THE USE OF EDIBLE SCIENCE PROJECTS IN TEACHING SCIENCE CONCEPTS

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ABSTRACT: Students have difficulty in learning the concepts of science and similarly teachers have difficulty in teaching the concepts of science. In order to overcome these difficulties, different teaching methods are tried and it is attempted to attain success. Educators usually study the question of "how can we provide an easier and more permanent teaching?" As a solution to this problem they agree that activities which draw the attention of the students and which the students get pleased and entertained while doing enable the effective learning in teaching the concepts of science. In this regard project-based learning is one of the effective methods. However, it is not often preferred by the teachers due to the problems in the supply of materials and being long-term activities. Thus, primarily students were made to experience a scientific process by using the processes of project-based learning and a method which had an easy and cheap material supply was used in the study. By using the materials which everyone could buy easily and in a cheap price, senior students of Education Faculty were made to do edible projects. For these projects, students were divided into groups of two people and each group modelled a concept of science that they chose themselves by using edible materials such as sugar, cake, chocolate, pasta. In total, 15 groups of two people developed 26 different projects. These projects were mostly made by using the concepts of science such as cell, DNA, RNA, mitosis and meiosis, brain, atomic models, periodical table, planets, solar system and earth's crust. These projects were later exhibited and they were introduced and presented to the other students in the Faculty. It has been observed that the students' awareness for the concepts of science increased while the projects were being done and exhibited. It has been observed that this presentation drew attention as students tasted the models and shared them with the other students. It is quite important that these projects are introduced and published in order to popularise the use of such projects in all levels of teaching. For this purpose, it is aimed to discuss how these projects are going to be used in science teaching and the contribution of such projects to science teaching by explaining how these twenty-six projects were done.

Key words: Edible science projects, pre-service science teachers, science teaching

INTRODUCTION

While students have difficulty in learning some concepts of science, teachers also have difficulty in teaching them. In order to overcome these difficulties different teaching methods are tried for attaining success. While all educators aim to achieve an easier and more permanent learning, it is generally thought that activities which draw the attention of the student on one side and which the students are entertained with on the other side enable effective learning. It is emphasized in the constructive approach, which is the common education understanding today, that the students should actively be responsible for their own learning and actively participate in the class and the learning activities. In this regard, project-based teaching is one of the effective teaching methods. Project-based teaching method stands out as a teaching method which the students can use by bringing their previous knowledge together with the new knowledge and produce solutions to certain problems in this way. In the studies related to project-based teaching methods mostly results about the effectiveness of the method are reported.

In Yılmaz's study (2015) where he has researched about the influence of project-based teaching approach on the academic success of the students and their skills of scientific process in respect to the "Electricity in our Life " unit of the 6th Grade Science course, it was revealed that the project-based learning is effective in increasing the academic success of the students and their skills of scientific process.

According to the outcomes of the study by Han, Capraro and Capraro (2015), there is a significant increase in the academic successes of the students in the low-success rank group among the high school students who learn through project-based learning applications based on the STEM approach. As a result of another innovative experimental study where project-based learning and STEM approach are used together, it has been reported that

there has been a positive change in the attitudes of the students following the 5 weeks-long implementations (Tseng, Chang, Lou and Chen, 2013).

Moreover, it has been indicated that project-based learning eases the learning of the subject, encourages the students for researching, and contributes to building the cause and effect relation between the learned subjects and daily life problems, to making researches, to forming their knowledge on their own and in short to a more effective and meaningful learning (Erdoğan, 2012). Similarly, according to the results of an experimental study where the effectiveness of the project-based learning method on the subject of genetics is examined, project-based learning method has a positive effect on success, attitude and permanent learning in Science course (Keser, 2008).

On the other hand, according to the results of various studies where the effect of project-based learning method on environmental education, project-based learning method has a positive impact on students' learning, expressing, and attaining general knowledge of the concepts related to the environment (Morgil, Yılmaz and Cingör, 2002; Yavuz, 2006; Erdoğan, 2007).

Hung, Hwang and Huang (2012) indicate in their experimental study of determining the impact of project-based digital storytelling that the success of the students, their motivations for learning and their problem-solving skills have increased. They also point out that project-based learning could be effective in increasing the interactions among the students and giving them more opportunities of learning (David, 2008).

