Summer science camp for middle school students: A Turkish experience

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Abstract

The present study aims to identify the effectiveness of summer science camp experience on middle school students' content knowledge and interest towards biology. For this purpose, two instruments including reflective journal and pre-post questionnaire were developed by four researchers who are expert in science education. Besides, the instruction was observed and students' field notes were taken during the camp by a graduate assistant. These instruments were administered to 48 students enrolled summer science camp which is referred to "Funny Discover of Mysterious World". However, only ten students were randomly selected for preliminary case study. The findings showed that students' understanding developed during science camp. However, their understanding is broadly partial and some of students have misconceptions. On the other hand, science camp had impact positively on their interests toward biology, their career decision and perception regarding biology and daily life.

Keywords: Biology, science camp, career decision, interest, knowledge

Introduction

Some elementary students struggle to learn science and loss interest in science. Students feel that advanced science is not necessary for their future careers and that they will never use the science they learn in school later in life (Science and Engineering Indicators, 1998). According to the Indiana Department of Education (2009), 65 % of fifth grade students in Indiana passed the science portion of the Indiana Statewide Testing for Educational Progress-Plus exam. This is concern because many of ten jobs within the next several years will rely heavily on a strong background in science (Coveny, 2010). The reason cited for the loss of interest in science by students is that science texts and classroom activities do not appear relevant to the lives of students (Roth, et al., 2006).

A current science curriculum of Turkey is endorsed to engage students in biology/science to use hands-on activities related to daily life. This approach supports students' natural interest in science; students are engaged to connect between biology/science and their life. However, research pointed that there are

some limitations to practice in biology/science classrooms (Çimer, 2004; Adali, 2005; Salman, 2006). First, the time limitation does not facilitate doing these activities (Çimer, 2012). Second, biology curricula, indirectly favour memorization facts (Anderson et al., 1990; Kaya and Gürbüz, 2002; Özcan, 2003; Çimer, 2004). Third, classrooms (for biology settings) do not provide instruction materials for doing these activities (Kaya and Gürbüz, 2002). Thus, students' logical understanding and curiosity cannot be supported and they cannot get opportunities to increase interest in and connect biology/science and their life (Prokop et al., 2007).

The alternative way to improve student' interest toward science is non-formal learning carried out through science centers (Eshach, 2007). The nature of non-formal learning is to provide students opportunities to explore, experience, and interact with others as they learn science in settings outside of the classroom (Dillon et al., 2006, Salmi, 2003, National Research Council, 2009). Non-formal learning occurs in a planned; however, highly adaptable manner in institutions, organizations, and situations beyond the spheres of formal or informal education. It shares the characteristic of being mediated with formal education, but the motivation for learning may be entirely intrinsic to the learner.

The impacts of non-formal science education programs can serve as a domino effect. Increased interest in science developed by students in these education programs can enable to the improvement of a more positive attitude to learn science, which in turn, can affect students' attitudes towards science in a formal context. Students that express a positive attitude toward learning science and science in general might be more likely to take learning outside of the classroom and learn on their own. Learning on their own, outside of the classroom, may lead to experiences that can shape individuals' career aspirations and personal actions and lead them down a pathway to science careers (Fenichel and Schweingruber, 2010).

Many non-formal science education programs such as summer science programme and camp provide students with opportunities to explore and build a foundation of knowledge and motivation. Several studies examined the effectiveness of non-formal science learning (Dillon et al., 2006; Rickinson et al., 2004). Gibson and Chase (2002) found that longitudinal, 2-year impact of an inquiry-based science summer programme positively influenced middle school-students' attitudes toward science. An increased interest for science was detected for students who were experienced the summer science programme than students that did not. Knox

et al. (2003) examined effects of relative short lasting (2–4 weeks) science summer programme in high school students; post-test scores of participants revealed that their knowledge and skills in science were significantly increased. Subsequent study of Markowitz (2004) confirmed that effects of summer science programmes had a long-term impact on students' attitude and interest in career in science.

