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Reflections from the Experiences of Elementary Mathematics Teaching Undergraduate Students within the scope of Mathematicians Who Left a Mark on History Project: A Project of CSP Course

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Abstract

This study aimed to examine the experiences of the second-year undergraduate students of Elementary Mathematics Teaching (EMT) within the scope of the Mathematicians Who Left a Mark in History (MWLMH) Project carried out within the scope of the Community Service Practices (CSP) course. The case study method, one of the qualitative research designs, was used in the study. The participants of the research consist of 14 undergraduate students studying in the second year of the EMT program of a state university in the Western Black Sea region of Turkey in the spring semester of the 2021-2022 academic year. The research data were gathered from the reflective diaries that the students kept regularly every week from the beginning to the end of the project process and from the focus group interviews held with the students after the process was over. The gathered data were subjected to content analysis. As a result of the research; it has been determined that the MWLMH project contributes to EMT undergraduate students in different aspects such as gaining teaching experience, experiencing designing materials and how to integrate History of Mathematics (HoM) into lessons and strengthening their communication skills. In addition, EMT undergraduate students were determined mostly pre-service teacher-related challenges as designing materials, also administrator-related challenges as being unwilling/indifferent. Lastly, EMT students emphasized that the activities/materials they developed were useful, interesting and entertaining for students and contributed to their awareness towards HoM. Based on the results of the research, various recommendations were provided.

Keywords: Community service practices, history of mathematics, undergraduate students, mathematics education.

İlköğretim Matematik Öğretmenliği Lisans Öğrencilerinin Tarihte İz Bırakan Matematikçiler Projesi Kapsamında Yaşadıkları Deneyimlerden Yansımalar: Bir THU Dersi Projesi

Öz

Matematik tarihi (MT); hem matematik bilim dalının hem de matematik eğitiminin ayrılmaz bir parçası olarak karşımıza çıkmaktadır. Bu araştırmada İlköğretim Matematik Öğretmenliği (İMÖ) ikinci sınıf lisans öğrencilerinin Topluma Hizmet Uygulamaları (THU) dersinde yürütülen Tarihte İz Bırakan Matematikçiler (TİBM) Projesi kapsamında yaşadıkları deneyimlerin incelenmesi amaçlanmıştır. Bu amaç doğrultusunda nitel araştırma desenlerinden özel durum çalışması yöntemi kullanılmıştır. Araştırmanın katılımcılarını 2021-2022 eğitim öğretim yılı bahar döneminde Batı Karedeniz bölgesinde bulunan bir devlet üniversitesinin İMÖ programında ikinci sınıfta öğrenim görmekte olup THU dersini alan 14 lisans öğrencisi oluşturmuştur. Araştırmanın verileri, proje sürecinin en başından başlamak üzere en sonuna kadar öğrencilerin her hafta düzenli olarak tuttukları yansıtıcı günlüklerden ve süreç sona erdikten sonra öğrencilerle gerçekleştirilen odak grup görüşmelerinden elde edilmiştir. Elde edilen verilerin analizinde içerik analizinden yararlanılmıştır. Araştırma bulgularından hareketle; TİBM projesinin İMÖ lisans öğrencilerine öğretmenlik deneyimi elde etme, MT etkinliklerinin derslerde kullanılabileceğini görme, iletişim becerilerini güçlendirme gibi farklı açılardan katkı sağladığı tespit edilmiştir. Bunun yanı sıra İMÖ lisans öğrencilerinin kendilerinden kaynaklı olarak en çok materyal tasarlamaya yönelik güçlük yaşarken; yöneticilerden kaynaklı olarak ise en çok okul yöneticilerinin isteksiz/ilgisiz olmasına yönelik güçlük yaşadıklarını belirlenmiştir. Ayrıca İMÖ lisans öğrencilerinin MT'ye yönelik olarak öğrencilerin ilgisini çektiğini ve akılda kalıcılığı arttıracağını düşündüğü saptanmıştır.

Anahtar kelimeler: Topluma hizmet uygulamaları, matematik tarihi, lisans öğrencileri, matematik eğitimi.

