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# Experimental Demonstration of Colligative Properties of Solution on Material Phase Transition to Students with Intellectual Disabilities

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***Abstract***--- *This study demonstrated strategies in teaching colligative properties of solution to students with intellectual disabilities. This study used a single-subject design. Teaching process was done by combining conventional method and experimental demonstration. The conventional method was done in the first session (30 minutes) of teaching in the class. After the conventional method, the experimental demonstration was done in the next 2 sessions. The experimental demonstration was carried out by doing and observing melting and freezing of solution. We compared effect of additional of salt and sugar into water on phase transition of mixed solution (from ice to liquid and vice versa). The results showed that students' knowledge increased. Learning material could be understood by 75% of students. Students with intellectual disabilities found it difficult to understand a complex and abstract information because they had of problems in making communication and memorizing. The experimental demonstration with interesting concrete media helped the students to understand the subject matter. In addition, to improve students' enthusiasm, we used dye in the solution when doing the experimental demonstration.*

***Keywords***--- *Students with Intellectual Disabilities, Colligative Properties, Material Phase Transition, Teaching, Education.*

## I. INTRODUCTION

Colligative properties of solution are one of the science subjects at school. The colligative properties of solution discuss a physical explanation of lowering vapour pressure, increasing osmotic pressure, elevating boiling point, and depressing freezing point [1]. One of the things discussed in the colligative properties is the phase transition. For example, the phase transition changes a solid to a liquid or vice versa [2].

Teaching colligative properties of solution to students requires appropriate learning method. Appropriate learning methods help to facilitate student in understanding the subject matter [3]. This is a challenge for teacher to make learning the colligative properties of solution more concrete and simple. Good learning can foster students' curiosity and creativity.

Many studies discussed on teaching the colligative properties of solution and the materials' phase transitions. The learning of the colligative nature of solution used inquiry method for normal student in regular school [4]. Students

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must have experience and high order thinking because the learning process has student centered, the demonstration method used in the learning process of the colligative properties of solution to normal students [5]. However, the inquiry method uses only for normal students. One method to easy learning of science is the experimental demonstration. Demonstration method caused to the improving of student learning [6]. Experimental demonstration motivated students to learn [7], Science learning was suitable for using the experimental demonstration method because experimental demonstration improved students' learning outcome [8-10]. But, research discussed only for normal students in regular schools.

Discussion about student with special needs is still limited. One example is students with intellectual disabilities. The students with intellectual disabilities have characteristics: forgetfulness, difficulty communicating, difficulty understanding and conveying information, difficulty to understanding complicate and abstract concept. Student with intellectual disabilities find it difficult to concentrate, like to disturb friend, passive, and unstable emotion [11]. That causes research on science in student with intellectual disabilities to be rarely found. Teachers assume student with intellectual disabilities cannot learn difficult science.

Therefore, the purpose of this study was to demonstrated strategies in teaching colligative properties of solution to students with intellectual disabilities. This study used a single-subject design. Teaching process was done by combining conventional method and experimental demonstration. The conventional method was done in the first session (30 minutes) of teaching in the class. The teacher explains verbally about the colligative properties of solution and the substances' phase transition. After the conventional method, the experimental demonstration was done in the next 2 sessions. The experimental demonstration was carried out by doing and observing melting and freezing of solution. We compared the speed at which materials change from solid to liquid or vice versa. Pure solvents freeze faster than salt or sugar solutions, but pure solvents melt longer than salt or sugar solutions. The more dissolved materials added to the solution, the lower the freezing point. The results showed that conventional methods were less effective in learning science. Students do not paid attention the teacher, look passive, and do not concentrate. Almost all students could not answer questions from the teacher. However, after using experimental demonstrations, students' knowledge increased. The experimental demonstration with interesting concrete media helped the students with intellectual disabilities to understand the subject matter.

