



PRE-SERVICE TEACHERS' VIEWS REGARDING THE EFFECT OF LEARNING SCIENTISTS' BIOGRAPHIES ON STUDENTS' MOTIVATION

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Abstract:

The purpose of the study is to explore the third year elementary education students' views about the effect of learning-knowing the biographies of scientists on students' studying at every level from primary school to university in terms of thinking, questioning, inquiry skills as well as studying, learning and achievement. The study is a descriptive study. Of 81 third year students studying in elementary education program, 29 male and 52 female students participated in the study. The data of the study were obtained via an interview form consisting of four open-ended questions developed by the researcher taking expert opinion. Moreover, semi-structured interviews were carried out with six undergraduate students chosen randomly among the students who volunteered and had free time to participate in the study. It was revealed that the percentages of the participants who stated that learning the biographies of scientists interest me, I dreamed of being a scientist, and the biographies of scientists will lead the elementary, secondary, and high school students to think, to do research, to study, and to learn more were 87.6%, 39.5% and 95.0%, respectively. Moreover, it can be stated that regarding the question "Does reading-learning the biographies of scientists motivate undergraduate students to think, to do research, to study, to learn, and to achieve more?", 85.2% of the participants said "yes", it does-it can". Considering that using the biographies of scientists for acquiring and implementing the scientific process skills and actualizing values education at national or universal levels will be effective and efficient, it is suggested that the biographies of scientists should be used frequently.

Keywords: scientists, biographies, student motivation, pre-service teachers' views

1. Introduction

Based on the documents examined, it can be stated that biographies make contribution to gain meaning and reinforce knowledge acquired in different courses (Oğuzkan, 2000;

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Çalışkan & Öntaş, 2018, pp. 8-9). The researchers assert that because biographies support achievement motivation and contain many humanistic values, it is important that they are used for children-students (Kyoon, 1984; Dedeoğlu, Ulusoy & Alıcı, 2013). Based on the assumption that biographies can be effective on students-individuals studying at every level, it is considered that it will be useful to include- mention four scientific biographies prepared about Galileo Galilei, Leonardo da Vinci, Max Planck and Marie Curie in the study.

Galileo is one of the central figures in scientific Renaissance (James, 2015, p. XI). Galileo is a scientist who pioneered natural philosophy with his experiments, measurements, and mathematical calculations. Because the method he used is the quality that is required with all scientific research till today, Einstein called the Italian astronomer "*the father of modern physics*", in fact, "*the father of modern science*" (Robinson, 2014, p. 32).

Galileo Galilei was born in 1564 in Pisa. Following his father's wish, he began to study medicine at the University of Pisa when he was 17 years old. It is stated that while studying medicine, he listened to mathematics courses in the doorway (Yıldırım, 2012, p. 87). Due to his interest in mathematics, four years later he quit studying medicine. He earned his living by working as a private tutor in mathematics and made speeches at the University of Siena and the University of Florence. When Galileo was 25 years old (1589), he was appointed as a lecturer of mathematics at his former university run by the Church. Three years later (1592), Galileo was appointed as a Professor at the University of Padua in Venice, one of the most important universities in Europe at that time, where Copernicus lectured and Dante received education. He taught applied courses like military, architecture, basic astronomy and perspective at Padua (James, 2015, p. 4). Galileo invented the geometric and military compass and taught how to use it to those who bought it (Robinson, 2014, p. 32).

Galileo learned that a Dutch optician (Hans Lipershey) invented a tool (a lens-a telescope) in 1609 that makes distant objects appear magnified and closer (Robinson, 2014, p. 34; Yıldırım, 2011, p. 103). As a result of his studies to improve the design, his telescope could magnify objects 30 times. Galileo discovered the rough and uneven surface of the moon which could not be seen by a naked eye and the mountains on it, many stars, the structure of the Milky Way, and four moons revolving around Jupiter (Robinson, 2014, p. 34; James, 2015, p. 6). In short, Galileo became the first person who could record the astronomical observations of the sky made with the help of his telescope (James, 2015, p. 6).

Galileo made experimental studies at the University of Padua which made the accuracy of traditional ideas obtained in Ancient Greece skeptical. He disproved Aristotle's assertion "*heavy objects fall faster than lighter objects*" by dropping heavy objects from The Leaning Tower of Pisa and rolling balls/objects down an inclined plane. Stating that the reason for the different acceleration rates of the falling bodies from the same height at the same time was the buoyant force, he defended that all objects fall at a constant acceleration (Robinson, 2014, p. 32).