In the literature, researchers usually focus on children's interest and attitude changes towards science as a result of summer science programmes. Researchers are not interested adequately in questions such as what the child thinks he/she will gain from his/her experience in summer science programmes science. While some researchers found that learning in summer science programmes is ineffective (Kubota and Olstad, 1991), others have argued that students constituted extremely valuable learning outcomes (Ayres and Melear, 1998; Ramey-Gassert et al., 1994). Realizing that children gain knowledge as a result of experience of science programme is important. However, I feel that it is also important to seek out a theoretical explanation with regard to the potential for increased understanding of scientific concepts as a result of science programme. This might help educators to improve their designing of scientific fieldtrips to be more efficient.

Science programme which is occurring non-formal learning of science is new theme for many researchers specifically in Turkey while its importance of has been increased rapidly in modern societies (Prokop et al., 2007). Hence the results of this study can be incorporated in short and long-term summer science program development. In the short term, the results of the study can be incorporated into the effective planning, design and evaluation of new programs. On a broader level, the results from this study can aid in the improvement of program planning, design and evaluation, which will better serve the thousands of children nationally through non-formal science education programs.

This study describes a preliminary study discover impact of on the middle school students' knowledge and interest biology as well as effect on their career decision regarding biology and perceptions of biology. Within the context of a summer science program, held at the Recep Tayyip Erdoğan University as a project, and supported by TUBITAK (Scientific and Technological Research Council of Turkey), this research was conducted and mainly research questions in below were investigated:

- How did biology day activities effect on the middle students' knowledge at the end of the biology day?

- How did biology day activities effect on the middle students' interest in biology at the end of the biology day?
- How did biology day activities effect on the middle students' career decision regarding biology and perceptions of biology day activities?

Methodology

This study was conducted to investigate the effectiveness of summer science camp experience on middle students' content knowledge and attitude towards biology. For this purpose, a descriptive case study methodology was implemented. The descriptive case study is used to describe an intervention or phenomenon and the real-life context in which it occurred (Yin, 2003).

Data were collected from three sources to examine the effectiveness of summer science camp on middle students' content knowledge and identify their attitude towards biology. The data sources included 1) a pre and post questionnaire (included open-ended questions) which was used to determine students' interest in biology and whether or not there is a connection between biology and daily life in students' mind before and after the camp, 2) reflective journals to identify students' learning and perceptions of their performances while performing the biology day, and 3) observation which is used in instruction during the biology day (see Table 1).

Table 1. Timeline of Research Questions and Data

Research Questions	Pre-test questionnaire	Reflective Journal	Observations	Post- test questionnaire
How did biology day activities effect on the students' knowledge at the end of the biology day?		P	S	
How did biology day activities effect on the middle students' interest in biology at the end of the biology day?	P		S	P

How did biology day activities effect on the middle students 'career decision regarding biology and perceptions of biology day activities?	P		S	P
Data Collection Time	One week before science camp	During the science camp	During the science camp	One week after science camp

P: Primary data source, S: Secondary data source used to answer the research questions

Setting and participants

This study was implemented at Recep Tayyip Erdoğan University, Faculty of Education, in Rize, Turkey. The participants of the camp consisted of 48 middle school students who completed 7th grade. However, only 10 students selected randomly from the population of 48 participants for this study. The students were selected from five different middle schools and taking into account their teachers' recommendations including students' interest against science. In accordance with the teachers' recommendations students who have a negative interest against science and at the same time are volunteered to attend the science camp. Table 2 represents the descriptive information related to participants. All names shown in the Table 2 are pseudo names. The names of the schools are shown as U-A, U-B, U-C, and P. Whilst U represents urban schools, P represents private school.

Table 2. Ten students' descriptive information

Name	Type of School	Sex	Age	Name	Type of School	Sex	Age
Nurcan	U-A	F	13	Selin	U-B	F	13
Elif	U-B	F	13	Cagri	U-B	M	13
Ismail	U-B	M	13	Ipek	U-C	F	13
Zeynep	U-A	F	13	Deniz	U-C	F	13
Salih	P	M	13	Mertcan	U-C	M	13

U: urban, P: private

The participants attended a camp referred to "Funny Discover of Mysterious World' which was funded by TUBITAK (Scientific and Technological Research Council of Turkey). The camp was carried out in two weeks. Each session has lasted one week. Whilst all activities were carried out at Faculty of Education for the four days of each week in science camp, the last day of each week was carried out at different places such as a museum, an aquarium, a bird conservatory and a butterfly garden where were located at Rize district.

