

PAPER • OPEN ACCESS

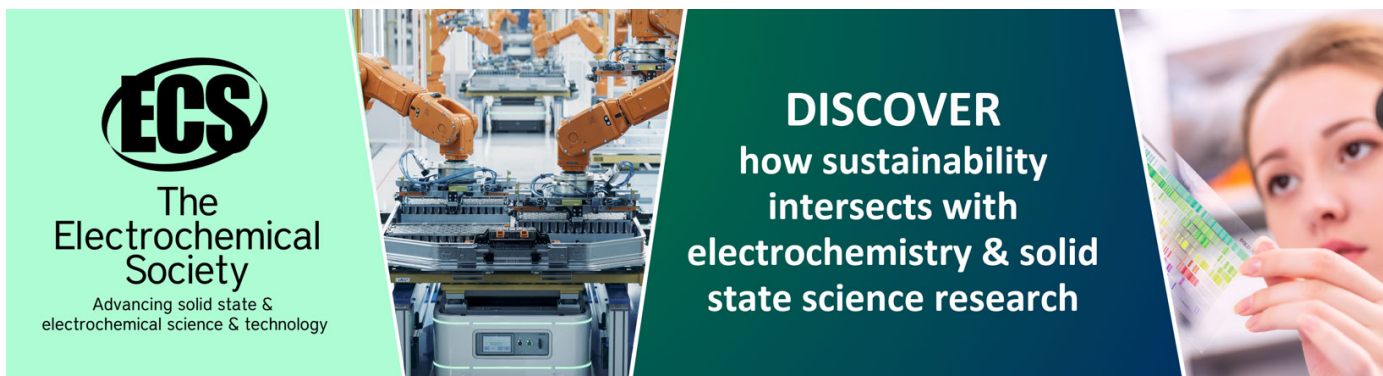
## Investigate Grade 7 Students' Knowledge Construction About Diffusion and Osmosis


To cite this article: Phattaraporn Ponddee and Chokchai Yuenyong 2019 *J. Phys.: Conf. Ser.* **1340** 012074

View the [article online](#) for updates and enhancements.

### You may also like

- [Anisotropic osmosis filtering for shadow removal in images](#)  
Simone Parisotto, Luca Calatroni, Marco Caliari et al.
- [Design and performance of small-scale reverse osmosis desalination for brackish water powered by photovoltaic units: a review](#)  
Vo Nguyen Xuan Que, Doan Van Tuan, Nguyen Nhat Huy et al.
- [Nanostructured materials for water desalination](#)  
T Humplik, J Lee, S C O'Hern et al.





The  
Electrochemical  
Society

Advancing solid state &  
electrochemical science & technology

**DISCOVER**  
how sustainability  
intersects with  
electrochemistry & solid  
state science research

# Investigate Grade 7 Students' Knowledge Construction About Diffusion and Osmosis

**Phattaraporn Ponddee and Chokchai Yuenyong**

Department of Science Education, Faculty of Education, KhonKaen University,  
40002, Thailand

Corresponding author's e-mail address: phattaraporn.sp@gmail.com,  
ychok@kku.ac.th

**Abstract.** This research aimed to investigate the students' constructing scientific knowledge about diffusion and osmosis with analogy approach. The subjects were selected by purposive sampling method including 30 Grade 7 students in Yasothonpittayakom School, Muang District, Yasothon Province, Thailand, in second semester of 2014 academic year. Gathering data by semi-structured interviews and open-ended questionnaire. The data analyses were qualitative analytical techniques. The results of study revealed that almost students held the concept of dissolve to mention diffusion and held the concept of the particulate and the movement of particulate. Their explanations of diffusion and osmosis mentioned various phenomena.

