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How is Mathematics Popularized as the Basis of Engineering Education?

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Abstract

Mathematics in engineering is very large areas of use. In fact, it is so much that engineering is the profession that uses mathematics the most. Especially survey engineering is an engineering field that uses mathematical knowledge so much since it has already entered the field of Applied Mathematics as a branch of Science. As a science fiction, mathematics, which has been active in all periods of human history, is a "very lovely" by some of today's students and a "*never loving*" one for some. In this study; a questioner has been conducted on the questionnaire "How is Mathematics endeared?" with approximately 445 students at different grade levels in different schools (Osmaniye İmam Hatip, Anatolian, Science, Social Sciences, etc./Turkey) who teach different types of education in Osmaniye province and 20 mathematics teachers who work in these schools participated. The answers are analyzed and interpreted with Excel graphs, and it is aimed to contribute to ingratiate and liking of the mathematics course in this way. After all; with this study, awareness about mathematics has been formed in teachers and students, negative factors that decrease mathematics success have been determined, everyone has offered suggestions for solution of the problem and it has been reached that mathematics can be ingratiate and liked when appropriate methods and techniques are used.

1. Introduction

There is a historical background that is matched to the history of mankind, science fiction mathematics. It is a fact that it is always used by people, even when it is not known when, where it is shaped and how it is used. Today, every person knows and uses the word "mathematics". Mathematics in our age; it can be likened to a magnificent multi-story building with beautiful architecture and acoustics. Many scholars have contributed to the construction of this building. Most of these scientists have gained an international character, representing the whole world, out of a nationality. Some of those are Euclid, El-Harezmi, Ömer Hayyam, Ebu Reyhan Biruni, Archimet, Ebu Ali İbn-i Sina (Avisenna), Nasireddin Tusi, Ebul Fazl Tebrizi, Ebul Vefa, A. Cauchy, G. Leibniz, Leonard Euler, Friedrich Gauss, Nils Abel, Evarista Galois, Ramanajuan. These great people continue to be a model for anyone interested in science today (Nasibov & Kaçar, 2005). Leonardo Da Vinci, a famous painter and scientist, said about the

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metamorphic: “no research can be worthy of taking the name of Science after math has been proved.”

Mathematics course among students at secondary level in Turkey is not at the desired level. Some of the main reasons for this are that some students do not like mathematics, are not interested, and are prejudiced or unnecessary. Besides, some mathematics teachers do not use appropriate methods according to the availability of learners and they also teach monotonous lessons are among the negative factors.

There are lessons that every person does not like during their education period. Generally, mathematics is an unfavorable course and students are becoming the biggest nightmare in time. Students who are prejudiced against numeric expressions often can’t understand this course clearly and experience problems throughout their school life. For this reason, it is necessary to approach with some numerical point of view. Mathematics is usually composed of difficult subjects, and it is a must to learn with every combination of different phases. Mathematics, which is as easy as the fourth year of elementary school, becomes difficult after this stage and always leaves a question mark on students' minds, and students find that the approach is only directed at verbal learning (URL_1). For many people the difficulty of understanding mathematics is a fearful dream. Since students' success in mathematics teaching is generally low, students are in a negative attitude towards mathematics. Changing the way their mind is a hard lesson to remove the negative factors on mathematics and using different methods may be an effective case (URL_2).

The famous mathematician Einstein said that prejudice is difficult to break down atomic atoms. This prejudice is the duty of the educators to destroy, as well as the duties of the students and the parents in this regard. Many of the people who succeed in mathematics are mathematics-loving people. When the popularity of mathematics is gained, mathematical success is also achieved. A person with good mathematics can think rationally, fluently and rationally. This opens the door to success in other areas and increases the overall level of success in life (URL_1).