Two factors were considered while selecting the content of the biology day activities as well as other science activities. Firstly, the concepts were identified from popular and attracted biology topics such as cloning, DNA, blood, and microorganism to increase students' motivation in participating these activities. Secondly, concepts of many activities were selected among the topics which students have not seen before in their formal learning environment except blood topic. Table 3 represents the content of biology day including learning activity types and concepts.

Table3. Content of biology days

Name of activities	Type of activity	Individual /Teamwork	Concepts
Strange DNAs	Experiment	Individual	DNA, nucleus, cell, chromosome
Let's make DNA and eat	Model	Individual	DNA bases, deoxyribose, Phosphate, DNA pairs
Let's clone a mouse	Simulation experiment	Teamwork	Nature of cloning
Let's make blood with candies	Model	Teamwork	Blood cells, functions of them, plasma, inorganic matters, food, hormone
What is my blood type?	Experiment	Teamwork	Blood types, identification of blood type
Bacteria and virus features	Model and Drama	Teamwork	Bacteria and virus features(growth, structure of cell, tolerance)
Bacteria cultivation	Experiment	Individual	Bacteria's living areas

A faculty member and five graduate teaching assistants were available to help the students during implementations. The faculty member and the others were expert in science education such as physics, chemistry, biology and environmental science

fields. They performed as team coach for each team. Except them, three graduate students worked as a research team to collect data for this study. Whilst one of them observed the students during the biology day, the others implemented pre and post-test questionnaire and collected reflective journals which students have written for each day.

All participants from five different schools (U-A, U-B, U-C, U-D, P) consisting of private and urban schools district of Rize completed a pre questionnaire in a meeting held before the science camp to determine their interest in biology and their perceptions about biology and their daily life. The students' performance and behavior were observed then field notes and photos were collected to determine their performance. When the biology day was completed students were asked to write reflective journal to determine their perceptions about their learning during biology day. Reflective journal took time around 60 minutes. The students completed the post questionnaire in a meeting which was held after the science camp done. Both pre and post- test questionnaires lasted around 50 minutes.

Data Collection Tools

To answer our first research question— How did biology day activities effect on the middle students' knowledge at the end of the biology day? —It was asked students to write reflective journal about their learning and performances at the end of biology day (see table 3). In addition, it was observed their performance by using field notes and photos (see Appendix 1 and 2). Because students have not seen the concepts which are thought in biology day activities except the concept of blood in their formal learning, the pre-test examining students' preliminary knowledge was not applied.

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To answer our second and third research question— how did biology day activities effect on the middle students' interest in biology at the end of the biology day?, and

how did biology day activities effect on the middle students' career decision regarding biology and perceptions of biology day activities?—It was used pre-post questionnaires included open ended questions (see Table 4). Pre and post questions were asked about students' interest in biology, their association between biology and daily life and also their career decision regarding biology. Also it was observed their behavior by using field notes and photos.

The validity of the instruments was established by one researcher in the field of biology education via using questionnaire queried whether the items in reflective journal and pre-post tests were relevant to the goal of the study. There was an explanation part which enables him to write his comments. Revisions were made according to his comments and suggestions.

Data Analysis

Qualitative content analysis method was used to provide descriptive statistics of the students' response about their knowledge and interest toward biology using pre-post questionnaire and reflective journal. Based on the analysis, students' understanding related to biology day activities in reflective journal were coded as correct, partial, misconception and no response (Abraham et al., 1992; Ayas, 1995; Ayas, 2001). The categories were given in a form of a frequency table which encompassed direct quotes as well. During the coding process, the researcher and an expert in biology education viewed the students' response independently several times. Next, the results were compared across the two coders' output. The agreement of two coders was found % 87.3. There was almost complete agreement, with just a few discrepancies related to students' content knowledge in some topics. These discrepancies were resolved after a meeting, resulting in complete coder agreement. After the frequencies were tabulated for each code, their responses were analyzed qualitatively to develop themes relating to perceived knowledge and interest toward biology. This involved constant iterations between the data and emerging themes to ensure soundness of fit (as per Schilling, 2006).