## II. LOGICAL FRAMEWORK

One effect of the colligative properties of solution is the depressing freezing point. We know the freezing point of depression by calculating the difference between the freezing point of the pure solvent and the freezing point of the solution formed. The Solutes (salt or sugar) in the solution make in the freezing point of the solution being smaller than the freezing point of the solvent. The equation can be written as follows:

$$\Delta Tf = Tf\text{solvent} - Tf\text{solution} \quad (1)$$

$$\Delta Tf = kf \text{ x } m,\ \Delta Tf = kf \text{ x } \frac{g}{Mr} \text{ x } \frac{1000}{p} \quad (2)$$

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where $\Delta Tf$ is the freezing point reduction ($^{o}$C), *kf* is the constant freezing point change ($^{o}C\ kg\ /\ mol$), m is the solution molality ($mol\ /\ kg$), g is the mass of solute ($g$), Mr is the relative molecular mass, and $P$ is the total mass of substance ($kg$).

The freezing point of depression in the freezing process is different from the melting process. The solution ices melt more easily than pure solvent. This is because solute particles block the water molecules so that the bonds are weaker and are easily separated.

The addition of salt and sugar (solutes) affects the process of accelerating the change in the form of solids into liquid or vice versa. "The density of water increases as water freezes and therefore freezing temperature does not stay constant; the higher the density the lower the freezing temperature" [12]. The event of the influence of the colligative properties of solution in phase transition of material is very easily understood by children in general. However, children with intellectual disabilities need special learning; treatment, methods, and media for understand them. In fact, studying this science is very important because it is basic science before studying more complex science.

## III. METHODOLOGY

### 3.1 Research Subjects

This study used a single-subject design. The type of single-subject design was A-B design. A is the baseline and B is the intervention. This study focused on limited research subjects (i.e., the subject of the colligative properties of the additive solution in the materials' phase transition). The study participants were four students with intellectual disabilities in the elementary school special education (SLB B-C) Dharma Wanita in Kuningan District, Indonesia. This school is only for students with special needs. In the teaching and learning process, students with intellectual disabilities were not mixed with normal students because research was conducted in special schools not in inclusive schools. Teaching delivered with conventional methods equipped with demonstration experiments. Then, to improve students' understanding, we completed teaching with a simple experimental demonstration using interesting media. This is because students with intellectual disabilities require a concrete and simple learning process.

In addition, in order to obtain basic information from students, such as IQ levels, demographic information, and their basic knowledge abilities specifically in subjects (Indonesian language, social science, science, religion, and mathematics), we conducted interviews with teachers in schools. The data collected used to develop research instruments. After that, to simplify the analysis of students' ability levels, all information obtained was assessed using a scale score of 4, from 0 (cannot do anything), 1 (not good), 2 (good enough) 3 (good), 4 (very well).

### 3.2 Teaching Conditions

Teaching was conducted in 2 sessions. Each teaching session was conducted in 60 minutes inside or outside the classroom. We limited the matter to the colligative properties of solutions in the materials' phase transition so that teaching was simpler. We explained the colligative properties of solution that occurs when the liquid form changes into a solid and vice versa. We complement student learning with pretest and posttest to find out the level of students' understanding.

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In the first session, we taught students the importance of colligative properties in everyday life, while second session we used the experimental demonstration of the colligative properties in the substances' phase transition (from liquid to Ice or vice versa). We also put dye into solution. Experimental demonstration was used to provide an understanding of the solution freezing longer than water, besides that the solution will freeze faster than water. The more dissolved substances in the solution, the lower the freezing point.

### 3.3 Experimental Demonstration

Experiments were carried out inside and outside the classroom. Experiments were carried out in 210 mL of transparent glass. We used salt, sugar, mineral water, and various types of food coloring (red, yellow, green, and brown). The first step taken was done, in which students put water into five cups of 150 mL After that, glass (a) was dropped by 1 mL of red dye and 3 tablespoons of salt, glass (b) was dropped by 1 mL of yellow dye and 1 spoon of salt, glass (c) was not dropped by dye, glass (d) was dropped by green dye (1 mL) and 1 spoon sugar, and glass (e) was done by putting 1 mL of brown dye drops and 3 spoons of sugar.