In primary and secondary schools, many students find it difficult, uncomfortable and boring to learn mathematics (Sedighian & Sedighian, 1996). Therefore, students do not want to learn mathematics. Studies conducted in Turkey and in various countries; demonstrates that there are many factors that negatively affect students' math learning and math thinking. Some of those; teachers' lack of field knowledge, inability to use effective teaching techniques, low level of students' readiness, interaction with the student's environment, learning environment (Fuys et al., 1988; Messick & Reynolds, 1992; Wentzel, 1997; Freitas & Jameson, 2006; Yalçınkaya & Özkan, 2012).

In our fast-changing and changing world, the prominence of mathematics, which is often seen as a discipline of boring, disliked, and abstract (student language difficult, nightmare,) is increasing quickly. How do we like mathematics? First of all, we need to look at mathematics and lift our prejudices. Because mathematics is everywhere in our everyday life. It's something we buy when we are in buy something, something we use when we cook, we set the scale of the material, or when we build a building, that is, what we use often. So mathematics is not just a number of lessons. Mathematics also includes the ability to see relationships, to establish cause-and-effect relationships, to read and write, to interpret and use tables, pictures, and graphics. Our everyday activities such as solving puzzles and reading newspapers are also about to practice mathematics for us (URL_2).

Learning mathematics at a certain level is a requirement for all students. Mathematics therefore takes a serious place in the curriculum. However, in order for the students to learn mathematics, they first need to find the popularity of mathematics and it is necessary to find the mathematics course meaningful. When the right methods are identified and applied, students learn mathematics more easily, and it becomes easier to learn and teach mathematics.

New alternative teaching methods are being developed instead of methods that have been going on for years in mathematics teaching and can no longer yield. Accordingly, in mathematics education in Turkey; there are being made studies on alternative learning methods and techniques such as computer assisted instruction, collaborative learning, probing based learning, drama and games learning, concept mapping learning, visual learning, full learning model and problem-solving method (Yalçınkaya and Özkan, 2012).

2. Mathematics and Engineering

The people who use mathematics the most are engineers. Engineers are perhaps the most extreme of the Science of Mathematics. They have taken many courses at undergraduate level, such as linear algebra, number theory, differential equations. The basis of engineering is mathematics. It is impossible for anyone who doesn’t know math to do engineering. Engineering; it is the activity of producing solutions in the face of human problems and needs. People who have attained the knowledge to perform this activity are called engineers. Mathematics in engineering is very large areas of use.

The origin of “engineer “in English is the Latin word “ingeniatorem”, which means the creator of the invention. Simply engineering is the application of science to practical problems. ABET (Accreditation Board for Engineering and Technology) definition: “thinking is systematic and mathematical thinking skills, and all the information obtained through science, mental and experience through the synthesis of concrete, to be useful to humanity, science, economy, time and physical resources in a good, harmonious and aesthetic way to evaluate the optimal solution is defined as searching.” At the same time, mathematics is a guarantee of what engineers do. It is not possible to find a middle way between securities and low cost without mathematically taking into account only intuition and estimation. For instance, planes can't fly without math. One of the benefits of digital thinking is that it gives a perspective on very large and very small quantities related to

technology. However, engineers use a coefficient as a "safety factor" in mathematical calculations (URL_3).

While natural sciences such as physics and chemistry provide the theoretical subdivision, engineering is the process of transforming this subdivision into practice. In fact, people who are known as inventors in the past are engineers at the same time, they are scientists. Mathematics, on the other hand, is a tool that both the theoretical sub-structure and engineering are using for identification, analysis, modeling, calculation and application. As a result, if science is an infrastructure for engineering, mathematics is the most basic infrastructure for both. Engineering is a fundamental design task. Designs are provided to solve real life problems or to make existing systems work more functionally and efficiently. Modeling of system designs based on engineering studies and defining system properties of these models. It uses a great deal of mathematics to analyze and describe the results of design decisions. Traditional mathematical discipline uses continuous mathematics, i.e. analysis and differential equations. In software engineering, models are shaped by techniques based on discrete mathematics, logic, and set theory (Yenioğlu, 2017).