Table 4. Open-ended Questions in Pre-Post Test and Reflective Journal

Pretest	Reflective Journal	Posttest
Before Science Camp	After Biology Day	After Science Camp
I'm interested in Biology. Because;	What have you learned about the fallowing activities?	I'm interested in Biology. Because;
I'm not interested in Biology. Because;	Strange DNAs	I'm not interested in Biology. Because;
I think that Biology is related to daily life. Because;	Let's make DNA and eat Let's clone a mouse Let's make blood with candies What is my blood type?	I think that Biology is related to daily life. Because; I think that Biology isn't related to daily life. Because;
I think that Biology isn't related to daily life.	Bacteria and virus features	You write quickly what Biology is related to
Because; You write quickly what Biology is related to	Bacteria cultivation	Dou you want to choose a job related to Biology? Why?

Results and Discussion

The students' knowledge in biology day activities

The students' understanding in terms of broad category was classified such as blood, genetic parents, bacteria, virus and process of activities. The listing of numbers for correct/partial/misconception/no answer replies is across these categories. As seen table 5, their responses were very varied and limited to each sub category.

Table 5. The students' understanding content knowledge about all activities in Biology day

Broad Category	Correct	Partial	Misconception	No Response
	n	n	n	n
Blood cells	3	5		2
Functions	3			7
Blood plasma	1			9
Blood	7	5	-	1
Structure of DNA	1	1		8
Location of DNA	2	1		7
DNA bases	4	1		5
DNA pairs	3			7
Chromosome		2		8
Gen	2			8
Monohybrid cross	1			9
Nature of Cloning	1	5	1	3
Genetic Parents	6	5	1	-
Structure of cell		1		9
Growth	2			8
Living areas	1		1	8
Diversity	2			8
Tolerance against antibiotic			2	8
Bacteria	5	1	2	3
Living area	2			8
Diversity	1			9
Tolerance against antibiotic	1			9
Virus	3	-	-	7
Strange DNA	2	2		6
Blood type identification	2	4		4
Lets Clone a mouse	1	6		2
Bacteria Cultivation	2	1		7
Process of Activities	4	8	-	-

For blood concept, whilst 7 students gave correct answers, 5 students gave partial correct answers. The students have no misconception and only one student did not mention about blood concept. Some students' correct and partial correct answers were given below.

Correct answers:

I learned that erythrocyte red color in blood and oxygen are carried by erythrocytes and also I learned that the role of white blood cells is to defense body against microbes. Moreover, I learned that the role of thrombyetes is to clott the blood in human body (Mertcan).

Partial correct answers:

I learned that Erythrocyte gives red color to blood and white blood cell fight microbes (Deniz).

For concept of genetic parents, whilst 6 students answered correctly, 5 students answered partially. Moreover, one student had misconception. The student stated that the mouse has same amount of chromosome with human. The following quotations show some students' correct and partial correct answers.

Correct answers:

In the activity of "Let's clone a mouse", firstly we took out nucleus of the mouse which gave away somatic cell. Secondly, we took out nucleus of the other mouse which gave away egg cell and got rid of nucleus of the second mouse. Thirdly, we put the nucleus of the first mouse into egg cell of second mouse when the fusion between the egg cell and the first mouse's nucleus occurs, Morula is formed. (Nurcan)

Partial correct answers:

We saw surrogate mother, nucleus, ovary, baby mouse and cloning stage. (Selin)

Misconception answer:

One of them drew on his reflective journal following figure as interpreting cloning. He considered that mouse have 46 chromosome similar with human (see figure 1)

