Promoting science communication skills in the form of oral presentation through pictorial analogy

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Abstract. Prospective biology teachers are demanded to have skills in communicating science in the form of oral presentation when someday they teach. However, over-expectation towards biological concept comprehension has led them to lower their participation in class. In such a case, rote learning is standing still to support biological content knowledge delivery in university level and thus impoverish the potential of them due to its excessive practice. This study then comes to explore the significant improvement over the use of pictorial analogy to promote university students’ skills in science oral communication towards the nervous system topic. Case study has been a design for the study. It involved two group of different students who participate in natural setting of human anatomy and physiology course. The data was gathered by observation and analyzed in descriptive manner. Quantitative and qualitative data are mixed up altogether to describe the reality behind learning process. The result showed that although both high and low achieving students are successful to communicate science concepts through pictorial analogy they are different in the way they accommodate what they want to explain. High achieving students outperform low achieving students in all aspects of oral presentation. They also employ more complex sources to draw the target concepts. To sum up, pictorial analogy can be used as a tool for students to do science communication skill in the form of oral presentation.

1. Introduction
As prospective biology teachers are demanded to have skills to keep in touch with their students someday when they teach, they must be able to communicate effectively. They talk to semi-open public situation where students’ attentions are gathered to provide learning environment conducive. It is similar to a scientist doing a seminar and having explanation to reason in a systematic way to keep audience stay focus and thus make them interested and fascinated towards what the scientist discovered. Without state the art of presentation skills this will not occur successfully. Such is an example of science communication skills [1]. In doing so, prospective biology teachers then need to master science communication skills with regards to learning preferences including visual (V), aural (A), read write (R), and kinesthetic (K) abbreviated as VARK [2]. Visual corresponds to both simple and complex images presenting information; aural is related to social interaction in delivering information. For instance, oral presentation is the central activity to do information exchange. Sometimes the communication is done through written form that require students to read the information; and kinesthetic is by which information is obtained from learning by doing.

Although science communication skills are mandatory for prospective biology teachers, several research findings ascertain that they are still lacking competencies to communicate effectively when they are engaged in a content-heavy knowledge when it comes to aural domain. Ariyulina [3] found that
prospective biology teachers need more improvement over their skill to ask questions. They usually explain the material itself without widening students perspective and involving them to more motivating learning atmosphere. Edessa [4] contended that teaching biology is usually becoming poor because the lecturers are often trapped to do traditional teaching. Information is transmitted just in one direction, lecturers to students without having much conversation to dig down student knowledge further. This occurrence makes prospective biology teachers as students exposed to a boring situation at which they lower their participation in class. Hence, their capability to skillfully explain what they have learned is just limited to what their lecturers taught. In other words, they are not capable of elaborating explanation of concepts to a new systematic way [5].

The problem becomes more obvious when abstract concepts available to be learned; for instance, nervous system [6]. It constitutes abstract processes by which cells generates physiological activities that contribute to physical and chemical reaction to transmit information from one nerve to the others, involving ion channel responses and enzymes. After spending too much time learning the concepts, prospective biology teachers encounter difficulties due to unfamiliar things. They do not know how to explain clearly about the way impulses are generated and transmitted along axon and cell-to-cell communication. Thus, when taking lesson study they seem to omit concept explanation in detail because they do not know how to present concepts in a more accurate, systematic and relatively easy way. In such a case, according to Baker and Lawson [7], prospective biology teachers need to narrow the gap between unfamiliar objects to familiar objects.

Bridging unfamiliar as target and familiar objects as source refers to pictorial analogy by which those two things share characteristics in common [8]. According to Issing [9], pictorial analogy is the use of picture to obtain interrelated information from two different domain. Personal experience is involved to characterize whether a picture has meaning to make sense what students learn. Bean, Searles, Singer, & Cowen [10] gave an instance; a factory can be a source of information for cell concept which is not all students familiar with. Every single aspect of cell, such as cell wall, mitochondria, and cytoplasm, can be compared to the functioning of factory wall, power plant, and working space.

Due to its benefit to harvest more information, pictorial analogy or related to it can promisingly help prospective biology teachers build science communication in interesting way, since Schott [11] used a pattern of analogy to describe even more abstract than concept, pain. This exciting example portray people who suffer from illness communicate their pain using depiction of color and images and explain how they feel in detail. Sifonis and Chernoff [12] utilized analogy in different field. Innovation is communicated through analogy and makes it easier to understand in a company business. The focus in such is delivering information from thinking into real-life situation using familiar one.