Moreover, 2013 Science Course Teaching Program carries the vision of "bringing up all students as science literate individuals". For this reason, the people to be educated in the program are expected to be individuals who determine the problems, seek for and questions the solution ways, take right decisions for the solutions that they have found and have self-confidence on themselves as they solve the problems. All these require to own knowledge, skills, positive attitude, perception and values about science. Many methods are used to obtain this goal. One of these methods is to produce and present projects about science. While the project is being implemented scientific method is used and the student drives conclusions as to how to solve a problem. However, it is not often preferred by the teachers because of the problems in the material supply and for being long-term studies. When the body of literature is examined, it is observed that there are various problems about project producing and that the teachers avoid using this method due to these problems. According to Çelik (2003) the problems related to project producing are the teacher, the program, student-centred administration and supervision problems and physical condition problems (Pektaş, Çelik and Köse, 2009). In this project, it is attempted to introduce the projects related to the scientific concepts produced from edible ingredients as a project which the students and the teacher will want to eagerly implement and doesn't require significant budget and time for finding the material and implementing the project. In this regard, edible science projects produced with the project-based learning method are examined in this study.

METHOD

Concretisation using project processes from edible ingredients is targeted in this study. For this target, edible project samples are implemented on Science Education students from a government university in Teaching Technologies and Material Design class and these projects have been displayed.

ADDIE model from teaching design models has been used in the implementation of this study. ADDIE design model which is one of the anonymous models consists of analysis, development, application and assessment stages (Şimşek, 2009). Assessment possibility which is available in each of the stages in ADDIE model makes room for correction and fulfilment of mistakes and insufficiencies noticed in the process.

Sample

The study group is consisted of 4 male and 26 female senior students studying in the department of Science Education at a government university in Istanbul. These students have studied in pair groups. A total of 15 project groups has been formed.

Study Process

The study has been implemented in 2015-2016 fall term. Teaching Method and Material Design is a course taught in the last grade of Science Education department. This course taught by researchers consists of three stages. The course is taught under the titles of preparing and using classical course material in teaching, using technology in teaching and developing projects in teaching. For the third stage of the course the students are given a theoretical lesson about producing science project on scientific concepts and project-based teaching during two hours-lesson

in the beginning of the term. In this study, teacher candidates have prepared science projects related to basic science topics by using completely edible ingredients. The aim in these projects has been determined as concretisation of especially the scientific concepts with which the students have difficulty in comprehending with the use of project processes within the teaching methods and material design class. In the analysis stage of ADDIE Model, the teacher candidates primarily searched about on which topics they can prepare a model/project from the topics that the primary school students have difficulty in comprehending and what they would need for preparing this model/project. In the design stage, they have prepared their projects by using completely edible ingredients. In the development stage, teaching faculty members have given feedback to the students about the insufficient and wrong parts of their projects following the pre-assessment and the projects are made to be more complete in their final forms. In the application stage, the projects have been displayed in the faculty and the opinions of teacher candidates and faculty members from both the science education department and other departments have been asked. In the assessment stage these opinions have been examined and final improvements on the projects have been planned. In the study the introduction and dissemination of these exhibited projects are targeted. Table 1 shows the project-producing process and timing.

Table 1. Project producing process and timing

Time	Work
1st and 2nd Weeks	Theoretical presentation of project-based teaching and project producing steps
3rd Week	A sample project presentation
4th Week	Determination and submission of project suggestions
5th Week	Assessment and Admission of project suggestions
6th, 7th and 8th Weeks	Researches about the project and studies on its production
9th Week	Experiment of the production of the projects and their display (pilot work)
10th Week	Presentation and Exhibition of the projects

Each group has prepared different numbers of projects according to the difficulty level of their projects. The following Table 2 shows the names and the fields of the selected projects.