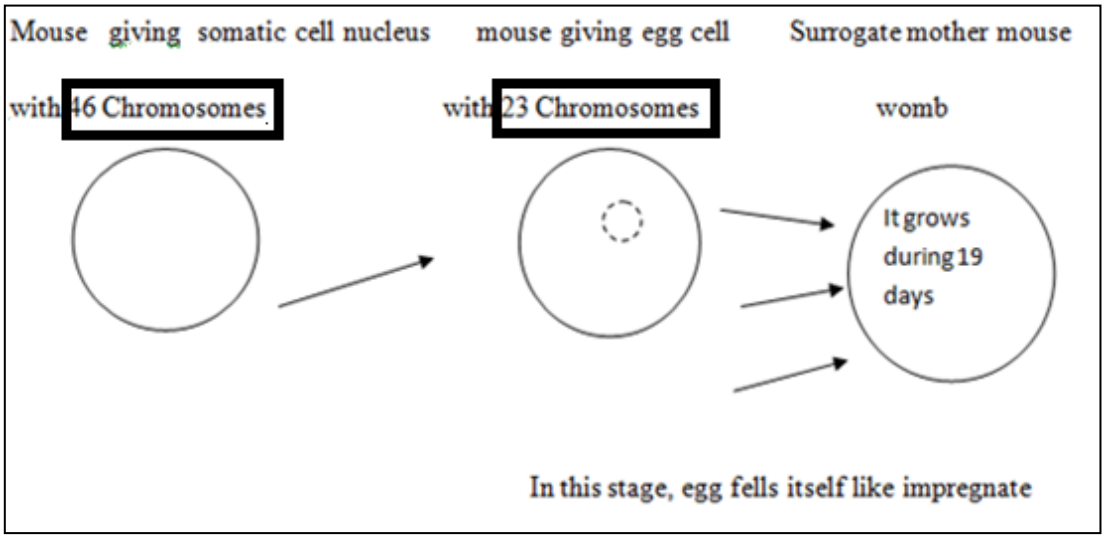

Figure 1. Çagrı's drawing on reflective journal (translated to English)

Regarding the concept of genetic parents as broad category, the students did not represent comprehensive understanding particularly about cloning. Field notes during observation supported this finding. Some students said: 'The stages of cloning were very difficult and confusing'. The reason of that the students faced first cloning including many abstract and complexes concepts in science camp. Similarly, Wenville and Donovan (2007) stated that one potential reason for this occasion might be the submicroscopic and abstract nature of the concepts of the genetics. However, most students were surprised during the activity referred to "let's clone a mouse". The students were very curious about how the mouse's cell can be extracted and transferred to another mouse. They wondered especially about how a mouse's could have the same features such as sex after being cloned. Therefore, they asked a lot of questions in this step to understand the process. This might indicate that cloning activity is an effective motivational factor which got students' attention. Therefore, the students interested in biology even if it is confusing for them.

For concept of bacteria, whilst 5 students stated the correct answer, one student stated partial correct answer. Besides, 2 students had misconception. The students who has misconception stated that bacteria are not affected antibiotics like virus. Also, 3 students did not mention about bacteria. Some students' answers were given below to show their correct, partial correct understandings, and misconceptions.

Correct answer:
I learned that useful bacteria exist, such as bacteria providing fermentation of

yogurt. I learned if we expect swab anywhere to called bacteria and then cultivate it (Salih).
Partial correct answer:
I learned some features of bacteria such as its living areas and their reproduction period (Zeynep).
Misconceptions:
I learned that bacteria are not affected by antibiotic (Selin).
I learned that bacteria grow at that same time viruses do not affected by antibiotic because they live in vivo (Deniz).

For concept of virus, whilst 3 students gave correct answers, any of the students gave the answers related to partial correct and misconception categories. Besides, seven students did not mention about virus concept. The followings include some students responses related to correct and partial correct categories.

Correct answer:
I learned that virus lives inside the cells (İpek).
Partial correct answers:
We understand the life cycle of the bacteria and the viruses (Salih).

During the Drama time, the students read poetry related to features of bacteria and virus while they were performing role of virus and bacteria. As a result of this, whilst majority of the students showed a considerable understanding on some features of bacteria and virus, a few of them did not understand these concepts. One potential reason of this might be that activity of drama time is performed as group because in group activities, the students can encourage each other.

For the process of activities, whilst 4 students answered correctly, 8 students answered partially. Also there is no misconception about the process of activities.

Correct answer:
I learned how to identify blood group. First we dropped three drops blood on lam, and then we dropped Anti A on one of blood drops, Anti B on other of blood drops and Anti D on the other. Than if sedimentation occurs in A, it means A protein exists. On the other hand, if sedimentation occurs in B, it means B protein exists. However, if sedimentation does not occur in D, it means Rh factor is negative. If sedimentation occurs in D, it means Rh factor is positive (Elif).
Partial correct answer:

> I learned if I drop some chemical matters on blood, I can identify which groups they are. I had the result of which group exist in sedimentations (İsmail).

