contagion of CoViD-19.

Table 1. Questions about the understanding of CoViD-19 virus particle contagion through of aerosol droplet to students with special needs.

No.	Questions	Answer	
		No	Yes
1	Do you know about viruses?		
2	Do you know the CoViD-19 virus?		
3	Do you know the size of the CoViD-19 virus?		
4	Do you know the form of the CoViD-19 virus?		
5	Do you know what particles are?		
6	Did you know that the CoViD-19 virus resembles small particles?		
7	Do you know how the CoViD-19 virus is transmitted?		
8	Do you know what a droplet is?		
9	Did you know that droplet is another term for spark or drip?		
10	Do you know when sneezing your nose takes out a droplet or splashes of water?		
11	Do you know when coughing mouth droplets or splashes of water?		
12	Did you know the CoViD-19 virus is transmitted through droplets when sneezing?		
13	Did you know the CoViD-19 virus is transmitted through droplets when coughing?		

Table 1. (continue). Questions about understanding of CoViD-19 virus particle contagion through of aerosol droplet to students with special needs.

No.	Question	Answer	
		No	Yes
14	Did you know CoViD-19 is in a droplet or spark when sneezing?		
15	Did you know CoViD-19 is in a droplet or spark when coughing?		
16	Is a droplet or splash of fluid a source of CoViD-19 virus transmission from a sick person to a healthy person?		
17	Do you know ethics when sneezing?		
18	Do you know the ethics when coughing?		
19	Do you have to close your mouth when you cough?		
20	Do you have to close your nose when you sneeze?		
21	Do we have to wear a mask when we leave the house?		
22	Is mask very important to be used to prevent transmission of CoViD-19 virus?		
23	Does the mask have the same function as a droplet anchor when sneezing or coughing, both the wearer's droplet and others?		
24	Do you know the symptoms of CoViD-19?		
25	Is sneezing a symptom of CoViD-19?		
26	Is cough a symptom of CoViD-19?		
27	Do you know of two ways of transmitting the CoViD-19 virus through droplets?		
28	Do you know that physical distancing or maintaining distance is one of the efforts to prevent the transmission of the CoViD-19 virus through droplets directly?		
29	Did you know that the transmission of the CoViD-19 virus indirectly can occur if someone touches a surface or an object that has been exposed to a droplet or a spark from someone exposed to COVID-19?		
30	Is your CoViD-19 virus able to survive for several hours on various surfaces, such as glass, plastic, steel, copper, paper, to wood?		
31	Did you know that the transmission of CoViD-19 virus directly can occur through aerosol droplets?		
32	Did you know that droplets containing the CoViD-19 virus enter the lungs through the breath?		
33	Do you know aerosols?		
34	Do you know what aerosol droplet is?		
35	Do you know what airborne aerosol is?		
Total			

4. Results and Discussion

4.1. Student demographics

The subject was students ranging from 7 to 26 years old. 8% of students are 11, 21, 22, and 26 years old (each having a percentage of 2%). 30% of students had ages

of 8, 10, 14, 15, 19, and 20 (each age had a percentage of 5%). As many as 21% of students had ages of 7, 9, and 18 (each age had a percentage of 7%). 27% of students had ages 13, 16 and 23 (each had a percentage of 9%). 14% of students are 12 years old. Table 2 shows student data in terms of age.

This table also presented student data regarding types of obstacles they have. As many as 11% of students are down syndrome (DS), having characteristics of unclear pronunciation, thick short tongue and fingers, motor resistance, lack of concentration, and below average intelligence [22]. As many as 4% of students are children with physical impairment with problems in perception of motion, gross motor and fine motor [23]. In the cognitive aspect, some of them have not experience obstacles, and they could follow learning like children in general. 19 % of subjects in this study are students with hearing impairment, they have problems in language, speech, and communication. They have visual learning characteristics and difficulty in socialization and behavior [24]. 8% of students are students with visual impairments, having obstacles in orientation and mobility, understanding abstracts, and including auditory learning. The 58% of students are children with intellectual disabilities with issues in concentration, adaptive behavior, and intelligence [25], including characteristics for easy to forget, difficult to focus, difficult to understand something abstract, problems in independence, and are easily bored.

