Diagnosing Students' Misconceptions about Plant Parts in Turkey

Merve Gültekin
Master Degree Student
Yıldız Technical University
Department of Primary Science Education
34220 Istanbul, Turkey.

Ünsal Umdu Topsakal
Assoc. Prof. Dr.
Yıldız Technical University
Faculty of Education
Department of Primary Science Education
34220 Istanbul, Turkey.

Abstract

The main aim of this study was to understand what students consider about plant parts. Therefore, the goals were (1) to identify 7th grade students' misconceptions about plant parts concepts and (2) to understand which variables (gender, parents' education level and attitude towards plants) influenced students' conceptions. Qualitative research method was used and 50 7th grade students participated to this study. An instrument, consisting of 10 open ended questions and semi-structured interviews were applied to students. Data analysis allows us to conclude that students had serious difficulties in understanding plant parts. Gender, parents' education level and attitudes towards plants did not influence students' conceptions.

Keywords: Plant parts, misconceptions, science education, primary school students

1. Introduction

Science and technology curriculum which is based upon constructivist approach, aims at recognition of the world by students and forming knowledge actively in their minds on their own (Aydın ve Balım, 2007). According to constructivism it is very important for students to learn concepts correctly. During learning period activities should be designed and implemented for restraining misconceptions. Students can learn subjects well only by constructing the concepts regarding the subject in their minds correctly (Aydın ve Balım, 2007).

In the development of children's thoughts daily language words are effective. The science curriculum isolates the students from other domains of knowledge (especially called everyday knowledge) and attempts to control the classroom environment such that student attention is dominated by a teaching manipulation (Cobern, 1994). If daily language word's meaning is different in scientific language, it is a problem for children (Gilbert & Osborne, 1980 as cited in Bakırcı et al., 2010, p. 32). Because of it is very hard for the child to construct correct scientific meaning of the concept. For example the word animal is a very common word in daily language but its usage in science is different. So children may develop thoughts about animals apart from meaning that scientifically approved (Bell & Frayberg, 1985 as cited in Bakırcı et al., 2010, p. 32). Of course one may counter that it is those who experience trouble accepting a scientific concept that need to break with everyday concepts or prior concepts (Cobern, 1994). Also in our curriculum children try to learn science topics sequently. That prevents the acquisition of concepts substantively and students have an aim for memorizing the knowledge that they think is enough for exams. 'Information that students construct is far away from scientific facts and based upon interpretation; poses an obstacle in front of science teaching' (Ausubel et al, 1978; Driver, 1989 as cited Türkmen et al., 2003, p. 54). 'This information is also known as naive theories, preconceptions, misconceptions, childrens' science and alternative conceptions' (as cited Türkmen et al., 2003, p. 54).

Türkmen and friends (2003) indicate that primary school students define plants according to their preconceptions and models in their minds. Researchers also noted that students' most common examples for plants are fruits, vegetables and decoration plants that they have seen in their daily lives. According to this study some of the students think that fruits and vegetables aren't plants.

The main aim of this study was to understand what students consider about plant parts. Therefore, the goals were (1) to identify 7th grade students' misconceptions about plant parts concepts and (2) to understand which variables (gender, parents' education level and attitude towards living things) influenced students' conceptions.

2. Method

2.1. Design of the Research

Qualitative research method was adopted for this study. The interviews were semi-structured.

2.2. Sampling

The data were gathered from 50 (25 male, 25 female) seventh grade students of a state school in Istanbul, Turkey. 7th grade students are familiar to the subjects about plant parts, plant growth and plant reproduction. Therefore seventh grade students' are chosen for this research. In this grade students are expected to recognize plants, plant parts and distinguish fruits and vegetables.

Gender, parents' educational level and family income of students are indicated in the charts (Figure 1). Semi-structured interviews were carried out with all the students participated in this research.