Table 2. Project groups and subjects

Group	Project Name		Project Field
Group 1	Plant Cell Model		Biology
	Skin Layers Model		
Group 2	German Cake Experiencing Meiosis		Biology

Group 3	Atom models		Chemistry
Group 4	Solar System Pasta		Astronomy
	Eye model Cake		Biology
Group 5	The Phases of the Moon Cookie		Astronomy
	Life Cycle of the Butterfly		Biology
	Life Cycle of the Frog		Biology
Group 6	Lungs Model cake		Biology

	Hand and Foot Skeleton Cookie		Biology
Group 7	Edible RNA		Biology
	Edible Atom Model		Biology
Group 8	Plant Cell Cake		Biology
	Cup Cake Scientific Concepts		Science
Group 9	Candy DNA		Biology
	Brain Cake		Biology
Group 10	Periodical Table Cake		Chemistry

Group 11	Muffin Mitosis		Biology
	Animal Cell Cake		Biology
Group 12	Chocolate Planets		Astronomy
	Animal Cell pizza		Biology
Group 13	Plant Cell pizza		Biology
Group 14	Animal Cell Cake		Biology
	Earth Crust Layers		Geology
Group 15	Periodical Table Cookies		Chemistry

Three of the projects are explained in detail below and their purposes are given.

Example 1

Project Field: Science (Chemistry)
Project Name: Periodical Table
Problem: How to prepare a periodical table model which would arouse interest and curiosity in middle-school students?
Hypotheses: Periodical table model which would arouse interest and curiosity in middle-school students can be prepared as edible cookies.
Purpose: Modelling the periodical table by using edible ingredients.

Preparing the Periodical Table Cookie

Ingredients: 1 pack of margarine, 2 tea glasses of olive oil, 2 packs of vanilla, 1/2 pack of cooking powder, 2 water glasses of starch, 2 tea glasses of powdered sugar, cinnamon, flour, sugar paste, decoration.
Preparation: The ingredients are added in order and a soft dough is made out of them. The margarine is used in the room temperature without being melted. The flour should be added until a soft and not sticky dough is obtained. As the dough, can easily disintegrate, the dough is spread in square forms instead of using moulds. The cookies are put in the oven tray covered with baking paper and they are baked for 25 minutes in the oven set to 180 degrees beforehand. The cookies are removed from the oven when white before turning red. The cookies are coloured by using different colour sugar paste for each group in the periodical table. The sugar paste is spread and cut in the cookie size and put on the cookies. The decorations are left in the warm water for some time. The symbol, name and mass and atom numbers of the elements in the periodical table are written on the cookies and put in row as in the periodical table on a table.

Tips: The butter should be in room temperature while the cookie is being prepared. The cookie can be flavoured with cinnamon etc. The cookies should not be baked more than needed. For sticking the sugar paste on the cookie, honey, water or jam can be used.

Example 2

Project Field: Science (Biology)
Project Name: Plant Cell Model
Problem: How to prepare plant cell organelles from edible ingredients which would arouse interest and curiosity in middle-school students?
Hypotheses: Plant cell and organelles which would arouse interest and curiosity in middle-school students can be prepared from cake and fruits as edible ingredients.
Purpose: Preparing edible Plant Cell and organelles.

Preparing the Plant Cell as a Cake

Ingredients: 2 packs of pudding, 1 kiwi, 2 litres of milk, 1 potato, 1 pack of whipped cream, chocolate pieces, 3 packs of petite-beurre biscuit, bonbon, 1 orange, 1 apple, 1 banana, rectangular glass pot.
Preparation: Firstly 2 packs of pudding and 1 litre of milk are put in a middle-sized pot and are boiled. After the pudding is ready, the biscuits are lined in the glass pot and pudding is poured on the biscuits. The same process is applied for the desired number of layers. Pre-prepared whipped cream in the fridge is poured on the cake and spread. The organelles are formed using the remaining ingredients. The chloroplast is made of kiwi, the cell is

made of orange, the endoplasmic reticulum is made of orange peel, cell wall and membrane are made of bonbon candies, golgi apparatus is made of apple, mitochondria is made of potato, peroxisome is made of mandarin, ribosomes are made of chickpeas and vacuole is made of banana.

Tips: If you prepare the cake and keep it in the fridge one day before serving, the pudding and the whipped cream will have a more beautiful appearance. For the fruits, not to get dry and change their colour, their contact with air should be eliminated. Stretch film can be used for this purpose. The bonibon and fruits on the cake should be placed as late as possible before serving the cake. For not to confuse which fruit represents which organelle their names can be written on them with the help of a toothpick.