One of the most controversial issues in recent years is the mathematics education of Engineers (Allen, 2000; Kent & Noss, 2000; Sutherland & Pozzi, 1995). In the study done by the engineering Council in England, it is stated that the importance of Mathematics has decreased compared to the last ten years (Sutherland & Pozzi, 1995). The reasons that lead to this situation are increasing computer use, increasing the importance of design and communication compared to analytical thinking. Another point they are focusing on is that there is a need to work harder on some issues. These topics are: which mathematics issues are given examples of engineering problems, and which ones are taught better without engineering problems are needed to work harder. An unclear point is how the increase in the use of computers by professional engineers affects the mathematics education given to engineers at universities (URL_4).

2.1. Use of Mathematics in Survey Engineering

The map is an example of a bird's eye view of all or part of the earth, drawn on a plane with special signs, scaled down by the mathematical methods according to the desired scale. Because the map is the most important way to transmit geographical information, we know from the works that thinkers (especially ancient Greek) and mathematicians are dealing with the purpose of knowing the world. For example, Miletus Anaksimandros, who observed and described the progress of the Great Menderes River Delta in Turkey, speaks more about geographical relations (Çobanoğlu, 2016).

The map is called the transfer of some or all of the earth to the plane of the model reduced by certain scales and methods. Map is a compulsory tool for the use and planning of a place. In addition, as people are dependent on terrene, a mapping and mapping profession has emerged with the need for measurement to be based on the processing and arrangement of the terrene. Survey engineering are used geography, geology, geomorphology, physics and especially mathematics such as science branches.

Survey engineering deals with the shape of the earth, the position of artificial and natural objects on it, and the relationship between each other by using mathematical model and measurement methods to determine and graphically represent. Geodesy and Photogrammetry Engineering that developed considerably with the recent technological developments has gained a new dimension in Turkey through the European Union (EU) Accession Phase. Therefore, standards and accreditations in EU countries in this sector have also gained importance for our country (Palancıoğlu et al., 2007).

The survey engineer uses mathematical knowledge too much. Because it is already in the field of Applied Mathematics as a branch of Science. The famous German mathematician G. Leibniz (1646-1716) said; "Geodesy is an excellent application of Mathematics". Logarithm charts, sliding calculators, arm and electric calculators and computers are the tools that the survey engineer uses continuously for various calculation techniques. In addition to this, the use of the concepts of "Ingenious Geometer" or "trigonometric" for the survey engineer in some countries is a proof of how close they are to these issues. In addition, probability calculations, statistical theories, and the least squares method are the subjects developed by survey engineers rather than mathematicians, which are extensively involved in the teaching of Geodesy (URL_5).

In cartography, the mathematically defined shape of the earth is considered to be a rotational ellipsoid or a sphere. For a reference surface defined for the earth according to a certain coordinate system defined points on the plane or plane can be opened to the surface according to specific mathematical models to transfer work is called "map projection" (Figure 1). Map projections can be considered as a special application of mathematical projections in cartography. Therefore, "Mathematical cartography" and "cartographic projections" have emerged. In order to describe the earth as mathematical, the reference surface of the sphere or ellipsoidal is considered. Calculations of coordinate and Meridian convergence angles and calculations on projection plane are the subject of mathematical cartography (Uçar et al., 2004; Uçar et al., 2011; Çobanoğlu, 2016).

In 1514, German mathematician Johannes Werner (1468-1528) and Austrian cartographer Johannes Stabius (1450-1522) worked together to reveal the Stab-Werner projection, which is known as its own name. This projection is a non-real conical projection and its image is in the form of heart (Figure 2), (Çobanoğlu, 2016).