While the students' understanding in some categories (topic) was depth such as genetic parents, blood, process of activities and bacteria, only three students showed understanding about virus. The students represented correct understanding about blood (7), genetic parents (6), bacteria (5), process of activities (4) and virus (3), respectively. Also, they indicated partial understanding about process of activities (8), genetic parents (7) and blood (5) whereas there was not partial understanding about bacteria and virus. Besides, these findings showed that misconceptions identified in some biology topics such as cloning, bacteria. It is believed that most of the misconceptions are originated from students' experiences from daily life. The commonality of the misconceptions across different populations suggest that outside effects such as instructional practices, textbooks and the excessive reliance on everyday language should be considered as potential sources of misunderstandings (Yalçın et al., 2009). The other potential reason for the misunderstanding is that genetics and bacteria concepts are submicroscopic and abstract.

One of the interesting finding which the students mentioned in their reflective journal is that how the process of biology day activities occur instead of what knowledge they learn from each biology day activity. This showed us that reflective journal prompted some questions which are required to revise for future study.

The students' interests toward biology and career decisions related to biology

During the pretest, 3 students indicated that they were interested in biology, but this number increased to 9 for the post-test (see Table 6). The research have pointed out that similar results were found in some studies which conducted with quantitative approach (Gibson and Chase, 2002; Knox et al., 2003; Markowitz, 2004; Orstein, 2006; Prokop et al., 2007).. On the other hand, this study also investigated why the students changed their ideas, which this is a different investigation from the other studies done in this field. Moreover, in the pretest, students who were not interested in biology argued that it was hard, boring and they did not like it.

Table 6. Students' interest towards Biology in the pre and post test.

Pre- test		Post-test	
I am interested in biology	3	I am interested in biology	9
I am not interested in biology	7	I am not interested in biology	1
I want to chose a job related to biology	1	I want to chose a job related to biology	4
I don't want to chose a job related to biology	9	I don't want to chose a job related to biology	6

Whilst 7 students stated that they were not interested in biology in the pre-test, only one student stated that he was not interested in. This result shows that students changed their opinion against biology in a positive way. They explained the reason for changing their ideas as that they liked the activities such as DNA, cloning, blood types. They also stated they found biology fun, feat, amusing, and enjoyable. The only student who did not change his mind about biology argued that biology was more boring than the other science subjects. Some students' responses were illustrated below:

> '..before I came to the camp, I had not liked some biology topics. However, after camp all of my ideas changed. Biology is so funny lesson. But I didn't know it before.' (Mertcan)
> '..because we performed a lot of activities which I didn't know before. The most attractive for me to learn is that our blood types by dropping anti A, anti B and anti D.' (Zeynep)
> ' I learned DNA and how to clone a mouse. It was a great experience for me.'(Çağrı)

While only one student stated that she wanted to choose a career related to biology in the pre-test, 3 more students showed their interest against biology related to career selection after the biology day activities. The students stated the reasons of their interests in career regarding biology as their curiosity on living things, DNA, and cloning. In addition, they highlighted that they were interested in biology because it gives them a lot of knowledge about the living things. The others who they didn't want to choose biology-related career explained their reason as they wanted to chose other jobs such as computer science, policeman, math teacher. In general, Biology and science are not considered attractive careers (Prokop et al. 2007). In this context, we can say that this science camp has impact on students' career decision. Science camps like this may be a trigger interest biology related career. Similarly, a report on

the evaluation of the National Science Foundation Informal Science Education Program pointed out that many adults with science –related careers credit their initial interest in science to these non-formal programs such as science camps (NSF, 1998).

As seen table 7, in biology pretest, seven students found that biology is related to daily life; on the other hand, in the post-test nine students thought that biology is connected to daily life. Besides, in pretest and post-test, the students who considered biology is related to daily life argued that biology is connected with living things, systems, diseases and feeding.

Table 7. The students' perceptions whether Biology is related to daily life or not.

