

## **Analogies Developed by Prospective Classroom Teachers in Science and Technology Training**

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This study attempts to present the analogies developed by prospective classroom teachers in science and technology training and to bring out their abilities of displaying the relationship between the target and the source. This study is carried out by case study approach with the prospective teachers in 2008-09 education term. They are asked to develop analogies in science and technological subjects after given literature and technological information about analogies. It is determined that the analogies analyzed according to some criteria have been well-developed correctly relating to make the relationship clear between the compared concepts and the concepts to be given. The findings of semi-structured interview made with 10 prospective teachers support that as well. However, in some findings, some analogies that may lead to conceptual misunderstandings and cases where technique of analogy and technique of the experiment are confused are found as well.

**Key Words: Analogies, Science education, Prospective teachers.**

### **INTRODUCTION**

Many strategies, methods and techniques are being used for determining the misconceptions and the ways of removing these misconceptions in teaching of abstract concepts in science<sup>1</sup> and one of these techniques is the analogy. In the related literature, it is emphasized that the analogies familiar to students are significant in terms of meaningful learning<sup>2-4</sup>. Analogy is the explanation of an unfamiliar phenomenon by associating it to an unfamiliar one. The unfamiliar (unknown) phenomenon is the target whereas the familiar one is the source<sup>5,6</sup>. Analogies serve as bridges between what is known and what is unknown as a phenomenon, case or concept<sup>7</sup>. However, one should pay special attention while making comparisons and association. During the effective teaching of the unfamiliar concept, the similar should be easier, comprehensible but not complex and complicated than the similarized<sup>8</sup>. In the relevant studies, it is stated that the analogies which are not clearly and effectively presented can lead to misconceptions for students<sup>9-11</sup>. In order to provide an effective presentation and be an effective guide, it is essential to acquire necessary information and skills about this technique. The improvements in science and technology require the educational programs to be revised and

equipped accordingly with today's world. With the revision of these programs, the prospective teachers who are pursuing their educational lives in the departments of education should be informed about these programs and should be provided with practical skills. As it is well known, just like the other teaching methods and techniques, the analogies should be presented in an effective and thoughtful way in the process of teaching<sup>12</sup>. At that point the teacher has a significant role. In this sense, when prospective teachers are considered to present concepts in science and be guides in their coming professional lives, the necessity to get them gain the skills to use the analogy technique in a desirable and equitable level appears. This study is aimed to present the analogies developed by prospective classroom teachers in science and technology training and to bring out their abilities of displaying the relationship between the target and the source while developing these analogies.

### EXPERIMENTAL

This study has been carried out by using the case study research approach. This approach enables to explain the cause-effect and variables (in terms of their mutual relationships) of the data which have been gathered *via* more than one technique<sup>13</sup>.

The reason why the study has been carried out by using the case study research approach is the examination of the analogies developed in the science teaching course by the 3rd grade students in the program of classroom teaching and the realization of this study just in the Faculty of Education at University of Amasya. Additionally, the interviews made with the students in order to determine their viewpoints and cause-effect relation, which study field of science they have chosen and why, difficulties they have encountered while developing the analogies have also been examined within this scope.

The participatory group of this research is constituted by 245 prospective classroom teachers that have been registered to science teaching II course in the spring fall of 2008-09 academic term in the Faculty of Education at University of Amasya.

**General procedure:** Science teaching is a 4 credits course (2 + 2) offered in two semesters in the Faculty of Education-Classroom Teaching Program. In the second semester, skills for prospective teachers in the issue of techniques and methods that can be used in teaching science are brought in.

In the theoretical part of the related course, studies on the analogies effective in teaching science with the guidance of the instructor have been carried out. The procedure is as follows:

- The description and explanation of analogy.
- The features of analogy and expressing its significance.
- Types of analogy and explanation of the samples.
- Explanation of points that should be paid attention while developing analogies.
- The presentation of analogies that is present in the literature on science and technology.
- Prospective teachers' examining the analogy samples in the literature in pairs.

- Creating a discussion atmosphere on analogies.
- Asking the prospective students to develop and examine analogies on science and technology subjects for primary school during the course.
- Assigning the paired prospective students with one month period for preparation of analogy activities based on either the 5th or the 6th grade science and technology topics.

At the end of this given period, students with their group members have presented their analogies to the related instructor. These analogies have been examined by researchers of the study. The required information is given in the data analysis part. Moreover, a semi-structured interview has been made with 10 prospective teachers on the analogies they have developed.