2.3. Instrumentation and Analysis

The data was collected in two steps. Firstly, a survey instrument consisting of 10 open-ended questions which was prepared by the researchers was given to the students. Seven plants were shown to the students and asked which plant part are they. The students also were asked to draw a plant and show parts of them by labels. Drawings have been considered as simple research instruments that enable easy comparisons at the international level. While many children dislike answering the questions, drawings can be completed quickly, easily and in an enjoyable way. Children's drawings provide a window into their thoughts and feelings; mainly because they reflect an image of his/her mind (Köse, 2008).

In the second step, semi-structured interviews were carried out in order to examine the attitudes of the students to plants and try to find out if attitudes influence this concept knowledge. With all the remaining questions, the students were allowed time to express their ideas freely without being interrupted. The answers received were recorded by the researcher by taking notes. Each student's interview lasted for approximately 15 minutes.

The data was treated by qualitative data analysis (open coding) (Bryman and Burgess, 2004). The data obtained from the survey instrument and interviews are categorized and arranged considering the alternative opinions of the students. The opinions of the students who gave same type of answers and the students who gave different types of answers are categorized and specified. The total responses are more than the sample because some student teachers mentioned more than one category. Some of the student statements that were different and interesting are included in italics in the section 'Results'.

The data was collected in the first semester of 2012- 2013 school year.

3. Results

Unexpected numbers of wrong answers observed for the first seven questions. According to the findings there are differences between the answers of females and males. In Table 1 it is seen that, females (F)' knowledge is better than males (M) about plant parts. Although all the students recognize the plant and have seen it before, none of the student knew about achene. Most of the students thought that they are pollens or some kind of leaves. So they don't presume that they would be fruits of the plant. Actually they think those parts as male organs of a flower but they define them as pollens on the papers that may be based on the knowledge that pollens are lightweight and fly in the air.

When it comes to the education levels of the parents a wide range of distribution can be seen (Table 2). The interesting thing is correct answers don't match the high education levels of the parents.

For nearly every question we can say that most of the right answers are given by the students whose parents' graduated from primary- secondary schools. But this may result from the fact that most of the students' parents' education level are primary school and secondary school.

Relation between the frequency distribution of students mentioning for plants and income are in Table 3. When we look at the interrelation between economic level and correct answer percentages (Table 3), we see a broad distribution so it is hard to generalize the results for monthly family incomes.

When the students were asked to draw a plant, it is seen that some drawings are stereotype. They are very similar to each other. Students draw daisy or apple tree when asked to draw a plant. There are few exceptions like rose (34), corn plant (44), tomato (35), tulip (27) and apple (8).

Some examples of students' drawings about plants are in Figure 2, Figure 3, and Figure 4.

The most common reason why they chose this plant was that, "it was the common plant I see." The other reason that was mentioned was "it is east to draw". Some of the students mentioned that they drew it because it came to their mind first.

When the students were asked to answer what they knew about fruits and vegetables, it is seen that there are many misunderstandings about fruits and vegetables. Maybe the most interesting one is students' obsession about where fruit or vegetable grow. They are pretty sure that there is no fruit growing on earth; they think they are just on trees. Another common verdict is that fruits are juicy and sweet; vegetables are tasteless and hard to eat.

The frequency distribution of students' mentions about fruits and plants are in Table 4. 32 students out of 50 mentioned that fruits and vegetables contain vitamins and they make people stronger.

Some examples of the students' views about fruit and vegetables are given below ("M" refers to male students, "F" refers to female students):

F22: "Fruits and vegetables are different from each other, because fruits mostly grow on trees while vegetables grow on earth…"

M8:"Green ones are vegetables…"

M10:"Fruits taste good that is why we eat them, we eat vegetables as for that they are healthy. And we eat vegetables' roots, we do not eat fruits' roots…"

M13:"Fruits grow on trees and they are juicy, they are healthy, vegetables mostly grow on soil and they are healthy too…"

M14:"Fruits taste good, vegetables don't…"

F19:"Fruits are generally sweet and we cook vegetables, vegetables can't be eaten raw…"

M47:"Fruits are healthy in common but when we fry the vegetables they become greasy and harmful…"

F45:"Fuits are the plants which grow on trees and source of vitamin c, they are cure for diseases. Apple is an example for fruit and carrot is an example for vegetable. Vegetables are mostly plants, they don't grow on trees and they are not the same…"

M50:"Fruits have flowers and vegetables grow on the ground. They are very nutritious, fruits also have pollens and vegetables have roots."