According to Aristoteles-Ptolemy's geocentric model, the Earth was at the centre of the planets moving in circles and the Earth is unmoving. In addition to this, there are stars revolving around Earth once per day. Copernicus (1543) asserted that Venus, Mercury, Mars, Jupiter, Saturn, and Earth revolved around the Sun (Robinson, 2014, p. 20). As a result of the observations made with the telescope, Galileo Galilei understood that it was Copernican model that was accurate, but not Aristoteles-Ptolemy's model. Galileo's work called *Dialogue* which was published in Italian in 1632 caused him to get into trouble with the Pope Urban VIII and the Inquisition. Because he defended Copernican theory, the Inquisition convicted Galileo of "*vehemently suspect of heresy*" and banned the *Dialogue*. Moreover, the Pope decided that Galileo should be imprisoned for an indefinite period of time (Robinson, 2014, p. 39). It was determined that Galileo who was kept under house arrest suffered from cataract and glaucoma and also lived under the close supervision of the Inquisition for the last eight years of his life. He still continued his studies when he was under house arrest and had eye problems. He also completed his final and the most important book called *Diskorsi e Dimostrazioni Matematiche Intorno à due Nuove Scienze* (The Discourses and Mathematical Demonstrations Relating to Two New Sciences) (James, 2015, p. 10). His final book was published in 1638 in Leiden, the Netherlands far from the Inquisition. Galileo continued his correspondences via his secretary because his eyes were forever closed. It is stated that his final masterpiece shed light on the works of Christian Huygens and Isaac Newton who were born one generation after him and made great contributions to their works. Galileo died in his house in Arcetri near Florence in 1642 (Robinson, 2014, p. 39; James, 2015, p. 10).

Leonardo da Vinci (1452-1519) like Dante, Michelangelo, Galileo, and the other great Italians of the period is known with his first name rather than his surname (James, 2015, p. 3). Leonardo was the greatest inventor and scientist of the period in which he lived and also his understanding of scientific method was close to the modern understanding (Yıldırım, 2012, p. 70). Leonardo, a unique artist, the symbol of Renaissance, an outstanding sculpture and philosopher, was also the painter of *Mona Lisa* and *The Last Supper* (Yıldırım, 2012, p. 70). Leonardo did not publish his scientific works and also he wrote with a special kind of short hand, that is, from right to left so that his notes could not be read directly by people. 5000 pages of notes and drawings by Leonardo were kept in a vault for 400 years and they could be read only by reflecting them on a plane mirror (Yıldırım, 2012, p. 70). Leonardo's notes included his observational findings he made throughout his life, research results related to the fields of botany, geology, geography, and anatomy-physiology, projects about architecture, urban planning, water and sewage system, and discoveries and inventions related to military technology (Yıldırım, 2012, p. 70).

Max Planck, born in 1858 in Kiel, Germany, was a scientist who originated quantum theory as a result of his explanations (December 14, 1900) for the studies he carried out about the black body radiation. He won the Nobel Prize in Physics in 1918 due to his discovery of energy quanta. His only surviving child (Erwin) from his first marriage was one of those who was accused of assassination plot against Adolf Hitler

(1944) and the Nazi officials suggested he should sign “the declaration renouncing faith and loyalty in Nazism” so that he could save his son from the execution. However, he refused to sign the declaration because it contrasted with his attitudes towards life (Serway, 1996, p. 1147; Yıldırım, 2012, pp. 168-171; James, 2015, pp. 268-269). He spent the last two years of his life in Göttingen as an outstanding and a respectable scientist and as human rights advocate. Planck died from a stroke on October 4, 1947 when he was about to celebrate his 90th birthday (Serway, 1996, p. 1147; James, 2015, pp. 268-269).