One of the important scientists in this field lived between 1512-1594 Gerard de Kremer and also known as Gerardus Mercator. He's a mathematician and a geographer. He lived in the Spanish Dutch, which forms today's Belgium. He created a projection with his own name. He also drew many maps. In 1935, the International Astronomical Association called a crater Mercator in the moon. Johann Heinrich Lambert (1728-1777) is a Swiss physicist, mathematician and

astronomer. Lambert invented seven cartographic projection systems. The Planar Projection that protects the area is currently used in France, the European Environmental Agency and the taper projection that protects the angle. The other scientist is Johann Georg von Soldner (1776-1833), German physicist, mathematician and astronomer. The coordinate system, known as its own name, was the 20th century. It has been used in Germany until the middle Ages. Carl Friedrich Gauss or Gauß (1777-1855) is a German mathematician and scientist. Some of his contributions are numbers theory, analysis, differential geometry, geodesy, electricity, magnetism, astronomy, and optics. It is also known as the "Prince of mathematicians" and "the greatest mathematician who has lived since ancient times." Johann Heinrich Louis Kruger: (1857 - 1923) is a German mathematician and surveyor. Carl Friedrich Gauss' work on geodesy records, published in 1912, "the projection of ellipsoid that protects shape on the plane" created the basis of the Gauss-Kruger coordinate system established in 1923 (Uçar et al., 2011; Çobanoğlu, 2016).

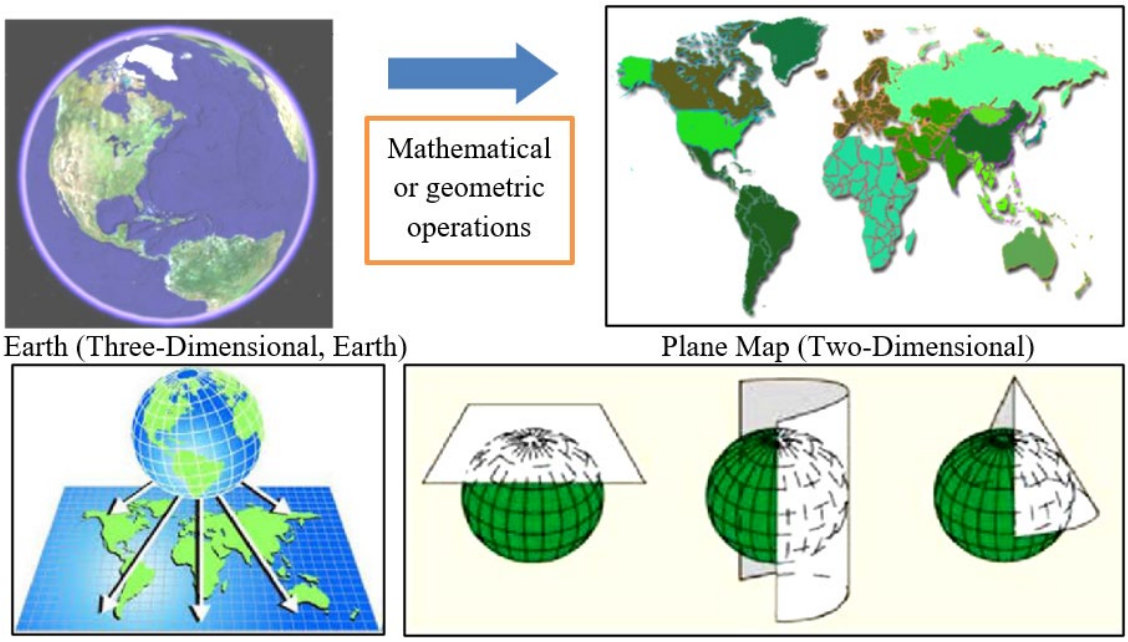

Figure 1. Map Projection (Uçar et al., 2004).