M25:"Fruits never grow on the ground, inside the soil but some of the vegetables may grow there. Some vegetables' leaves can be eatable but we don't eat fruits' leaves…"

During the semi-structured interviews it is tried to investigate students' attitudes to plants. When the students were asked to answer what the importance of plants is, most of the students mentioned that plants are very important of the life. Some answers of students for this question are below:

M49: Plants are the life sources of people. There are plants added even in the medicine. Besides black sesame is cure for every disease. Humans should intake vitamins from the plants.

M48: Plants make world more beautiful. They emit oxygen to the atmosphere…Forest fires decrease the amount of oxygen in the world, they ruin its beauty. Also people make books and notebooks from trees. Without forests children can't find notebooks.

F41: Plants are very important for us because they are the source of oxygen in the air. Plants in our houses release oxygen too. I don't like the people, who damage trees or pick plants, I am angry about this.

F16: Plants cleans the air and they prevent disasters. They prevent landslides and some flowers release good scents into the air. People should not pick flowers or step on flowers, they should think themselves as plants and try to understand what they feel…

F27: Plants make oxygen, clean the air, plants can turn into fruits and vegetables and we eat them, they do photosynthesis. They give food to people and animals. Animals already eat plants. Most people don't know how beneficial and important plants so they harm plants. People pick beautiful flowers so bees can not make honey because they can not carry buds flower to flower. Flowers can not reproduce…

F19: Some plants are important, they give fruits and vegetables, and they garnish nature. Also plants with flowers are effective on formation of some foods like honey. Picking a plant is like a crime for me because they are alive. People, who damage plants, must be punished.

F20: Plants are green things. Everything in a forest is plant. We feel good in a forest because of the plants' beauty and scent. Plants produce oxygen and absorb carbon dioxide. So plants are very important for people, health, peace and fruitfulness… the air coming from the plants makes people peaceful. Fruits give people health and also people can sell fruits and make Money…

As a result of semi- structured interviews, it is seen that most of the students have positive attitudes towards plants. They remark that they are trying to protect the grass and flowers. They consider plants as fruits and vegetables, in other words food. So they are generally aware of the importance of plants for our lives. They see plants as an indivisible part of the nature. But it is found that the attitudes towards plants do not influence the knowledge of plant parts.

4. Discussion and Implications

According to Kete (2006), root, stem, leaf, flower and fruit parts of the plants are not well understood by students. We agree this opinion because many misunderstandings about plant parts can be seen from the mentioning of the students. Kete (2006) also found that students think that onion and potato were roots and they did not know the fruit and vegetable concepts correctly. We found similar results indeed. There are many unscientific arguments that students remark for the fruit and vegetable indication. Bakırcı and friends (2010) investigated students' views about plants and they found that some seventh grade students did not regard fruits and vegetables were even plants. In our research it is found that females' knowledge is more than males about plant parts. Çakıroğlu (1999) emphasized that in general male students are more successful than female students. At the other side when trying to investigate the gender influence for learning strategies, Sadler-Smith (1996) emphasized that female students are more successful than male students on memorization.

Some students defined the plants as creatures that have roots, stems and leaves (Türkmen et al., 2003). Köse (2008) emphasized that, one of the reasons of students' present misconceptions is the teachers' misconceptions. Like in Köse (2008)'s research most of the students drew flower and trees when they were asked to draw a plant in this research. The reason of this may be they learn that images of flowers and trees during their school lives. When you leave behind seventh grade students, even student teachers have misconceptions about plants. 'Uşak (2005) found that student teachers confused function of flowers and they could only draw root and flower diagrams, they could not draw leaf structure' (as cited in Mutlu & Özel, 2008, p. 109). It is stated in the recent research of science teaching, students have unscientific thoughts and alternative frameworks (Bilen & Köse, 2012).