Example 3

Project Field: Science (Astronomy)
Project Name: Solar System
Problem: How to prepare solar system from edible ingredients which would arouse interest and curiosity in middle-school students?
Hypotheses: Solar system which would arouse interest and curiosity in middle-school students can be prepared from pasta as edible ingredient.
Purpose: Preparing an edible solar system.

Preparing Solar System with Pasta

Ingredients: Boiled pasta, cucumber pickles, peas, carrot and potato garniture, boiled corns. Boiled potato, carrot, radish, boiled beet, green pepper, red pepper, yoghurt.
Preparation: Firstly, the pasta is boiled. Garniture, corns and pickles are mixed and put in medium-deep pot. The prepared mix is poured on the boiled pasta and mixed together. Finally, the yoghurt is added and all ingredients are mixed together. They are placed inside a deep and rectangular pot in an orderly way and the upper layer of the solar system is made with the remaining ingredients. The sun is made of a big slice of boiled potato, the earth is made of green pepper, Mars is made of red pepper, Venus is made of potato garniture, Saturn is made of white radish, Uranus is made of red radish, Jupiter is made of corns, Neptune is made of beet and Pluton is made of a single pea.

CONCLUSION

In this study, it has been targeted to show the teaching of scientific concepts with the use of science projects from easily found, cheap and edible ingredients by using project-based teaching processes compatible with the scientific process stages. For this purpose, education faculty senior students have been separated to pair groups and each group has prepared science projects using edible ingredients such as candy, cake, chocolate and pasta about a science subject that they have chosen and they have exhibited these projects. As a result of the study it can be said

that the projects related to scientific concepts from edible ingredients have been successfully developed and that the students could complete the projects successfully in accordance with their purposes. The fact that this kind of projects can be prepared from edible ingredients which can be accessed easily and in a cheap way can be thought as a different project method. The students have chosen their project topics on their own and prepared their projects using different methods in consideration of their possibilities and situations. It has been observed that the female students generally prepared the ingredients on their own and the male students mostly preferred to use ready ingredients or had the material done by others. It can be asserted that such kind of projects challenges the imagination of the students and improves their creativity. It is observed that the motivations of the students increase with this kind of projects with reactions regarding their presentation of the projects and the following eating activity despite the small problems experienced during the preparation. One of the most striking results about edible projects is that the students not only use the scientific processes and challenges their creativity but also enjoy the project processes while trying to prepare edible projects as a solution to a problem. The presentation of projects and the following tasting of the projects and the comparisons made between the projects have added entertainment and excitement to the study. In conclusion, it can be said that the students have used scientific process skills, their scientific creativity has improved, their interest, curiosity and motivations have increased and especially that they have enjoyed while preparing the edible science projects. It has been observed that tasting the models that they have prepared following the presentation of the projects and sharing these with the other students have resulted in attracting more attention as compared to other projects. The study by Keser (2008) also suggests that project-based teaching applications have positive impact on success, attitude and permanent learning in Science education. It has been observed that the awareness of scientific concepts in students have increased during the preparation and exhibition of the projects. The study by Acaray (2014) also suggests that the project-based teaching applications have increased the awareness of students about the subject. Some teacher candidates have indicated that they noticed that they had misunderstandings and lack of understanding about the project subject and they have corrected these in this process. According to the results of the experimental study by Yılmaz (2015), project-based teaching applications have positively influenced the academic success of the students according to the control group. Also, there are many studies supporting this conclusion (Morgil, Yılmaz and Cingör, 2002; Yavuz, 2006; Erdoğan, 2007; Cam, 2013, Han, Capraro and Capraro, 2015).

This study is expected to contribute to the related literature and to be one of the first studies analysing the edible science projects as an innovative approach with the potential of being used as a teaching material as well as being one of the projects which the primary school students can prepare within the science class. The introduction and dissemination of these projects which are implemented for the increase of such kind of projects and their use in all grades of education are quite important.

SUGGESTIONS

It is thought that the dissemination of this kind of projects in all stages of education could revive and add entertainment to activities such as science festivals in the middle-schools and that they could increase interest, curiosity and motivation of the students. The implementation of this kind of projects in middle-schools is also possible. However, as it is a cooking activity it can be planned in a way that the parents also participate. It can also be said that there could be more opportunity for the school, the family and the students to socialise in this way.

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