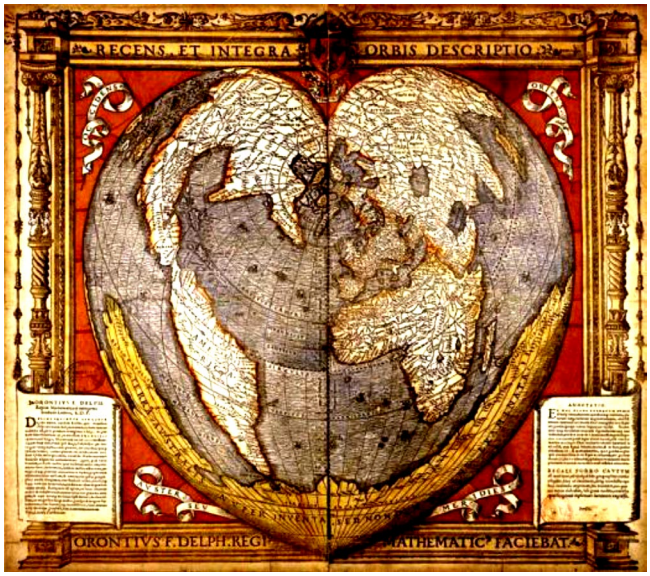

Figure 2. World map in Stab-Werner projection (Çobanoğlu, 2016).

3. Method

This study has emerged from the movement of "Why mathematics achievement in Turkey is not at the desired level?" question. The ideas of students and mathematics teachers, both sides of mathematics teaching, are considered to contribute more to mathematics success by increasing the liking of mathematics lessons.

Firstly, a preliminary study was carried out with the student group to work with, and directed the students and mathematics teachers in Osmaniye Şehit Mehmet Karacatilki AİHL to ask "How is Mathematics endeared?". A questionnaire form was prepared by organizing answers. The survey was conducted with 526 students from different levels (1st, 2nd, 3rd and 4th grade students) in different high schools in Osmaniye province (Imam Hatip, Anatolia, Science, Social Sciences etc.) and 20 mathematics teachers who participated in these schools. However, some of the students did not answer some questions. The answers are analyzed and interpreted with Excel graphs, and it is aimed to contribute to the endearing and liking of the mathematics course in this way.

3.1 Questionnaire Study Applied to Students

The suggestions/thoughts used in the questionnaire study applied to students and the answers are given below in Table 1.

Table 1. The suggestions/thoughts used in the questionnaire study applied to students and their answers.

No.	Suggestions / Thoughts	Answers						
		Agree	Rate (%)	Partially	Rate (%)	Disagree	Rate (%)	Total
	I already like mathematics.	236	52.8	160	35.8	51	11.4	447
	I don't think it's possible to like mathematics.	32	7.2	95	21.3	319	71.5	446
	It is wrong to try to make everyone like math. I think everyone should learn the lesson he likes.	239	53.5	122	27.3	86	19.2	447
	Mathematics can be liked by giving more responsibility and ensuring student attendance.	135	30.3	141	31.7	169	38.0	445
	Mathematics can be liked if it is explained by being related to real life and being more concrete.	287	65.1	118	26.8	36	8.2	441
	Mathematics can be liked if the student is taught directly in private lesson format.	168	37.8	174	39.2	102	23.0	444
	Mathematics can be liked by adding more activity, music and games according to age groups.	286	64.6	101	22.8	56	12.6	443
	Mathematics can be liked if the reason of putting curriculum of the mathematics course is explained nicely.	181	40.7	176	39.6	88	19.8	445
	Mathematics can be liked if explanatory explanations of th areas in which mathematics are used are arranged.	269	60.3	106	23.8	71	15.9	446
0	Referring to the history of the formulas in mathematics and explaining the mathematics related to the history can make him like.	100	22.6	136	30.8	206	46.6	442
1	Mathematics can be liked by telling the events and the miracles in the natural world.	233	53.0	128	29.1	79	18.0	440
2	Mathematics can be liked if teachers are able to reach the teachers more easily if the students can't solve them.	320	72.1	92	20.7	32	7.2	444
3	Mathematics can be liked by creating competition among students and organizing entertaining math competitions.	254	57.0	120	26.9	72	16.1	446
4	Teachers should be encouraged to tell fun lessons and to give students self-confidence for math lessons. This is the only way math can be liked.	335	75.8	84	19.0	23	5.2	442
5	Mathematics is learned when studied very regularly, and it is liked when it is learned.	303	68.2	104	23.4	37	8.3	444
6	A student in secondary education should have good mathematical background in elementary school to like mathematics.	323	72.4	79	17.7	44	9.9	446
7	Studies should be carried out to ensure that students are patient by saving them from the perception that mathematics is difficult and that they can't do it.	397	75.5	41	7.8	88	16.7	526