In this research, it is seen that there is no relation between parents' education level and knowledge of plant parts. There is no relation between students' economic level and knowledge of plant parts. Also there is no relation between this knowledge and attitudes towards plants. Teachers should design activities in order to break these misconceptions. Even students learn about the plants before they are confused about plants' structure. They have slightly idea of fruit and vegetable conceptions, even the best known plants can't be classified by children. Plants are important for future environment and as a result of this research it is recommended that the primary school students be taught plants deeply without looking gender, parents' education level and economic level.

5. References

Ausubel, D.P., Novak, J.D. & Hanesian, H. (1978). Educational psychology: a cognitive view. New York: Holt, Rinehart & Winston.

Aydın, G. & Balım, A. G. (2007). Fen ve teknoloji öğretiminde kullanılan kavramsal değişim stratejilerine dayalı örnek etkinlikler. Journal of Dokuz Eylül University Buca Education Faculty, 22, 54-66.

Bakırcı, H., Subay, S., Midyatlı, F. & Ünsal, N. (2010). İlköğretim ikinci kademe öğrencilerinin bazı fen kavramlarıyla ilgili düşüncelerinin sınıf seviyelerine göre incelenmesi. Journal of Abant İzzet Baysal University, 10 (1), 31-48.

Bell, B. & Freyberg, P. (1985). Language in the science classroom, Osborne, R. and Freyberg P. (Eds.) Learning in Science: The Implications of Children's Science (29-40). Hong Kong: Heinemann.

Bilen, K. & Köse, S. (2012). Yapılandırmacı öğrenme teorisine dayalı etkili bir strateji: tahmin- gözlem- açıklama "bitkilerde büyüme ve gelişme". Journal of Pamukkale University Education Faculty, 31, 123- 136.

Bryman, A. & Burgess, R.G. (Eds.). (1994). Analyzing qualitative data. London: Routledge.

Cobern, W. W. (1994). Worldview theory and conceptual change in science education. Presented at the 1994 Annual Meeting of the National Association for Research in Science Teaching, Anaheim, Orange County: California (CA).

Çakıroğlu, J. (1999). Gender differences in the science classroom. Journal of Hacettepe University Education Faculty, 16-17, 123-133.

Driver, R. (1989). Students' conceptions and the learning of science. International Journal of Science Education, 11, 481-490.

Gilbert, J. K. & Osborne, R. J. (1980). 'I Understand, But I Don't Get It": Some problems of learning Science. School Science Review, 61, 218, 664-674.

Kete, R. (2006). 6. Sınıf fen bilgisi biyoloji konularında kavram yanılgıları. Journal of Dokuz Eylül University Buca Education Faculty, 19, 63- 70.

Köse S. (2008). Diagnosing student misconceptions: using drawings as a research method. World Applied Sciences Journal, 3 (2), 283- 292.

Mutlu, M. & Özel, M. (2008). Sınıf öğretmen adaylarının çiçekli bitkilerin büyüme ve gelişimi konuları ile ilgili anlama düzeyleri ve kavram yanılgıları. Journal of Kastamonu Education Faculty, 16 (1), 107- 124.

Sadler-Smith, E. (1996). Approaches to studying: Age, gender and academic performance.Educational Studies, 22, 3, 367-380.

Türkmen, L., Dikmenli, M. & Çardak, O. (2003). İlköğretim öğrencilerinin bitkiler hakkındaki alternatif kavramları. Journal of Social Sciences, 5(2), 53-70.

Uşak, M. (2005). Fen bilgisi öğretmen adaylarının çiçekli bitkiler konusundaki pedagojik alan bilgileri. (PhD thesis). Gazi Üniversitesi Eğitim Bilimleri Enstitüsü, Ankara.