Table 2. Student Age and types subject of obstacles.

Age	SID	SHI	SVI	SPI	DS	Total	% Age
7	3					3	7
8	1				1	2	5
9	3					3	7
10		2				2	5
11	1					1	2
12	4	1	1			6	14
13	4					4	9
14	1		1			2	5
15	1				1	2	5
16	4					4	9
18	1	2				3	7
19	1				1	2	5
20	2					2	5
21	1					1	2
22	1					1	2
23	3					4	9
26	1			1		1	2
Total (number)	**32**	**5**	**2**	**1**	**3**	**43**	
Total (%)	**74,42**	**11,63**	**4,65**	**2,32**	**6,98**	**100**	**100**

*Note: SID is Student with Intellectual Disabilities, SHI is Student with Hearing Impairment, SVI is Student with Visual Impairment, SPI is Student with Physical Impairment, and DS is Down Syndrome.

4.2. Phenomena in learning and teaching process

Students with special needs found it difficult to emphasize, imagine, and understand the COVID-19 virus because its size resembles small particles. They had difficulties in understanding abstract and complicated information. Students with down

syndrome, intellectual disabilities, hearing impairments, and visual impairment needed simple explanations and concrete media to understand them. That is why this study used simple illustration as shown in Figs. 1-4.

Students with special needs understood CoViD-19 virus particles in the droplet through habituation and simple methods. We had a way to educate students through empowering the family environment. When they got information about how to transmit the COVID-19 virus and they often saw pictures in the news about the form of the COVID-19 virus. They would understood what the COVID-19 virus is in droplets, how it infects the body, and how to prevent its transmission.

Students with special needs had different characteristics and problems. Therefore, they needed media, methods, and special techniques in the learning process. The teacher must provide an interesting method because their concentration is easily distracted. We gave a test to find out the level of student understanding during the teaching process. Tests for understanding COVID-19 virus particles contagion through aerosol droplets should be started from basic to intermediate questions.

4.3. Analysis data

Figure 5 explains the average scores obtained by students in terms of age. Different scores were obtained. 27 students (or 62.8%) had scores of more than 70%. Students aged 8 and 26 had the lowest average score (less than 60%), while students aged 18 had the highest average score (up to 90.50%). students aged 8 and 26 years had complex obstacles and problems, They have limitations in knowledge and problems in concentration. Older age does not guarantee a good level of intelligence, especially for students with intellectual disabilities.

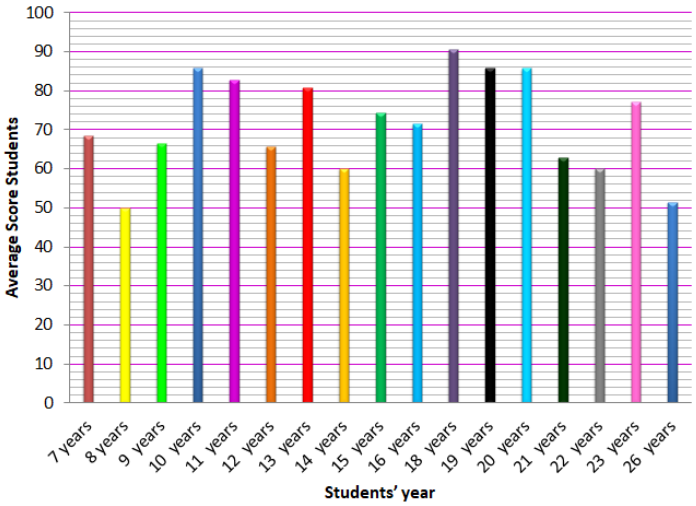

Fig. 5. Percentage of average values obtained by age.

Figure 6 explains the average scores obtained by students in terms of types obstacles. Different scores were obtained. Students with intellectual disabilities (SID) had average scores 68.8 or less than 70. Students with hearing impairment (SHI) had average scores 82.2. Students with visual impairment (SVI) had average

scores 67.1 or less than 70. Students with physical impairment (SPI) had average scores 100 and down syndrome (DS) had average scores 81.9 or more than 70. 50% student SVI and SDI had scores less than 70. They have problems in learning because they have obstacles more than other students.