After the mixture was stirred with a spoon, students put the five glasses of the solution into the refrigerator (freezer). Then, they let stand for 45 minutes and observed the changes. After freezing, students were drying in the five solutions by sun in the field. Students observed the process of freezing and melting the solutions.

## IV. RESULTS AND DISCUSSION

### 4.1 Students' Demographic Data

Figure 1 shows the demographic data of students with intellectual disabilities. There is eight information displayed from students aged 11 to 12 regarding the diagnosis of students with intellectual, motor, language, communication, concentration, independence, interaction, academic, and emotional barriers. This information is very important to know because it illustrates the extent of the ability of IQ and student development, as a basis in carrying out the teaching process of teaching further to students so that students can understand the material being taught. Students with intellectual disabilities have IQ levels of less than 70 which make them have various obstacles in various learning and development processes.

Student A shows level 3 in motor skills, which means that students have good motor skills, students can do gross motor activities and fine motor activities. Aspects of language development are at level 1 because students' language development is not good in the aspects of pronunciation and articulation. Students are sometimes not clear enough to say and have limited vocabulary. The development of student communication is at level 2 which means that the communication skills of children are quite good in receiving information even though sometimes there must be repetition of instructions. Concentration, independence, social interaction, and student emotion are also at level 2, which means it is quite good. From the explanation of parents, teachers and the results of student observations often do daily activities independently, besides that the interaction of students in school with their peers is quite good. But student A has poor academic ability, in the aspect of reading students are only able to recognize vowels and some consonantal letters, although the motor aspects of students are good but new students are able to write to the stage of copying and

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student writing is not neat. In the aspect of counting new students are able to recognize numbers 1 to 10 and count concrete objects 1 to 5.

Student B shows level 2 in motor skills, which means that the motor skills of students are quite good, students can do gross motor activities and fine motor skills quite well. Aspects of language development students are at level 3, children have quite a lot of vocabulary and students often talk. In the development of student communication is at level 2, which means the ability to receive and convey information is quite good child. Concentration, independence, social, and academic interaction of students are also quite good. Parents, teachers and observations explain that students often do their daily activities independently; besides that, student interactions at school with their peers are quite good. In the aspect of reading students are able to memorize letters and write through personal dictation, in the aspect of writing children are able to copy with neat writing and in the aspect of counting children are able to recognize numbers 1 to 10, counting concrete objects 1 to 7 and addition under 5 However, student B has poor emotional ability, when his friend is angry with his child, he immediately becomes angry.

Student C shows level 2 in motor skills, which means students' motor skills are quite good, level 1 in aspects of language and communication, which means children's language abilities are not good in receiving and conveying information, students tend to be quiet and passive. Concentration, independence, social interaction, academic and emotional children are not good. Students are more often dependent on their mothers in carrying out daily activities and students also often carry out activities as they wish regardless of the commands of their parents or others. Besides that, students often judge their friends.

Student D shows level 2 in motor skills, which means students' motor skills are quite good, level 1 in aspects of language and communication, which means children's language skills are not good in receiving and conveying information, students tend to be quiet and passive. Concentration, independence, social interaction, academic and emotional children are not good or are at level 1. Even though students have the potential for independence is quite good, but because of parenting parents who indulge make students always dependent on others.

Conclusions from previous observations, the level of student ability have been explained. If the classification from the high level to the lowest level is done, the researcher concludes the sequence is Student B, Student A, Student D, and Student C.