6. Tables

Table 1: Interrelation between Answers of Students about Plants and Gender

Plant parts	Strawberry		Onion		Spinach		Cherry		Carrot		Potato		Achene	
	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female	Male	Female
Fruit	15	18					16	24			0	1		
Flower		2											4	7
Leaf	2	1			14	20	3						7	2
Leaf or pollen													1	6
Pollen													1	2
Root	2		16	13	7	3	2		24	20	19	11	2	1
Seed													1	
Stem	6	4	9	12	4	2	4	1	1	5	6	13	2	
No answer													7	7
TOTAL	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**	**25**

Table 2: Interrelation between Answers of Students about Plants and Parents' Educational Level

Parent's education level	Correct answer percentage						
Mother - Father	Strawberry	Onion	Spinach	Cherry	Carrot	Potato	Achene
College-college	100%	0%	100%	100%	100%	100%	0%
College-primary	100%	50%	100%	100%	100%	100%	0%
High school-high school	60%	20%	80%	80%	100%	100%	0%
High school-secondary	50%	0%	50%	50%	100%	75%	0%
No school-primary	50%	50%	0%	50%	100%	100%	0%
No school-secondary	100%	0%	0%	100%	100%	100%	0%
Primary-high school	80%	80%	80%	100%	80%	40%	0%
Primary-primary	63%	38%	50%	75%	75%	50%	0%
Primary-secondary	78%	67%	89%	100%	78%	44%	0%
Secondary-college	0%	33%	100%	33%	67%	0%	0%
Secondary-secondary	70%	40%	60%	80%	100%	60%	0%
TOTAL	**66%**	**42%**	**68%**	**80%**	**88%**	**60%**	**0%**

Table 3: Interrelation between Answers of Students about Plants and Economic Level

Family income	Correct answer percentage						
	Strawberry	Onion	Spinach	Cherry	Carrot	Potato	Achene
<1000	64%	36%	79%	86%	79%	50%	0%
1000-1499	63%	56%	50%	81%	94%	56%	0%
1500-1999	71%	43%	71%	79%	93%	64%	0%
≥2000	67%	17%	83%	67%	83%	83%	0%
TOTAL	**66%**	**42%**	**68%**	**80%**	**88%**	**60%**	**0%**

Table 4: Frequency Distribution of Students Mentions about Fruits and Plants

| Students mentioning about fruits and plants	Number of students
Fruits and vegetables are very important for people.	2
Green fruits are vegetables.	1
We eat vegetables' leaves but we do not eat fruits' leaves.	1
Fruits have kernels but vegetables do not.	1
Fruits are sweet bur vegetables are not.	9
We eat fruits raw but we cook vegetables.	7
Fruits and vegetables contain vitamins, they make people stronger.	32
Fruits grow on the trees but vegetables grow on the ground.	4
Fruits have fowers and pollens, vegetables have roots.	2