Based on the argumentation above, it makes sense to bring the essence of pictorial analogy to facilitate prospective biology teachers who suffer from content-heavy lecture communicate what they learn effectively. In this study the nervous system is choosen as information target because it contains lots of abstract concept as explained above.

2. Method
The study is done through case study which means it is under natural setting of courses [13]. Participants involved in this research were 18 to 21 year old middler university students (n=6) who took human anatomy and physiology course under prospective biology teachers program in Universitas Negeri Surabaya. They consist of six students and are divided into two groups, high and low achieving student group. In choosing the sample, the research used non-probability sampling study by which groups who have features for providing understanding in depth towards phenomena of learning are selected [14].

Six students experienced a lecture with other students altogether in a normal class. The lecturer gave them material from Textbook of Medical Physiology authored by Guyton and Hall [15]. Afterwards, they are exposed to the analogy through depicting that nervous system is analogous to computer along with its pheripheral hardware. For the assignment, students must then use analogy to explain what they learn in front of other students using analogy of a series of domino. How the domino works is analyzed by students themselves.
In order to capture the data in a comprehensive manner, two instruments are used. First, rubrics are made up to assess and evaluate what the students do towards assigned tasks based on the listed criteria that articulate expectations of what counts, alongside with categorized description from low level to high level of achievement [16]. These include rubric for oral presentation and analogical portrayal of biology concept. Second, observation sheet functions to record data in accordance with the way students develop and engage in social interaction while doing learning.

Data is collected through observation, assessing students performance, and interview. Observation is accomplished by noting the way students learn and deal with the learning outcomes they are supposed to be. When making analogy and presenting oral communication, every aspect in rubric is used to pinpoint the extent to which their performance is done. Afterwards, in focus group students are interviewed to access information in depth towards collaborative information exchange.

In analysing the data, quantitative and qualitative data are matched altogether to portray analogy in promote students to successfully doing science communication in aural domain. Students’ performance in oral presentation and analogy was analyzed descriptively using scores and criteria of rubric. The scores varied from 1 to 4 and the criteria were determined by different level ranging from unacceptable to excellent. Hereafter, the judgment is made by consolidating to data interview that has been clustered and reduced [17].

3. Result and discussion
After doing learning process about the nervous system, prospective biology teachers are asked to present what they understand in aural domain of science communication, that is oral presentation. In such a case the oral presentation is assessed using rubric focusing on how student organize the way they present the nervous system concepts, engage and involve audience in discussion, and use technical tools of presentation as modified from the items proposed by Suprapto and Ku [2].

Talking about organizing what to speak up, communicating concepts consist of two aspects, introducing the topic and developing understanding of concept through analogy. In the first aspect of the assessment, high achieving students obtain score of 4, whereas low achieving students has score of 3. This indication means that both groups have narrow gap of presentation skill in the first place. The gap is about to take place in the way students giving example of related concept to familiar one. It is very important to do so because it can grasp audience’s attention and give them initial thinking to what presenters want to show. Additionally, it is said that using pictorial analogy, students also do better to communicate the content. Target and source becoming shortened as Holyoak and Thagard [18] echoed by which mapping the selected components of analog and target, the analogy can have its positive impact to learning. In other words, high achieving students are capable of familiarizing the abstract concepts into day to day phenomenon.

Aside from pictorial analogy itself, Wentzel as cited in McInerney and McInerney [19] argued that the success may result from collaborative working among students. Giving in mind those students who are socially responsible will greatly pay attention to the task completion and the quality of work at the same time. Thus, it provides benefits to group in preparing and doing oral presentation. Secondly, the social interaction within groups can promote good behavior and make students to be more responsible to engage in academic work. It is because they feel that pursuing success in that task will give advantages to group where they are involved in.
Figure 1. Assessment results of oral presentation between high and low achieving students.

Technique to present the topic requires both group to provide visual aid and everyday life example of what being spoken is. For this, high achieving students still outperforms low achieving students. They give flash video from McGrawHill online learning center and the analogy fits to it as well to audience while talking about the way impulse is generated and transmitted along the axon as shown in figure below.