Statement	Pretest		Posttest
Biology is related to daily life	7	Biology is related to daily life	9
Biology is not related to daily life	3	Biology is not related to daily life	-
No response	-	No response	1
Total	10	Total	10

*One student who thought biology related to daily life during the posttest did not answer the same question for the post test.

In the pretest, three students found biology is not related to daily life. However, in the post-test, none of students argued that it is unrelated to daily life.* In pretest the students stated that biology contains useless knowledge and also most people can't use the knowledge which they learned in their daily life. This result showed consistency with Science and Engineering Indicators' report (1998).

Even though students gave 18 indifferent concepts in the pretest, the number of indifferent answers decreased to 8 in the post test (see Table 8). Moreover, in pretest, the concepts given by students related to biology are environment, fungi mold, bacteria, health, human, biology laboratory, life cycle, ecosystem, diseases, hospital, muscles, birth, blood pressure, reproduction, energy, organism, blood types, and DNA. However, in the post test, the concepts given by students related to biology are that experiment tube, mouse, microscopic living things, simulation, bacteria cultivation bones, organs, and eyes.

To illustrate, whilst only one student thought that DNA is a related biology concept in the pre-test, this number increased to 8 in the post test. Besides, whilst none of the students thought that bacteria, virus, blood type and cloning were related to biology in the post-test, some students (7, 7, 6 and 4 students, respectively) found

that these concepts are related to biology. This finding showed that the content of biology day activities might affect students' perception of association between biology and daily life.

Table 8. The concepts of students connected with biology

Connected Concepts	Pretest	Connected concepts	Posttest
Cell	5	DNA	8
Living things	6	Bacteria	7
Plants	4	Blood	7
System	3	Virus	6
Animal	3	Cell	5
Science technology	2	Cloning	4
Life	2	Our body	3
Our body	2	Blood type	2
Bones	2	Animal	2
Others *	18	Others	8

*One response

To illustrate, whilst only one student thought that DNA is a related biology concept in the pre-test, this number increased to 8 in the post test. Besides, whilst none of the students thought that bacteria, virus, blood type and cloning were related to biology in the post-test, some students (7, 7, 6 and 4 students, respectively) found that these concepts are related to biology. This finding showed that the content of biology day activities might affect students' perception of association between biology and daily life.

Which activity or activities did you perform best in Biology day/ which activity or activities were you forced in Biology day?

As seen Table 9, five students thought that the activity referred to 'Let's make DNA and eat' was the best one. They stated that the activity was very enjoyable. Besides, they indicated that they matched DNA sequence correctly, understood the structure of DNA very well. Four students thought that the activity referred to 'strange DNAs' was the hardest one. It was caused that they had an experience with DNA first time during the activity and to gargle salty water was hard for them because that was pretty bit. None of students thought that the activities referred to "strange DNAs", "Let's make blood with candies" or "Drama time: Bacteria and virus" were the best ones. Surprisingly, none of them found that the activity referred to "Let's

clone a mouse" was the hardest one. However, field notes which are undertaken during observation argued that the student had difficulty in understanding the nature of cloning. The reason of this might be that they did not evaluate this activity taking into account the content of it. One of the students chose more than one activity as the best and the hardest activity.

Table 9. The students' perceptions about the best and the hardest activity

Activity	Best	Hard
Strange DNAs	-	4
Let's make DNA and eat	5	1
Let's clone a mouse	3	-
Let's make blood with candies	-	1
What is my blood type?	1	1
Drama Time	-	2
Bacteria cultivation	2	2

Implications

The present study identified the effectiveness of summer science camp experience on middle school students' knowledge and interest towards biology. The findings showed that middle school students' understanding increased; however, their understanding is mainly partial and also some of students have misconceptions. Although it is not appropriate to generalize from a single preliminary study, the findings suggest that misconceptions identified in this study can be seen elsewhere. This might help the researchers who want to conducted research in future. Identified misconceptions in this study and the others in biology reported in the literature should be considered while designing future science programs again.

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Appendix

1: A photo of Strange DNAs Activity

2: Some field notes taken during biology day activities (translated to English)

During the pretest, 3 students indicated that they were interested in biology, but this number increased to 9 for the post-test (see Table 6). The research have pointed out that similar results were found in some studies which conducted with quantitative approach (Gibson and Chase, 2002; Knox et al., 2003; Markowitz, 2004; Orstein, 2006; Prokop et al., 2007).. On the other hand, this study also investigated why the students changed their ideas, which this is a different investigation from the other studies done in this field. Moreover, in the pretest, students who were not interested in biology argued that it was hard, boring and they did not like it.