## 1. Introduction

Science does not exist as a body of knowledge separate from knower. On contrary, science is viewed as a set of socially negotiated understandings of the events and phenomena that comprise experienced universe [11]. The phenomena of science classroom of Thailand in the junior high school that will improve because the teachers emphasize rote learning, the Thai curriculum load overabundant content, and teachers lack the building motivation to students and the examination focus on the memorization [10]. So the teacher will relate the students to learn by themselves. The dominant theory of learning today is called constructivism. This theory claims that knowledge is actively constructed by the student, not passively absorbed from textbooks and lectures. The knowledge is constructed from experience [4]. The constructivist view comes in many variants in science education literature on students' learning [7]. Learners construct their own meaning, using their own ideas, beliefs, experiences, etc., to interpret the message conveyed by teachers [8]. Thereby the teacher will chose the appropriate approach to teach specific science content to promote meaning learning. There are several reasons why we should focus on diffusion and osmosis concepts in biology. Diffusion and osmosis are the key to understanding many important life processes [9]. Diffusion is the primary method if short distance transport in a cell and cellular systems. An understanding of osmosis concepts is the key to understanding water intake by plants, water balance in land and aquatic creatures, turgor pressure in plants, and transport in living organisms. In addition, diffusion and osmosis are closely related to key concepts in physics and chemistry such as permeability, solutions, and the particulate nature of matter [6]. [1] report about misconceptions were detected in six of seven conceptual areas: the particulate and random nature of matter, concentration and tonicity, the influences of life forces on diffusion and



osmosis, the process of diffusion, and the process of osmosis. [3] reported that college students in a “constructivist” course learned significantly more traditional biology course. It is motivation of learning. Various instructional methods can be used for meaningful learning. Using analogies in science classroom help students make connections between everyday life and the concepts. Humans use analogical reasoning naturally, especially when trying to explain something to others (S. Rena Smith and Sandra K. Abell). Analogy is attractive because it is a simple way to explain abstract ideas in familiar terms [2]. Analogies are considered because of their potential to compare one object or situation to another [5]. The participants are in the enrichment science classroom which this curriculum develop and promote students who talent in science, held integrating education; child center. To develop potential of individual student and emphasize higher-order thinking skill, problem solving skill, critical thinking skill and creative thinking skill. Students must to inquire knowledge by themselves. Accordingly this study presents to investigate students’ knowledge construction about diffusion and osmosis. The teachers can use the findings to develop students’ understand and chose appropriately approach to teach diffusion and osmosis.

## **2. Methodology**

The study involved investigating Grade 7 students’ knowledge construction of diffusion and osmosis. This study was designed for collecting and analyzing data in order to answer.

### *2.1. The qualitative research method was applied as an interpretive strategy*

#### *2.2. Participants*

The target group, selected by purposive sampling, was composed of 30 Grade 7 students (From 1/14) at Yasothonpittayakom School, who were in enrichment science classroom.

*2.2.1 School background.* Yasothonpittayakom School located at 34 Muang District, Yasothon province, Thailand which is part of the secondary educational service area office 28 and taught from grade 7-12. There are 3,291 students and 165 teachers.

*2.2.2. Target students background.* Target students included 30 Grade 7 students of from 1/14 of Yasothonpittayakom School who were in enrichment science classroom. There were 14 males and 16 females.

#### *2.3. Research instruments*

Research instruments included the diffusion and osmosis understanding test (DOUT) that is open-ended question. There were 2 items constructed and developed by myself and peer.

The first item is “After the boy finished watercolor brush, the boy took the brush dipped in water containers. The next time the boy seen the movement of colors spread over an area of water. Why the colors are so dispersed?”

The second item is “When you squash the orange, the orange juice move to lower part but the crude fiber cannot move. Why is it that?”

These questions ask the students to check their existing idea and construct knowledge about diffusion and osmosis. The question determine situation that can show concept of diffusion and osmosis.

The second instrument was the semi-structured interview form for the students’ understanding of the diffusion and the osmosis. This interview was conducted in order to confirm the results obtained from the questionnaire.

## 2.4. Data collection

2.4.1. School background, including student, teacher, and general data of target students were collected.

2.4.2. The researcher administered the questionnaire on students' understanding of the diffusion and the osmosis

2.4.3. Some students were selected for an interview who answered questions interestingly based on the semi-structured interview from the diffusion and the osmosis that confirmed the result of the questionnaire.

## 2.5. Data analyses

The data obtained from the questionnaire administrated with the students, and the semi-structured interview conducted with the students was analyzed as follows:

2.5.1. 1) The school baseline data was written in a descriptive style to reflect the holistic view of the school.

2.5.2. The practicum students' understanding of the diffusion and the osmosis were analyzed. Each students' answer was read to find key words, encoded to represent the constructing the diffusion and osmosis from analogy situation. The answers were read again to classify ideas.

2.5.3. Students' understanding of the diffusion and the osmosis from the questionnaire was analyzed into good understanding, unclear understanding, and understanding with discrepancies.

2.5.4. Students' interview on their understanding of the diffusion and the osmosis were transcribed to confirm the conclusion drawn from the questionnaire.