Born Manya Sklodowska on November 7, 1867 in Warsaw, Marie Curie was a physicist and a chemist. Her father was a physics teacher in a boy's school and her mother worked as a school director in the school where female students coming from upper- middle class studied. The family had five children, one boy and four girls. When Manya, the youngest of five children, was 10 years old, her mother died of tuberculosis. With the help of her father who received education at St. Petersburg University and who was a polite and an intellectual person, she overcame hard times and graduated at the top of her peers. However, it was so hard for women to find a job or receive a university education in Poland which was under Russian rule. (Robinson, 2014, pp. 152-153; James, 2015, pp. 283-284). Manya worked as a governess for three and half years and she sent her savings to her elder sister studying medicine in Paris. Once her elder sister Bronislawa finished her medicine education and could support herself, it was planned that Manya would go to Paris for her university education. Manya (Marie) became one of 23 women who enrolled in the Faculty of Science at the Sorbonne in 1891. She passed her physics undergraduate exam ranking at the top in 1893 and mathematics undergraduate exam ranking second in 1894. She met Pierre Curie, who was older than her, in the spring of 1894. Marie married Pierre in 1895 and after their daughter Irene was born in 1897, the couple continued their scientific studies together (Robinson, 2014, p. 153; James, 2015, pp. 284-285).

Marie Curie discovered the elements of uranium and thorium were radioactive (Serway, 1996, p. 1355). The Curies discovered two new radioactive elements which uranium ore contained and called them polonium (July 1898) and radium (December 1898). Due to their studies on radioactivity, Marie and Pierre Curie were awarded Nobel Prize for Physics with Antoine Henry Becquerel, who discovered radioactivity (1896) in 1903. Marie's husband Pierre died in an accident in Paris in 1906. He was run over by a horse-drawn wagon. Marie was appointed as a professor in place of Pierre and thus she became the first woman to teach at the Sorbonne where she was a student before. Due to Marie Curie's discovery of polonium and radium (1898) and isolation of radium, she was awarded Nobel Prize for Chemistry in 1911. Marie is the only woman who has been awarded the Nobel Prize in Sciences and the only scientist who has been awarded the Nobel Prize two times. Marie was the only woman Nobel Prize winner in Sciences until her daughter Irene won one in 1935 (Robinson, 2014, p. 156; James, 2015, p. 289; Emren, 2017, p. 66). Because she worked with radioactive elements for long years and was exposed to high-energy radiation, she died of leukaemia in 1934. Albert Einstein remarked, “*Madame Curie was probably the only person who could not be corrupted by fame.*” This statement about Marie Curie is so meaningful and important.

It is predicted that reading and learning the biographies of Archimedes, Euclides, İbni Sina, Copernicus, Kepler, Galilei, Darwin, Mendel, Marie Curie, Dmitri Mendeleev, Planck, Einstein, Fermi, Aziz Sancar and all other scientists at all levels-from the elementary school to university will enable students/individuals to think, to question, to inquire and to investigate more and realize permanent learning with much better motivation. Moreover, it is considered that it will make positive contributions to acquisition of national and universal values in the geographies or countries which give importance to values education.

1.1 The Purpose of the Study

The purpose of the study is to explore the third year elementary education students' views about the effect of learning-knowing the biographies of scientists on students' studying at every level from primary school to university in terms of thinking, questioning, inquiry skills as well as studying, learning and achievement.

2. Method

The study is a descriptive study. Of 81 third year students studying in elementary education program in a state university, 29 male and 52 female students studying in the second term participated in the research. The average age of the males participating in the study was 22 and the average age of the females was 21. 56.6% of the participants (14 male and 31 female students) stated that they liked reading, 39.5% of them (13 male and 19 female students) said that they sometimes read and 4.9% of them (2 male and 2 female students) said that they did not like reading.

The data of the study were obtained via an interview form consisting of four open-ended questions developed by the researcher taking expert opinion. The responses of the participants to each four open-ended question in writing and their explanations were examined and categorized in terms of their content, similarities and closeness. The responses grouped were presented in tables in different columns considering the student responses, their genders and total number, and percentages. At the end of each table, necessary interpretations and explanations were made about the data included in the table. Moreover, the question belonging to each table was given in quotation mark ("...?").

Of the 81 third year elementary education students who expressed their opinions about the effect of learning/knowning the biographies of famous scientists on student motivation, six students were chosen randomly among the students who volunteered and had free time and semi-structured interviews were carried out with them. No recording was made during the interviews when it is considered that the participants would be troubled or would not essentially like to be recorded.