**Data analysis:** The analogies developed by the prospective teachers have been analyzed by the researchers. The analysis of the analogies has been done by considering how the relationship between the target and source is conceived and whether the similar concept or topic is simpler, easy or more complex than the similarized one. Moreover, researches have been conducted on the matter of which subject (physics, chemistry or biology) have more analogies and data about that is presented. Furthermore analogies have been analyzed in terms of their being simple, narrative and pictorial. The data analysis of the semi-structured interviews made with 10 randomly chosen prospective teachers is done by paying attention to the similar, common and opposite expressions in the answers.

## RESULTS AND DISCUSSION

The data of the study are presented in two parts that are the examination of the analogies developed by the prospective teachers and the data gathered through the interviews.

**Analogies developed by prospective teachers:** Prospective teachers (245) have taken part in the study and they have developed analogies on science and technology subjects in pairs. Due to the paper number limitation, some simple samples of analogies are given in Table-1.

When analyzed according to the sub-topics of the science, it is found out that analogies are 61.67 % (140) in biology, 21.14 % (48) in chemistry and 17.18 % (39) in physics. The findings of analogies according to the categories, 63.87 % (145) is in the form of narrative, 28.63 % (65) is simple and 7.48 % is pictorial.

**Interview findings:** The interviews findings gathered from the interviews made by 10 randomly chosen prospective teachers who have participated the study are shown below by paying regard to the answers' being similar, common and opposite.

**What kind of difficulties have encountered while developing analogies?:** Most of the prospective students (80 %) have stated that while developing analogies it was sort of difficult for them to similarize the science terms, components with the daily events that the students could find easy to grasp. Moreover, they have expressed that they themselves do not have a comprehensive science competence

TABLE-1  
ANALOGIES DEVELOPED BY PROSPECTIVE TEACHERS

Target	Sources	Relationship
Antibody	Army	The army protects the country from the enemies and keeps it safe just like antibody protect the body from germs.
Germs	Enemy	The germs are just like the enemies who try to destroy the country.
Fire	War/battle	During a battle, when the army fights against the enemies, the tension gets higher in the country. When the antibody fight against the germs/bacteria, the temperature of the body gets higher as well.
Health	Victory	When the army wins a war, the country gets back to its formal order just like the body gets its formal health when the germs are thrown out of the body.
Immunity	Agreement	After the victory, the army announces its superiority, let the enemy accept it and makes it weaker. The body becomes well-prepared against the germs and gets immunized.
Blood circulation	Central heating system	The heart is compared with the heating room, our blood vessels with the heating tubes and the organs with the heater core.
Cell membrane	Peel of an apple	The cell membrane is compared to the cover/peel of an apple as it covers the cell.
Cytoplasm	Eatable part of an apple	The eatable part of the apple is compared to the cytoplasm.
Cell nucleus	Core/heart of an apple	The centre, core of an apple is compared to the nucleus of a cell in the centre.
The brain	President	The brain is compared to the president who has the highest status in a state and who has the authority to decide.
Cerebellum	Prime minister	Cerebellum is compared to the prime minister who has the power of decision secondarily.
Internal organs	TBMM (The Grand National Assembly of Turkey)	As they control different parts of the body, the internal organs are compared to The Grand National Assembly of Turkey which is comprised of members of parliaments from various places
Nerve cells	Governorship	As they convey the messages to the different parts of the body, nerve cells are compared to governorships who administer the cities.
The cells	Human beings	Cells are compared to human beings who are beneficial to the society and who build up the base of the society.
The cell	Grit	The cell is compared to a grit which is the smallest building stone of a house.
Tissue	Brick	The tissue made of the cells is compared to the brick made of grits.
Organ	Wall	The organ made of tissues is compared to the wall made of bricks.
The system	Room	The system made of organs is compared to the room made of walls.
Body	House	The body made of systems is compared to a house made of rooms.