Figure 2. Flash video used by high achieving students to strengthen their pictorial analogy taken from http://highered.mheducation.com/sites/0072495855/student_view0/chapter14/animation_the_nerve_impulse.html
In such a case they are successfully brings the audience to the new way of understanding concepts because falling domino game to strike at the target is having similar features to the concept of impulse generation. However, when they explain about the way sodium and potassium ions are transported across the membrane they do not consider that the falling domino does not employ such a process; rather they just give reason unmatched to it, i.e. domino which starts falling is having sodium ion influx and potassium efflux. Hence, the score is below 4, which means good in category and needs a little improvement. On the other hand, low achieving students do not give comparative portrayal images over the concept they talk. What they provide is just limited to the way domino cards are falling down to make a series of movement.

Looking further at the content students speak up, both groups use analogy in the form of a series of domino cards arranged upright to explain the impulse propagation. The results are compared using table modified from what Bean, Searles, Singer and Cowen [10] proposed. Two groups of students showed different opinion towards concept explanation they generate. High achieving students put complete familiar concept from pictorial analogy to target concept, while low achieving students put little illustration only. The work of the two groups is presented below.

| Group          | Component                  | Role                          | Analogy                                      |
|----------------|-----------------------------|-------------------------------|---------------------------------------------|
| High achieving | Myelinated axon            | Transmit-ting impulse        | A series of domino cards                    |
|                | Ion channels                | As a gate for ion movement   | A gap between two domino cards              |
|                | Ion influx                  | Influencing potential membrane to generate | Undetected |
|                | Ion efflux                  | returning potential membrane to the original state | undetected |
|                | Potential membrane difference | As a value to generate action potential | A movement of domino card to fall |
|                | Action potential and impulse transmission | Transforming potential membrane to impulse | Collision of dominos |
| Low achieving  | A neuron                    | Transmitting impulse         | A series of domino                          |
|                | Action potential            | Being an impulse             | Collision of dominos                        |
|                | Ion influx and efflux       | Generating potential membrane | Collision of dominos                        |
|                | Impulse                     | Information delivery         | A series of falling domino                   |

Figure 3. game-flash based used by high achieving students to explain the concept of impulse transmission taken from online gaming http://www.gamedesign.jp/flash/domino/domino.swf
Based on the table 1, it can be seen that high achieving students outperform low achieving students in terms of analyzing target concepts to source of concept. They successfully mention 6 elements of impulse transmission while low achieving put only four elements. However, there is a positive result by which both high and low achieving students can bring their thinking into the same track using pictorial analogy. They name all important concepts and bring to the list. Role of each element of impulse transmission is explained clearly. These indicate that all students sufficiently master the concept. They know how to organize what to present using pictorial analogy of domino. After having teacher-student discussion in class, high achieving students refine their statement over the use of analogy in regards to influx and efflux ions.

When asking the prospective biology teachers about what they experience in learning using pictorial analogy, both high and low achieving students express quite interesting thoughts. High achieving students perceive that the pictorial analogy is useful because it can be a comparative tool to the target concepts to explore the science concept in more detail. Through this way, they will have organized materials to present. “At first, I felt that pictorial analogy was just limited to show the picture and talked only about whether the analogy itself fit or not to the target concept. I’d never thought that it could be done through comparison between what use in analogy and abstract concept. In such a way, I had more chances and materials to be presented in front of my friends”.

Low achieving students contend that learning using analogy is difficult at first because it requires them to challenge themselves in terms of what to identify. However, after discussion session they feel that the difficulty being encountered is successfully solved because most of interactions scaffold their thinking. “Anyway, thinking through analogy made me stressful at the first place because I didn’t know how to analyze the targets and sources. But, after getting support from my friends, I could handle the way analogy provided me concept exploration. Hence, I felt confidence to communicate to others because I knew how to explore what I learn in interesting and more visualizing way”.

4. Conclusion

By looking at the data, it can be seen that generally both type of student group have successfully presented biological concepts using pictorial analogy in interesting way at least in acceptable category for low achieving students or score of 2. Access to exploring concept using analogy can help them to gain confidence and thus are able to develop skills such as choosing materials to speak, analyze what should to speak and choosing materials to present such as providing appropriate images. In all aspects of science communication assessment, high achieving students outperformed low-achieving students.

Acknowledgement


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