3. Findings

Table 1: The responses of the elementary education students related to the question
“Does learning-knowing the biographies of famous people draw your attention?”

Student responses	Explanations written for the responses	Male	Female	Total	%
Yes, it draws my attention	I wonder about what they achieved, how they coped with the problems/ They shape my life-they enable me to take a step	11	25	36	44.4
Yes, it draws my attention	-	5	18	23	28.4
Yes, it draws my attention	I read the biographies related to my field of interest	5	-	5	6.2
Sometimes, it draws my attention	-	2	5	7	8.6
It does not draw my attention very much	Especially I don't read but if someone reads, I can listen to them	3	2	5	6.2
No, it doesn't	-	3	2	5	6.2
Total	-	29	52	81	100

When Table 1 is examined, it is revealed that the participants wrote the following responses: “*Yes, it draws my attention (79.0%)*”, “*sometimes, it draws my attention (8.6%)*”, “*it does not draw my attention very much (6.2%)*”, “*No, it doesn't draw my attention (6.2%)*”. When the response “*Yes, it draws my attention*” is evaluated together with the response “*sometimes, it draws my attention*”, it can be stated that 87.6% of the participants want to learn/know the biographies of the scientists. Among the participants who have tendency to learn the biographies of the scientists, as 50.6% of those supported the response “*yes, it draws my attention*” with justifications and explanations given in the second column, it can be interpreted that the response was generally written intentionally-consciously.

Table 2: The responses of the elementary education students related to the question
“Have you ever dreamt of being a famous scientist?”

Student responses	Explanations written for the responses	Male	Female	Total	%
Yes, I have.	-	8	22	30	37.0
Yes, I have.	I would like to be a famous physicist or biologist	1	1	2	2.5
No, I haven't	-	12	19	31	38.3
No, I haven't.	Because it requires a lot of effort/ being famous scares me/ I have dreamt of being	2	1	3	3.7

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	a student of a famous scientist				
No, I haven't.	Because I have dreamt of being a famous man of letters/ teacher/ musician/artist/politician/ footballer/athlete/ police officer	6	9	15	18.5
Total		29	52	81	100

When Table 2 is examined, it is found that 39.5% of them wrote the response “*I have dreamt of being a famous scientist*” and 60.5% of them wrote the response *I haven't*. It draws attention that only two of the participants who gave the answer “*Yes, I have dreamt*” and 18 of the participants (22.2%) who responded “*No, I haven't*.” justified their responses.

Table 3: The responses of the elementary education students related to the question “In your opinion, does learning-knowing the biographies of famous scientists have positive effects on elementary and secondary school students’ thinking, questioning, doing research, studying, learning and achievement?”

Student responses	Explanations written for the responses	Male	Female	Total	%
Yes, it does	-	5	10	15	18.5
Yes, it does	Because it is inspiring / enlightening/ guiding/ it makes more eager/ it provides motivation/ it becomes a role model	21	41	62	76.5
Maybe	-	2	1	3	3.7
No, it doesn't	-	1	-	1	1.2
Total		29	52	81	100

When the data in Table 3 are examined, it is discovered that 95.0% of the participants share the opinions that learning the biographies of scientists will have positive effects on their thinking, questioning, doing research, studying, and learning. As the participants who gave the response “*Yes, it does*” supported their responses with justifications and explanations (76.5%), it demonstrates that the responses were not written randomly but consciously. Considering the fact that only one participant wrote the response “*No, it doesn't*”, it can be stated that third year elementary education students (98.8%) are of the opinion that knowing the biographies of the scientists will impel elementary, secondary, and high school students to think, question, do research, study, and learn more. This finding supports the opinion that biographies contribute to gain meaning and reinforce the knowledge acquired in different courses (Oğuzkan, 2000; Çalışkan & Öntaş, 2018, pp. 8-9).

Table 4: The responses of the elementary education students related to the question
“In your opinion, does learning-knowing the biographies of persistent scientists motivate undergraduate students to study, to read, to think, to inquire, to learn and to achieve more?”