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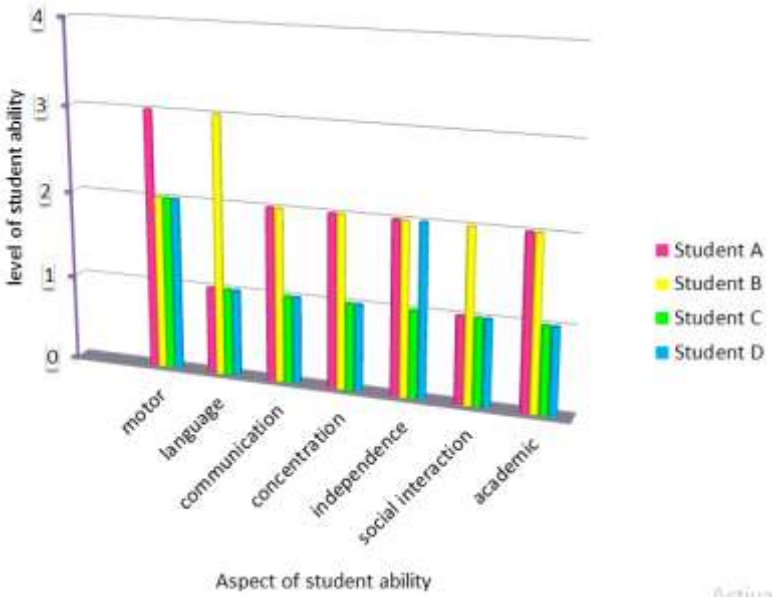


Figure 1. Data about Student Conditions

Figure 2 shows the level of understanding of children in the subject of learning subjects taught. There were five subjects observed, namely Indonesian, social science, science, Islamic religion and mathematics. This information is very important in knowing students' readiness to conduct experiments.

Student A and student B have an understanding of Indonesian subjects at level 2, meaning that in learn Indonesian Language students A can follow fairly well. Student C and student D are at level 1, so that student B can follow the learning well while student A and student D can take Indonesian learning less well. Language mastery is closely related to students' cognitive level. Student A, student B, student C, and student D also have problems with abstract and symbolic concepts which are the basis for learning mathematics [13]. Children with intellectual disabilities require a concrete learning process that is simple and fun. Student A, student B, student C, and student D have a poor understanding of science. However, students A, students C, and students D like religious subjects, they are always enthusiastic when following religious learning.

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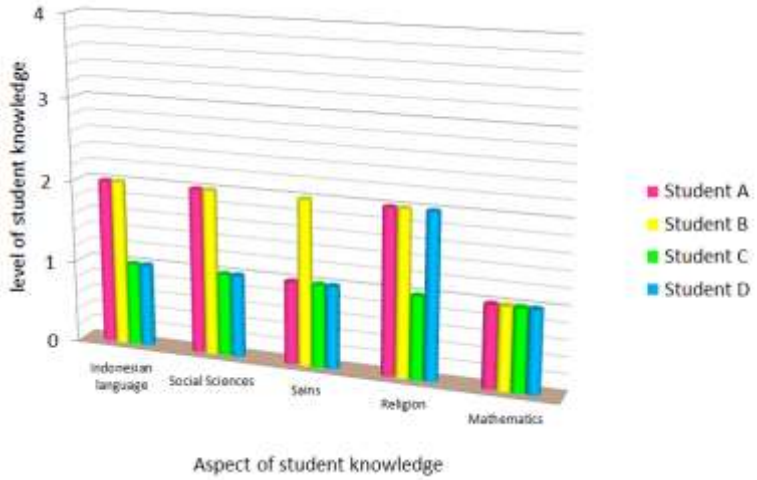


Figure 2. Levels of Student Understanding of Aspect Knowledge

Students with intellectual disabilities have IQ is below the average, this causes students to experience various problems in the learning process. Poor communication and the difficulty of understanding something complicated is one of the factors in students' poor understanding in the learning process. This is in accordance with previous research that language acquisition is strongly associated with the cognitive level of students [14]. In addition, problems in cognitive aspects make it difficult for students to understand symbolic and abstract concepts [15]. This makes students' understanding of learning mathematics low.