2.5.5. The analyzed results were interpreted the students' understanding and constructing of diffusion and osmosis to categorize group of the answer with the supervisor and research assistant.

## 3. Results

The results of this study are presented in second sections. First, the alternative concept of students' understanding of diffusion and osmosis from questionnaire are reported in Table 1. Second, the students' knowledge construction of diffusion and osmosis that resulted from the questionnaire and semi-structured interviews are reported.

### 3.1. Alternative concept

3.1.1. Alternative concept about diffusion. The students' answers from the questionnaire consist of two main concepts such as dissolve and reproduction that illustrate frequency of each concept in table 1.

**Table 1.** Alternative concept about diffusion of grade 7 students' understanding of the questionnaire

Topic	Concept	Frequency )people(	Percentage
Diffusion	Dissolve	29	96.67
	Reproduction	1	3.33
	Total	30	100.00

- Example of students' alternative concept about diffusion. Question: After the boy finished watercolor brush, the boy took the brush dipped in water containers. The next time the boy seen the movement of colors spread over an area of water. Why the colors are so dispersed?
- Description of diffusion concept. Diffusion is the net movement of a substance from a region of high concentration to a region of low concentration. The dipping a paintbrush is the diffusion and the route of the color is the movement of substance. The movement of the color liken substance that move from a region of high concentration to a region of low concentration.
- Example the answer that students held the concept of dissolve
 

"The color contact with the water, it spread around the area. (S01)" This answer show the concept about solvent and solute. The water is solvent but the color is solute.

"Because the color mixes the waterto occur diffusion. It similar the combination between solution and solvent (S05)." This answer illustrates the explanation about the combination between colors and water which as dissolve of solution.

"The color molecule insert in the water molecule (S06)." This answer shows that the explanation about insertion of molecule.

"Because the color has less volume than the water. The color can dissolve in the water (S10)." This answer shows the concept about volume of solvent (water) and solute (color) that volume means size of something which as 3D shape. The principle of dissolve uses the quantity of substance.

"Because the water breaks up bonding force of the color which make to occur the distribution of color (S21)." The answer shows explanation the breaking up of bonding force of color. The substance in nature is huddle. The energy is used to separate substance.
- Example the answer that students held the concept of reproduction
 

"The color seeks a mate that the distribution of color makes to occur new color (S04)." The student understands that the color breed between two color to occur new color. The principle of reproduction means the addition descendants that same their parent. This example shows misconception about diffusion.

3.1.2. *Alternative concept of osmosis.* The students' answers from the questionnaire consist of two main concepts such as movement of particulate and size of particulate that illustrate frequency of each concept in table 2.

**Table 2.** Alternative concept about osmosis of grade 7 students' understanding of the questionnaire

Topic	Concept	Frequency (people)	Percentage
Osmosis	movement of particulate	7	23.33
	Size of particulate	23	76.67
	Total	30	100.00

- Example of students' understanding about osmosis. Question: When you squash the orange, the orange juice move to lower part but the crude fiber cannot move. Why is it that?
- Description of osmosis concept. Osmosis is the spontaneous net movement of solvent molecules through a semi-permeable membrane into a region of higher solute concentration. When you squash the orange, the orange juice move to lower part but the fiber cannot move. It can explain

that a semi-permeable allow some substance through a region of low concentration to a region of high concentration.

- Example the answer that students held the concept of the movement of particulate  
 “The color cannot dissolve in the water and molecule move to around the water. (S08)” This answer show explanation concept the movement of molecule. But the student misunderstands about dissolving of color in the water.  
 “The water move from a region of high pureness to a region of low pureness (S29).” This answer uses the concept of the feature of water to explain water movement.
- Example the answer that students held the concept of the size of particulate  
 “The fiber has bigger size than filter so the fiber cannot through the filter (S02).” This answer shows the explanation size of particulate between particulate and container.  
 “The fiber is fluid. It can through the filter.” (S14) This answer use concept of state of matter to explain situation.  
 “Because the fiber has bigger than the filter. The orange juice is colloid and mixture. It is osmosis. The roots of the plant absorbed the water and mineral that must be small size enough to pass (S30).” This answer use the kind of matter to refer osmosis concept and illustrate example about osmosis phenomena.

### 3.2. Students' knowledge construction

This section presents the students' knowledge construction from the semi-structure interviews that use analogy approach to ask participants.