Element	Honey made by the bee just from the daisy	A bee's making honey just from a daisy is compared to the element.
Compound	Honey made by the bee from various flowers	A bee's making honey from several flowers is compared to the compound.
Solid	Flowers in a garden frame	As they are in a regular order, the flowers in a garden frame are compared to solid molecules.
Liquid	Flowers in a garden	Flowers in a garden are slightly arranged.
Gas	Flowers in the nature	The flowers in the nature are compared to the disorder way of gas molecules.
Electron	Truck	Electrons that move through the conducting wire are compared to trucks.
Energy	Sand	Energy carried by the electrons is compared to the sand carried by the trucks.
Bulb/lamp	Construction	The bulbs where the energy is used are compared to constructions.
Battery	River	The batteries that provide the energy are compared to the rivers where the sand is taken out.
Amperometer	Traffic policeman	The traffic policeman checking the trucks on the road is compared to amperometer
The form of DNA	Zip fastener	The parts of a zip are compared to the bases of the DNA molecules.
The spread of sound in the air	The drive of a car on unpaved road	The spread of a sound in the air is slow just like a car going slowly on an unpaved road.

and added that they have had difficulty due to this reason. They have told that they had to make use of course books in order to compensate their lacking competence of the subject. They have also said that when they become teacher, they feel the necessity of getting prepared for the science courses more particularly and in advance.

**Which subcategory of the science has chosen to prepare analogies and why?:**

The prospective teachers have stated that 5 of them have chosen biology, 3 of them chemistry and 2 of them physics. The ones chosen biology have told that they have chosen biology due to the fact that they know biology well and they find it easier to compare to our daily lives. One of these prospective teachers has added that biology topics are more concrete and it is easier to develop analogies on that.

**What type of analogy has chosen to develop and why?:** Nine of the prospective teachers have chosen narrative type of analogy and 1 of them simple type. The ones who have developed analogies in the narrative type have expressed that they think that type of analogies would attract students' attention more and would help to change the abstract concepts into concrete ones. One of the prospective teachers on the other hand has stated her reason of decision that she is more capable of narrating the concepts and events. Another one has told that narrative types of analogies are more effective in terms of students' progress. The ones who have chosen the simple type of analogies have emphasized that in that way, the topic would be comprehensively

acquired and it would be more effective in understanding the relationship between the target and source.

**Which part of the course should the analogies be introduced in and why?:**

Five of the prospective teachers interviewed have told that the analogies should be introduced and presented in the beginning of the course in order to draw the attention of the students. They have emphasized that the most effective method in science classes is laboratories and analogies should be used in the beginning of the course. The other 5 prospective teachers have stated that it is important to make use of analogies at the end of the course in order to sum up the course and to strengthen what the students have already learnt. Moreover, some of the participants have added that using analogies in the case of not being able to use of laboratories and equipments would be more effective.

**What are the advantages of developing and using analogies in the process of teaching?:** The prospective teachers who support the idea of using analogies in the beginning of the course have emphasized that students' attention is attracted on the concept that is to be given and it becomes easier for them to figure it out in that way. They have stated that analogies are extremely useful in strengthening the students' comprehension at the end of the lesson.

According to the data obtained from this study in which analogies developed by prospective classroom teachers in science and technology topics have been examined, while more than half of the participants (61.67 %) have preferred to develop analogies in biology, chemistry (21.14 %) and physics (17.18 %) analogies have been preferred less. The reason behind this has been searched in the questionnaires and a large amount of participants have stated that they are better in biology and it is easier for them to relate it to daily life. So, it may be inferred that prospective classroom teachers are better at biology as the biological topics are more related with daily life whereas they find it difficult to grasp and apply physics and chemistry topics. In this respect, basic concepts should be given as well as content and the applications should be done in the laboratory in the physics, chemistry and biology courses.

When the main philosophy of the primary education programs is taken into account, this has become a must. Applications and performance should be paid more attention in order to educate literate teachers in science and technology. It is found out that the participants have preferred to develop narrative analogies 63.87 % (145) rather simple 28.63 % (65) and pictorial 7.48 % ones. The reason of this is emphasized as they are found more effective in students' comprehension and the teachers' being more capable of developing such analogies. It may be concluded that prospective classroom teachers are more capable of comprehending the cases and narrating the concepts. However, effective physics and chemistry courses should be offered to the applicants because they are found to be more successful in developing narrative analogies in the biological subjects as they are better at them. Some analogies that may lead to misconceptions among the biology and physics analogies are happened to be as well.

One of the most important drawbacks of the analogy technique is the misconceptualization and this is also proved within this study. In this respect, this should be emphasized to the prospective teachers while developing analogies and the analogies developed should be examined one by one and should be discussed within the classroom. Moreover, whereas it is ascertained in the analogies that some of the students could not exactly express the relationship between the target and source in terms of comprehensibility of the concepts to be given, most of the students have accomplished this. It may be concluded that the students are good in developing effective analogies if they know the concept and subject well. This conclusion also indicates that prospective teachers should be offered science in an effective way.

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