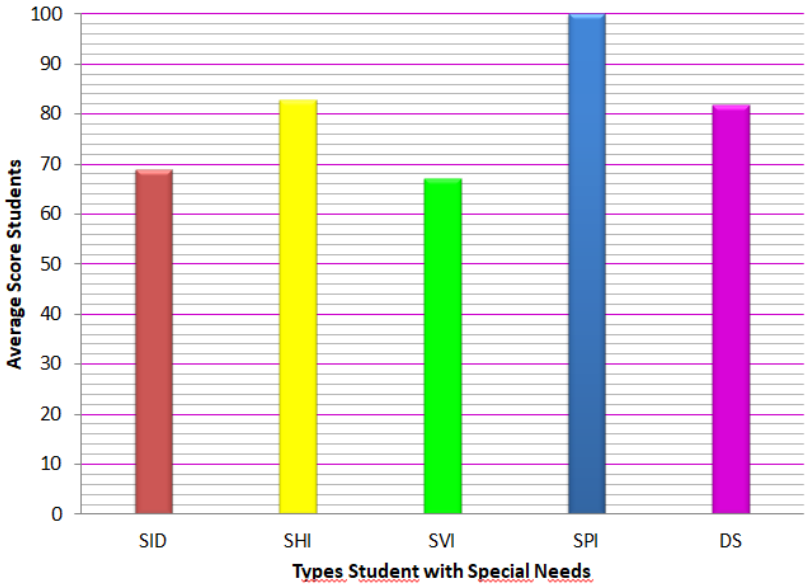

Fig. 6. Percentage of average values obtained by type subject of obstacles.

Based on the assessment analysis for each question (see Table 1), this study found that the level of difficulties in questions. All students (100%) answered questions number 17, 18, and 21 correctly. Students had knowledge about the ethics of coughing and sneezing as well as the importance of wearing masks because they gained continuous knowledge recently in the news and announcement. 70.6% of students answered wrong questions number 33 and 35. DS students (or 33.3%) and SID students (or 37.5%) answered questions number 33 and 35 correctly. 100% of SPI students answered questions number 33 and 35 correctly but 100% of SHI and SVI students did not answer.

The contributing factor was SPI students didn't have obstacles in intelligence. They had the same intelligence as children in general so they understood information easily. However, they had obstacles when it came to activities that require physical skills. In Fig. 6, SPI students also had average scores of 100. Most SHI and SVI students did not have intelligence barriers, but they had difficulty in receiving abstract information. They needed appropriate media to understand a concept. SHI students understood the concepts of aerosols and airborne aerosols through the visual senses. They rarely studied and visualized it so they had difficulties in answering questions number 33 and 35. But, they understood the droplet aerosol material and the CoVID-19 virus. They obtained an average scores more than 70 (or 82.2) in Fig. 6. Whereas SVI students had an average scores of less than 70 (or 67.1) because they had problems in understanding the concept of a visible shape or size. They needed appropriate media, repeating explanations, and comprehensive information about a concept, indeed they had difficulties in

answering questions number 33 and 35. More than 70%, SID and DS students did not answer questions number 33 and 35 correctly. They had below average intelligence. They had problems in concentrating, remembering, understanding information, and forgetting. They needed interesting and fun learning, concrete media, and habituation. SID students had an average scores of less than 70 while DS students had scores of more than 70. This was because SID students had more complex obstacles than DS students.

In other contributing factor, students were unfamiliar with the term of aerosol and airborne material. Thus, students with special needs had good knowledge, one of them is through habituation.

Students with special needs had limitations in understanding abstract and complicated information [26, 27]. The teaching process for students with special needs required special techniques [28]. The environment (in which students are located) affects the level of student understanding. Students accustomed to obtaining information from the surrounding environment and can continuously improve student knowledge. It is specifically for CoViD-19 virus transmission through droplets when sneezing, coughing, or talking.

5. Conclusion

Determination of the level of understanding of students with special needs for the transmission of CoViD-19 virus particles through aerosol droplets has been investigated. We obtained data through tests by giving 35 questions to students. Parents helped for raise questions to students. Students with special needs learn according to their knowledge through habituation as well as their learning from simple methods and concrete objects. Information from the environment greatly influences students' level of understanding.

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