Activity of Strange DNAs

They were surprised the beginning of the activity of strange DNAs when team coaches said today 'we will see our DNA clusters' most of them responded: what is DNA? Some of them asked: How can we see DNA without using a microscope? It is impossible.

Students didn't reveal their preconceptions about DNA because most of them didn't know anything about DNA. Little of them said I have heard DNA. But I don't have

any idea about it. They had fun in this activity. Responses of some students at lunch break:

I was the most surprised during strange DNAs activity. I didn't think that we could have done this type of important activity so easily with our own equipments. I was amazed to see how successful we were in carrying out such an experiment.

I was surprised much during the activities of strange DNA. In the activity of strange DNA, I was surprised to learn so long DNA is inside small chromosomes in nucleus.

I had the most fun during strange DNAs activity. I accomplished the results myself as applying step by step our team coach point out.

Activity of Let's make DNA and eat

This activity was fun for most students. While they were making DNA they seemed very excited and careful. They enjoyed to eat it at the end of activity. As they were eating it one of them said "It was hard for me to stick marshmallows. However it was great first to learn Adenine, Guanine, Cytosine, deoxyribase, phosphate" One of them said: I had fun much during the activity of lets make DNA. Because first time I learned knowledge about DNA and I like much making DNA with marshmallows.

Activity of let's clone a mouse

Most students were surprised during let's clone a mouse. How to can be the mouse's cell extracted and transferred to another mouse? They wondered especially about how mousses could have the same features such as sex after being cloned. Some students said: 'The stages of cloning were very difficult and confusing'.

Most of them surprised much during the activity of lets clone mouse. Some of them said: I feel like cloning a real mouse. They wondered how to be cloned Dolly. Gulsah lecturer explained as using computer software contains animations about cloning process. Most of them firstly didn't understood very well. Then lecture repeated. They asked a lot of questions in this step to understand process. Some of them said: it is so confusing. Some of them said: I supposed that cloning was so easy however it was not that. They looked very impatient to start simulation experiment. They cut and pasted mousses' egg cell and somatic cell. Each team prepared poster explaining mouse's cloning process and then presented their team coaches.

Activity of Lets make blood with candies

It was so easy for students to do this activity they had fun. Some of them said

candies are similar cells of blood such as erythrocytes and white blood cells. Some of them complained this activity is so easy for us. While they were making blood model team coaches asked teams guide questions about their roles in body. Most of them responded these questions. However they didn't reveal preconception about plasma and thromboses and its roles.

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Activity of what is my blood type?

Today It seemed that the teams liked and had fun during this activity. During this experiment, they identified their blood types. While most students enjoyed this activity others thought that it was boring. No one in two groups was volunteer to give blood. They said 'we think that It is painful'. The students in another team gave their blood for these groups to use. They tested these bloods. At lunch we asked them how is biology day going? They said All activities were hands on activities we had never done and heard before.

Some students said It is great to identify our team mates' blood types, learn about how to identify blood types and have fun while doing these. Some of them said it is surprising. I am learning my blood group as using various stuffs, not only I learned my blood group but also how to identify blood group.

Activity of what is my blood type?

In this activity male student was bored while making sock puppet. It was so hard for them to buttonhole for puppet. Team member shared their roles while making puppet. Most male students weren't interested in sewing button. And all teams performed drama as given poetry consist of bacteria' and virus' features. Some teams performed.

Bacteria Cultivation

The students were curious to cultivate bacteria and about petri which bacteria grow. It was interesting to see petri. All students haven't seen before it. They were surprised bacteria cultivation activity. They learned new knowledge about bacteria. For example one said that I learned that we could cultivate bacteria and they could

multiply so much that we could see them. Because I didn't know anything about bacteria cultivation and realized it was enjoyable to cultivate bacteria. On the other hand one of them said I was bored during the activity of bacteria cultivation. Because I worried about jug which we cultivated since it might be harmful.