Student responses	Explanations written for the responses	Male	Female	Total	%
Yes, it does	-	8	15	23	28.4
Yes, it does	Because it inspires them / it guides them/ they take them as a role model	13	23	36	44.4
Yes, it can	-	1	7	8	9.9
It sometimes does.	-	-	2	2	2.5
No, it doesn't	Because it is more effective at younger ages / in elementary education	7	5	12	14.8
Total		29	52	81	00

It is revealed that the written responses of the elementary education students to the question “Does learning-knowing the biographies of persistent scientists motivate undergraduate students to study, to read, to think, to inquire, to learn and to achieve more?” were *yes, it does* (72.8%), *yes, it can* (9.9%), *it sometimes does* (2.5%) and *it doesn't* (14.8%). The participants (12) who wrote negative answers to the fourth question even accept that knowing the biographies of scientists have positive effects. The explanation-justification “Because it is more effective at younger ages” by those who wrote the answer “*No, it doesn't*” verifies the assertion.

3.1 The Views Stated by the Undergraduate Students of Elementary Education in the Interviews

In addition to getting opinions of the third year elementary education students about the effect of learning-knowing the biographies of scientists on students' motivation by using an interview form consisting of four questions, semi-structured interviews were carried out separately with six students who were chosen randomly among the students who volunteered and had free time. Four different statements chosen among the original opinions of six different people about the same questions were presented below:

“Most scientists' biographies are interesting and such life stories draw my attention.”

“I would like to be a famous painter, but not a scientist.”

“To me, they have positive effects. I always wondered about their discoveries and inventions when I was at the elementary and secondary school.”

"They are motivating. Scientists are always a source of inspiration for university students."

4. Results, Discussion and Recommendations

It was revealed in the study that among the third year elementary education students who participated in the study, 87.6% of them shared the opinions that learning the biographies of scientists drew their attention and 39.5% of them stated that they dreamt of being a scientist. 95.0% of the participants agreed that learning the biographies of scientists had positive effects on elementary and secondary students' thinking, questioning, doing research, studying, and learning. Depending on only one participant who wrote the response *"No, it doesn't"*, it can be stated that third year elementary education students (98.8%) are of the opinion that knowing the biographies of the scientists will force elementary, secondary, and high school students to think, question, do research, study, and learn more. This finding revealed supports the opinion that biographies make contributions to give meaning and reinforce the knowledge acquired in different courses (Oğuzkan, 2000; Çalışkan & Öntaş, 2018, pp. 8-9).

Based on the 12 students' (14.8%) response to the question *"Does learning-knowing the biographies of persistent scientists motivate undergraduate students to study, to read, to think, to inquire, to learn and to achieve more?"*, it can be stated that 85.2% of the participants agree with the opinion *yes, it does/ it can*. It can be claimed that even the participants (12) who wrote negative responses for the last question accepted that learning the biographies of scientists had positive effects. The explanation-justification *"Because it is more effective at younger ages"* by those who wrote the answer *"No, it doesn't"* verifies the assertion.

It has recently become evident that *students* should acquire and use scientific process skills within the general framework and it is known that attempts have been made to provide them. The biographies of scientists could be effective to acquire and use scientific process skills. Despite many negativities, making observation, hypothesizing, classification, making deduction, making predictions, determining the variables, measuring, designing and doing experiments, making interpretation, and drawing conclusion can become more attractive, more exciting, and more fun for the students who learn the biographies of geniuses who achieved great success.

Considering that most scientists experienced many hardships, met many difficulties during their education, individual or family lives, and scientific studies and generally paid the price, it is thought that using their biographies could be effective and useful for values education at national and universal level.

It is known that due to his ideas, works, and works of art, Galileo was constantly hindered by the Church, convicted by the Inquisition, and kept under house arrest by the Pope Urban VIII. It is praiseworthy that although Galileo could not see very well because of cataract, he wrote his final and the most important masterpiece and prepared it for publication with the help of his secretary during the years when he was under house arrest (Robinson, 2014, p. 39; James, 2015, p. 10).

It must be considered that the biography of Max Planck should be used/discussed within the context of values education because Planck displayed an honourable, virtuous, and honest human attitude by being silent and bearing sorrow within himself when his son was executed rather than submitting to the wishes of the ruling party (the Nazis) whose implementations he did not approve (Serway, 1996, p. 1147; Yıldırım, 2012, pp. 168-171). As stated in a study (Yıldız, 2015), Planck stuck to his principles and decisions he made despite being disadvantageous to him in any case, that is he took a tough stance and this can be regarded as a model behaviour for the students and scientific literate individuals in general.

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