### 4.2 Phenomenon of Learning Colligative Properties on Phase Transition of Substance

Figure 3 shows an illustration of the colligative properties of solution. Figure 3 (a) shows illustration of pure-solvent molecules in phase transition of material. Water has decreased temperature and has a freezing point of 0ºC. Water molecules are close together when water becomes ice. Ice need heat for melt and water molecules far apart. Figure 3 (b) shows an illustration of colligative properties of solution that contains water and particles of solute in phase transition of material. The solution has decreased temperature and has a freezing point lower than 0ºC. Water molecules and particles of matter close together when water becomes ice. ice needs heat to melt and molecules of solution are far apart.

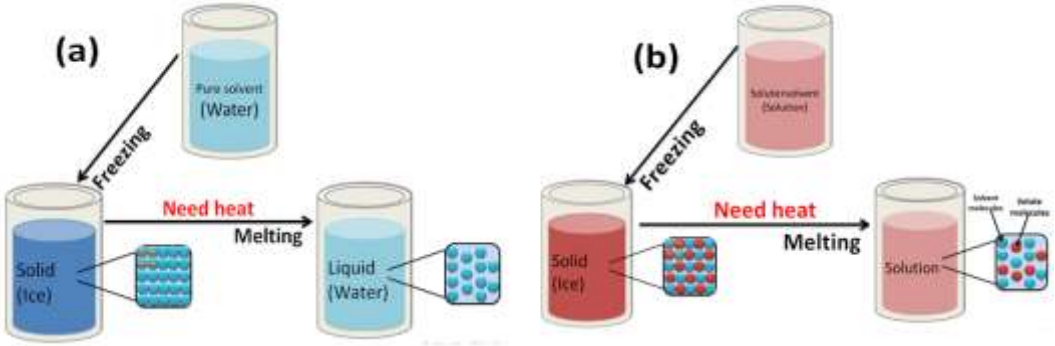


Figure 3. Illustrates The Colligative Properties of Solution (a) Pure Solvent and (b) Pure Solvent Plus Solute

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Colligative properties of the solution affect the process in phase transition of substances. In addition, the effect of temperature (heat) is very necessary in phase transition of solid into liquid or liquid into solid. The depression of the freezing point of solution from T0 to T at constant pressure p by the addition of solute of mole fraction x2, which does not enter the solvent crystal, is given by formula [16]:

$$-\int_{T_0}^{T} \frac{\Delta h_1^{fus}}{T'} dT' = \mu_1^{solvent}(p^{\circ}, T') - \mu_1^{soln}(x_2, p^0, T') \quad (3)$$

where $\Delta h_1^{fus}$ is the molar heat of fusion of pure solvent at $p^{\circ}$ and $T'$. A reasonable approximation to the integrand in many cases is to take $\Delta h_1^{fus}$ as temperature independent.

In this study, we discuss the colligative properties of the solution at the freezing point of depression which affects in phase transition of material. Freezing point of depression can be interpreted as the freezing point difference caused by the presence of solute particles. The freezing point of depression a solution is proportional to the product of molality times the solution with a decrease in the freezing point of solvent ($K_f$) [17]. One example is a salt and sugar solution. The freezing point of pure solvents or water is $0^{\circ}$C. If pure solvents are added with solutes (salt or sugar), the freezing point achieved will be lower than $0^0$C. Addition of solutes causes a decrease in freezing [18]. This causes the solution (salt or sugar) to freeze longer than pure solvents (water) because the solute particles prevent the solvent molecules from being close together.