3.2. Questionnaire Study Applied to Teachers

The suggestions/thoughts used in the questionnaire study applied to teachers and the answers are given below in Table 2.

Table 2. The suggestions/thoughts used in the questionnaire study applied to teachers and their answers.

No.	Suggestions / Thoughts	Answers						
		Agree	Rate (%)	Partially	Rate (%)	Disagree	Rate (%)	Total
	I do not think it's possible to like mathematics.					9	5	0
	It is wrong to try to endear mathematics to everyone. I think everybody learn the lesson they like.		5	0	0		5	0
	Mathematics can be liked by giving more responsibility and ensuring student participation.		0		45		5	0
	Mathematics can be liked if it is explained by being associated with real life and being more concrete.	7	5				0	0
	Mathematics can be liked if the student is taught directly in a private lesson format.		5	2	0			0
	More activity in mathematics can be endeared by adding games according to music and age groups.	4	0		0		0	0
	Mathematics can be liked if the reason for putting curriculum is explained well.		5	1	5			0
	If introductory trips are organized in the areas where mathematics is used, mathematics can be liked.	5	5		5			0
	The history of the formulas in mathematics is mentioned and the description of mathematics in connection with the history allows liking mathematics.		5	1	5		0	0
0	Mathematics can be liked by telling the events and miracles in the nature to be connected with mathematics.	6	0		5			0
1	Mathematics can be liked if teachers are provided with more convenient access to questions that students can't solve.	2	0		0			0
2	Mathematics can be endeared by creating competition among students and organizing entertaining math competitions.	3	5		0			0
3	Mathematics can be liked by teaching funny lessons to teachers and providing them with self-confidence in solving mathematics lessons.	5	5		0			0
4	Mathematics is learned if studied very regularly, and it is liked as well.	9	5					0
5	In order for a pupil in secondary education to like mathematics, he must have a good mathematical background in primary education.	8	0					0
6	Students should be aware of the difficulty of mathematics, and I should not be able to do, so that they can be patient.	9	5					0

4. Conclusions and Recommendations

In this study, it is aimed to contribute to endear and liking of mathematics course. While searching for an answer to the question "How is Mathematics endeared?", awareness about mathematics was formed in the teachers and students, negative factors reducing the mathematics success were determined, everyone thought about their deficiencies and empathized and made suggestions for solution of the problem. It was concluded that mathematics can be endeared and liked when appropriate methods and techniques are used. For this, firstly;

- When teaching mathematics, not only theoretical courses should be taught, but also practical activities should be used.
- Students' expectations should be taken into consideration while teaching mathematics.
- Such researches should be done constantly and the obstacles in front of the math loving and the student should be detected and this obstacle should be removed.
- Students should be informed about mathematical study techniques.
- Methods and techniques used in mathematics lessons should be diversified.
- Mathematics teachers should research and update themselves according to changing and developing conditions.
- We need to think about ways to make the curiosity in the students act and want them to explore the mysterious world of mathematics.
- In fact, the growing conditions and psychological conditions of today's young people are also important factors affecting teaching mathematics. According to our observations, today's young people often give up quickly when they see it hard. However, mathematics needs to be patient and to work steadily and regularly.

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Author contributions

The contributions of the authors to the article should be stated.

Conflicts of interest

There is no conflict of interest between the authors.

Statement of Research and Publication Ethics

Research and publication ethics were complied with in the study.

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