7. Figures
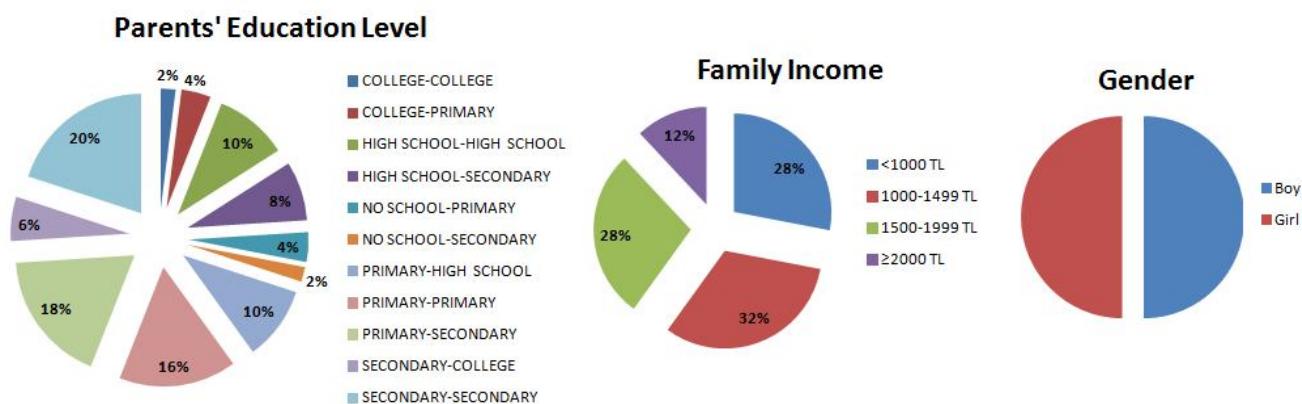
Figure 1: Parents' Educational Level, Family Income and Gender of Students
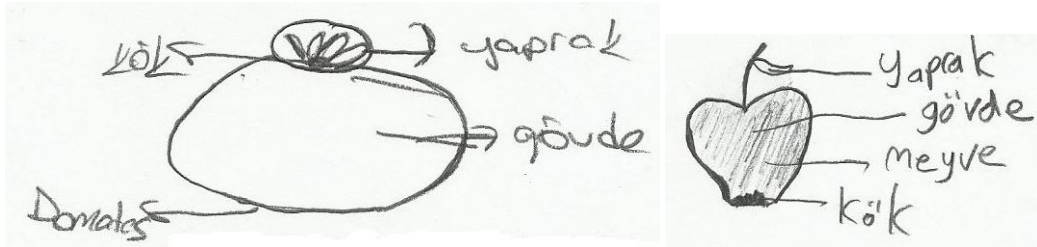
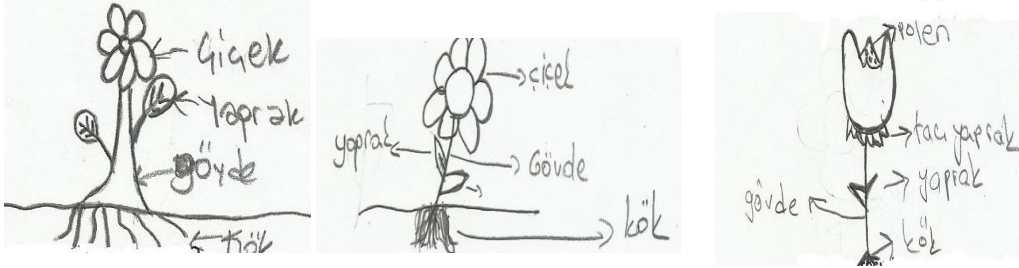**Figure 2: Students' Drawings about Plants (Apple)**

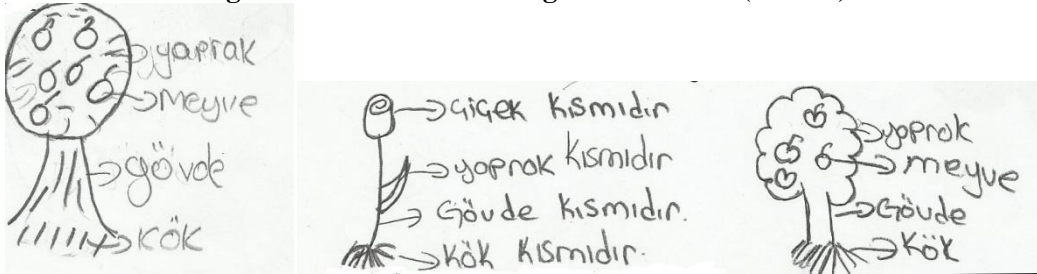**Figure 3: Students' Drawings about Plants (Flower)**

Figure 4: Students' drawings about plants (Tree and flower)

8. Appendix

Survey instrument

1)

Which part of the plant do you see in the picture on the left side?

STRAWBERRY

2)

Which part of the plant do you see in the picture on the left side?

ONİON

3)

SPINACH

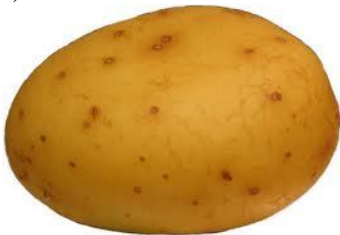Which part of the plant do you see in the picture on the left side?

4)

CHERRY

Which part of the plant do you see in the picture on the left side?

5)

CARROT

Which part of the plant do you see in the picture on the left side?

6)

POTATO

Which part of the plant do you see in the picture on the left side?

7)

You must have seen the plant on the left side before, you puff and feather like fragments start to fly. What do you think they are?

8) Draw a plant and show its parts on them.

9) Why did you draw that plant?

10) What do you know about fruits and vegetables? Give examples…