The students have a new experience with demonstrating the effect of the colligative properties of solution in the phase transition of substances, both solids into liquid and liquid into solids. Students observe the change of water into ice cubes. When water and solution are cooled to the lowest temperature of $0^{\circ}$C, water and solution freeze. This is due to the influence of temperature on the freezing point. We also explain that the colligative properties of solutions influence in the phase transition of substances. Water that is added with salt or sugar, turns freezing longer than water that does not add anything. This was proven by students observing the changes that occur in the solution added with salt and sugar freezing longer than water that was not given anything. That is because the particles of water molecules are blocked by molecules of table salt or sugar, so the water molecules are tenuous. The presence of solutes in solution result in the freezing point of the solution being smaller than the freezing point of the solvent. The more dissolved materials in water, the greater the freezing point. Based on equation (1), we can rewrite formula:

$$\Delta Tf \sim g \quad (4)$$

In addition, students have a new experience with demonstrating the effect of the solution's colligative properties on the process of changing the form of a solid to a liquid. Students observe the change of ice cubes into water. When ice cubes are exposed to sunlight, the process of changing the form of solids to liquid occurs due to the influence of heat (radiation).

We also explain that the colligative properties of solutions influence in the phase transition of materials. Water added with table salt or sugar turns out to melt faster than water that does not add anything. This was proven by students observing the changes that occur in the ice cube solution with salt and sugar added melting faster than water that was given nothing. That is because the particles of water molecules are blocked by molecules of table salt or sugar, so the

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water molecules are tenuous. The presence of solutes in solution will result in the freezing point of the solution being smaller than the freezing point of the solvent.

### 4.3 Teaching Process

Based on student demographic data, IQ and basic knowledge of students, we find the complexity of student learning with intelligence barriers. Students have difficulty understanding an abstract concept. Student learning must use concrete and applicable objects. Thus, we limit the application of heat transfer to changes in the form of substances in everyday life as the main subjects. Experimental demonstration methods can be done to improve the success of learning in the classroom [19]. The experimental demonstration method is one of the methods that lead to learning objectives [20]. The aim is to give students an understanding of the basic concepts of the colligative properties of solutions by adding additives to the phase transition of substances.

The results showed that the colligative properties of solution in phase transition of substances can be taught to students with intellectual disabilities. Because students with intelligence barriers have low IQ levels compared to other normal students, teachers must be skilled in teaching science technology themes related to daily activities so that students' level of understanding increases. Special techniques for teaching are also needed because the concentration of students with intellectual disabilities to learn something is limited and easily distracted. As such, they cannot absorb effectively using the usual teaching and learning process. Media and methods are needed that interest children to learn.

After teaching the subject the solution's colligative properties in phase transition of materials, we found:

1) In the initial session of the first 30 minutes, because teaching was delivered using the lecture method, students did not seem interested. The level of student understanding is questioned.
2) A simple experimental demonstration was added in the last 30 minutes of the first session and attracted students' attention. Indeed, this increases student interest. In particular, when you put kitchen salt, sugar and dripping food coloring into the glass. The students also tried to put water in a glass in the refrigerator freezer.
3) In the next session the students watched the process of changing the form of liquid to freeze and the process of melting under the blazing sunlight.
4) A simple additional experimental demonstration helped by learning media increases the level of student understanding, compared to conventional teaching with the lecture method only. Children begin to understand the learning material being taught.
5) The results showed that the learning methods and media used greatly influenced the level of student motivation and understanding.

From the results above, the teaching process for students with intellectual disabilities requires special techniques. Specifically, teachers need to provide interesting methods to attract students' concentration and focus. If not, the level of student understanding cannot be predicted. To ensure the students' level of understanding during the teaching process, a final test on the colligative nature of the solution in the process of changing the form of substances is given to students with intelligence constraints from elementary to intermediate level questions. Table 1 shows some questions related to the colligative nature of the solution in the process of changing the form of substances given to students. For evaluation,

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we ask seven questions. More specifically, the question is related to the heat transfer process of changing the form of a substance. To confirm the impact of additional experimental demonstrations on increasing student understanding, we compared the results of the teaching process with (W) and without (W/0) additional experimental demonstrations.