#### 3.2.1. Example of students' knowledge construction about diffusion.

Interviewer: Can you explain situation that it similar with the brush dipped in water?

S30: *Many events that can be easily seen.*

Interviewer: Can you instance situation?

S30: *My friend broke wind in the classroom. Then smell spread around the classroom.*

Interviewer: Does it relate to diffusion?

S30: *Yes, it is the diffusion of smell into the air.*

#### 3.2.2. Example of students' knowledge construction about osmosis.

Interviewer: Can you explain easy situation that it similar with the squashing the orange?

S05: *I think...if the fat man and the thin man walk through the narrow channel. The fat man cannot through the narrow channel but the thin man can through this channel.*

Interviewer: Why does it similar with the squashing the orange?

S05: *Because the thin man has smaller than the channel. So the thin man can through the narrow channel. Thus the thin man likens the orange juice.*

Interviewer: Does it relate to osmosis?

S05: *Yes, the men like substances that can movement through channel by the size of body. It is special characteristic that select substances to pass into cell of organism.*

The both of constructing concept illustrate that the students can construct situation to relate each concept. The student can explain situation to relate their concept which similar situation in the test.

## 4. Conclusion and discussion

These research findings indicated that grade 7 students' knowledge construction about diffusion and osmosis were unclear because the most students' can explain part of concept. The situation may not clear to relate to the concept of diffusion and osmosis. Alternative concepts illustrate students' understanding about their concept which according to major misconception about diffusion and osmosis. Similarly, Arthur (1995) report major misconception. The particulate and random nature of

matter look alike alternative concept in the research. From the result, students held concept of dissolve to explain about diffusion that students do not understand concept of concentration of solution. The learning activity will engage about the concept of dissolve to conduct about the concept of concentration of solution. The students' constructing concept of diffusion and osmosis mentioned various phenomena. Good constructing of knowledge that students develop their existing knowledge to change conceptual. Students will construct the knowledge from prior experience by themselves. Christianson and Fisher (1994) reported about constructivist course learned significantly more diffusion and osmosis concepts. It was suggested that motivation and learning could be enhanced by: Allowing teacher-student and student-student discussion, allowing time for prediction, using concept mapping to anchor concepts and construct meaning, using the a variety of teaching method. Different students will respond to different techniques. In conclusion, outcome of this research study can improve learning activity to appropriate to construct diffusion and osmosis.

### References

- [1] Authur Louis Odom 1995 *Secondary & College Biology Students' Misconceptions about Diffusion & Osmosis* (The American Biology Teacher vol 57) chapter 7 pp 409-415
- [2] Aubusson P J 2006 *Metaphor and Analogy in Science Education* (New York: springer)
- [3] Christainson R G & Fisher K M 1994 *Analysis of student learning about diffusion and osmosis in three different biology classes using Odom and Barrow's Diagnostic Test* (Unpublished manuscript)
- [4] Christie A 2005 *Constructivism and its implications for educators* Retrieved February 20, 2015, (from <http://alicechristie.com/edtech/learning/constructivism/index.htm>)
- [5] Duit R 1991 *The role of analogies and metaphors in learning science* (Science Education vol 75) chapter 6 pp 649-672
- [6] Friedley Y Amir R Tamir P 1987 *High school students' difficulties in understanding osmosis* (International Journal of Science Education vol 9) chapter 5 pp 541-551
- [7] Good R Wandersee J & Julien J St 1993 *Cautionary notes on the appeal of the new "Isms" (constructivisms) in science education* In K Tobin Ed *The practice of constructivism in science education* (Washington, DC: AAAS Press) pp 71-87
- [8] Gunstone R 1990 *"Children's science": A decade of developments in constructivist views of science teaching and learning* (Australian Science Teachers Journal vol 36) chapter 4 pp 9-19
- [9] Louis Odom and Lloyd H Barrow 1993 *Freshman biology majors misconceptions about diffusion and osmosis* Retrieved March 17, 2015, (from [https://archive.org/stream/ERIC\\_ED362399/ERIC\\_ED362399\\_djvu.txt](https://archive.org/stream/ERIC_ED362399/ERIC_ED362399_djvu.txt).)
- [10] Thomas 2012 *Critique the phenomenon of Thai classroom* Retrieved February 20, 2015, (from <http://www.qlf.or.th/Home/Contents/499>)
- [11] Tobin K Ed 1993 *The practice of constructivism in science education* (Washington, DC: AAAS Press)