Table 1: Questions about the demonstration of colligative properties of solution in phase transition of substances

| *Question* | *Student A* | | *Student B* | | *Student C* | | *Student D* | |
|---|---|---|---|---|---|---|---|---|
| | *W0* | *W* | *W0* | *W* | *W0* | *W* | *W0* | *W* |
| What is sugar taste? | 1 | 4 | 1 | 4 | 0 | 3 | 0 | 3 |
| What is the taste of salt? | 0 | 4 | 1 | 4 | 0 | 3 | 0 | 3 |
| Do we need to add the additive coloring agent to the solution? | 0 | 3 | 0 | 4 | 0 | 2 | 0 | 2 |
| Do we need to add salt or sugar to find out the colligative nature of the solution? | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 3 |
| Do we need to stir to dissolve salt and sugar? | 0 | 3 | 0 | 4 | 0 | 3 | 0 | 3 |
| Will the water and the cooled solution freeze? | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 2 |
| Does water freeze faster than salt and sugar solutions? | 0 | 3 | 0 | 4 | 0 | 2 | 0 | 3 |
| What is the relationship between the colligative properties of salt and sugar solutions in the freezing process? | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 2 |
| Is ice cubes a solid object? | 1 | 3 | 1 | 4 | 0 | 3 | 0 | 3 |
| Will the hot ice cubes melt? | 0 | 2 | 0 | 3 | 0 | 2 | 0 | 3 |
| Is sunlight a source of heat energy? | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 3 |
| What causes ice cubes to melt? | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 2 |
| Does the ice cube salt and sugar solution melt faster if exposed to heat? | 0 | 3 | 0 | 4 | 0 | 2 | 0 | 2 |
| What is the relationship between the collective nature of salt and sugar solutions in the melting process? | 0 | 3 | 0 | 3 | 0 | 2 | 0 | 2 |
| Total score | 2 | 42 | 3 | 49 | 0 | 33 | 0 | 36 |

*Comparison of students in understanding the colligative nature of additives on changes in the appearance of substances, W0 = Without experimental, and W = Experimental

Student A did not initially understand the colligative properties of solution in phase transition of material. After learning with the experimental demonstration method students' understanding of colligative properties of solution in phase transition of materials has increased. This can be seen from the acquisition of a score of 42 or 75% of the maximum score of 56, student A answers correctly when asked a question.

Student B initially did not understand the colligative properties of solution in phase transition of substance. After learning with the experimental demonstration method students' understanding of colligative properties of solution in phase transition of material has increased. This can be seen from the acquisition of a score of 49 or approximately 87.5% of the maximum score of 56, student B answers almost all correctly when asked a question.

Student C initially did not understand the solution's colligative nature in the process of changing the form of a substance. After learning with the experimental demonstration method students' understanding of colligative properties of solution in phase transition of material has increased. Although, not as big as student 1 and student 2. It can be seen

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from the acquisition of a score of 33 or almost 59% of the maximum score of 56, student C answers correctly when asked a question.

Student D initially did not understand the colligative properties of solution in phase transition of substance. After learning with the experimental demonstration method students' understanding of the colligative properties of solution in phase transition of substances has increased. This can be seen from the acquisition of a score of 36 or approximately 65% of the maximum score of 56, student D answers correctly when asked a question.

Students learn very enthusiastically when using the experimental demonstration method coupled with learning media that are tailored to the needs of the child. In addition, factors that influence children's enthusiasm and learning motivation when added color to each glass of the experiment. This aims to make it easier for children to remember which glass is given an additional substance (granulated sugar and table salt), so that students easily understand the effect of the colligative properties of solution in phase transition of materials.

Most students after learning by using the experimental demonstration method can understand the effect of the colligative properties of solution in phase transition of materials. Three out of four students or 75% have an answer score of more than 64% of the maximum score.

The results of this study indicate that the experimental demonstration method is very influential on the process of increasing the understanding of students with special needs. This is consistent with the results of research by [21] that the experimental demonstration method can improve the understanding of children with special needs in learning. Students need learning that is concrete, interesting and in accordance with the needs of children. Involvement of children in the learning process results in failure in the teaching process [22]. Children will easily understand learning when children feel happy [23]. Teaching experiments in the colligative properties of solution in phase transition of materials needs to be informed to each school. So that teachers have confidence that children with special needs can learn something that feels difficult. The main factor that teachers must think about is how teachers can create learning processes according to the needs of children [24-26].

### 4.4 Qualitative Analysis

All students showed improvement in understanding the learning process the effect of heat transfer on changes in the form of matter. Look at the explanation in Table 1, 75% of students have increased understanding. In the learning process, the first session of students A, B, C, and D was given fourteen questions as one of the student's pre-test data. Most questions cannot be answered by students A, B, C, and D, students answer carelessly. The question was repeated four times. Student A only knows about the taste of sugar is sweet and ice cubes are solid objects. Student A answers "sweet guya ma'am" with a hesitant attitude and unclear pronunciation, in contrast to student A who has quite clear pronunciation and a loud voice and is able to know the taste of kitchen salt and sugar and ice cubes are solid objects. Students C and D tend to be passive and do not want to answer. That is because student C is more interested in bullying students A and B by taking their stationery. Student D he is more pleased and interested in staring at the teacher. After that, students are invited by the teacher to do a simple experiment demonstration. Students are invited to leave the

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classroom, students look enthusiastic when pouring water into a glass, applying coloring agents, putting salt and sugar and then putting it into the refrigerator fridge.

Each student took turns taking 150 mL of water with a measuring cup and putting it into a 210 mL of beating glass. Student B was able to find out the water dosage of 150 mL, in contrast to student A who took less than 150 mL and students C and D who took more than 200 ml. Students C and D pour water while pouring water into the ice pan, because students C and D are too hasty. After that, students are asked to drop 1 mL of coloring agent and salt and sugar alternately. Student C is dripping with haste and salt in a mess. Students put water and solution into the fridge and rest while waiting for the next session. Before entering session B, the teacher invites students to look at the glass in the fridge and observe which glass quickly freezes water. Students C and D have difficulty when determining the relationship of the solution's colligative properties with the freezing process. Students only stare and repeat questions when asked.

In session 2, after learning in class, the child is brought to the school field. Ice cubes in the refrigerator were taken and dried in the sun. Students conduct experimental demonstrations and observe the process of the effect of the colligative nature of the solution that occurs in the process of changing the form of a solid into a liquid. Students were asked to compare which ice cubes melt faster. Students have an understanding of the sun as a source of heat energy, a process of radiation, and the concept that water added to salt and sugar melts faster. Students C and D have difficulty when determining the relationship of the colligative nature properties of solution with the melting process. Students only stared and repeated questions when we asked. In session 2, students were given the same fourteen questions as questions in session 1 with four repetitions. All students showed increases in understanding of the experimental nature of colligative properties of solution in phase transition of substances in ice cubes. Although the level of understanding of C students is still below 60% the maximum score. That is because student C has poor concentration and academic abilities and communication barriers.

The results of the analysis above explain that learning by the lecture method alone is not effective for students with special needs. They have difficulty understanding something abstract. Learning for children with special needs must be concrete [27]. Therefore, the use of experimental demonstration methods is very necessary in the learning process of students with special needs. This is consistent with previous research that uses the demonstration method of experiments in the learning process of nanotechnology so that students' understanding processes can be improved [8].

## V. CONCLUSION

The results of this study indicate that difficult subjects (such as the effect of the colligative properties of solution in phase transition of solids into liquid or vice versa) can be taught to students with intellectual disabilities. Some things that must be considered such as learning methods and the media used must be made as concrete and attractive as possible according to the needs of children. The use of the addition of food coloring additives to the solution is one factor that makes children enthusiastic about learning. Children with intellectual disabilities find it difficult to understand abstract learning concepts. Experimental demonstration learning has been shown to increase understanding of heat transfer from changes in the form of solids to liquid.

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