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INTRODUCTION

Statement of the Problem

Mathematics can be regarded as a collection of knowledge that has taken its place in all periods and that has reached the present day in a way that will guide the development of society since the beginning of human history. This period of time, from the first moment that mathematics was born to its present form, can be called as the history of mathematics [HoM]. Considering mathematics both as a branch of science and as a course, those who have helped mathematics develop cumulatively and reach its current state because of their studies are undoubtedly scientists who deal with mathematics (Baki, 2014). Upon analyzing HoM, which briefly and concisely summarizes the process of mathematical progress spanning thousands of years, it is divided into five different periods (Ülger, 2006) as Egyptian-Mesopotamian Mathematics, Greek Mathematics, Indian-Islamic Renaissance Mathematics, Classical Mathematics and Modern Mathematics including many mathematicians who left their mark on each period. On the other hand, due to the studies of many mathematicians with different paradigms and philosophies, mathematical knowledge continues to enhance. In this regard, HoM is an integral part of mathematics and mathematics education (Siu &Tzanakis, 2004; Taşkın et al., 2010) and has evolved into an interdisciplinary domain of educational research and practice by exploring the possible relevance and significance of the history of mathematics in the context of mathematics education (Chorlay et al., 2022, p. 1407). The National Council of Teachers of Mathematics (NCTM, 2000) considers that the use of HoM in lessons is necessary and significant in order to increase motivation and develop a more positive approach towards mathematics, to understand the difficulties of learning in today's mathematics by identifying the problems, to see the human factor by making use of historical sources in gaining perspective towards mathematical knowledge, to guide historical learning and to develop students' mathematical thinking of historical problems. In other words, HoM provides us with the support we need to transcend and better understand ourselves (Radford & Santi, 2022). Likewise, Baki (2008) noted that teaching practices containing HoM contents and activities can make sense of students by revealing how mathematics shapes our world of thought and finds a response. On that point, it is of great importance to bring students together with HoM activities. However, it will be impossible for teachers to integrate the HoM into lessons unless they have the necessary equipment, knowledge and skills regarding the HoM (Taşkın et al., 2010). However, on the one hand HoM helps students understand that mathematics is a human activity, people have struggled with it for a long time, and it is a subject that has been developed and applied by many over time the HoM, on the other hand helps teachers to show that mathematics is in action, a creative process, and a meaningful activity, thus it is a resource for them to make their lessons more meaningful and cognitively demanding for students (Agterberg et al., 2021). Therefore, the significance of the practices that allow EMT undergraduate students, who are the teachers of the future, to gain concrete experiences about HoM during their undergraduate education should not be underestimated. In this context, considering that CSP is a suitable opportunity, it is aimed that pre-service teachers get concrete experiences in the course of CSP course, and their opinions are taken after these experiences.

In line with the Higher Education Law No. 2547 ([YÖK], 1981), the Community Service Practices [CSP] course, which was included as an experience-based course to various undergraduate programs of Education faculties for the first time as of the 2008-2009 academic year, consists of total of three course hours, one hour of which theoretical and two of which are practical in the curriculum. CSP course contents in the Elementary Mathematics Teaching (EMT) Undergraduate Program prepared by YÖK (2018) are “Society, community service practices and social responsibility concepts; social responsibility projects in terms of social and cultural values; identifying current societal problems; preparing projects for the solution of identified social problems; voluntarily taking part in social responsibility projects individually and as a group; participating in social responsibility projects in various institutions and organizations; participating in scientific events such as panels, conferences, congresses, symposiums as audience, speaker or organizer; evaluating the results of social responsibility projects”. Within the scope of the CSP course, which is based on making undergraduate students active, students first determine a social need as a result of their research, examination and observations, and then they carry out the necessary social discussions and determine the subjects they will work on. Afterwards, they design a project to eliminate this need and carry out this project in the relevant public institutions and organizations. In such manner, undergraduate students have the opportunity to learn by doing, they also strengthen their social skills and self-confidence by establishing social relations with the institutions they include in their projects (Arcagök & Şahin, 2013; Boran & Karakuş, 2017; Çetinkaya, 2018; Kesten, 2012). Numerous studies revealed that students’ human relations and leadership skills are strengthened thanks to the CSP course (Kesten, 2012); their awareness towards

community and social issues has improved (Demir, 2019); their professional experiences have changed positively (Deliveli, 2021) and their reflective thinking skills have increased (Çetinkaya, 2018).

Thus, the second year undergraduate students were expected to carry out a project that included preparing posters about the lives of some mathematicians who left their mark on history, designing materials/activities related to their contribution to mathematics and presenting these posters and materials to secondary school students within the scope of CSP course. They were also requested to keep reflective diaries in which they epitomized all their experiences. Besides, focus group interviews were held at the end of the project. Hence, this study aims to examine the experiences of the second year undergraduate students, who took CSP in the spring semester of the 2021-2022 academic year, within the scope of the Mathematicians Who Left a Mark on History (MWLMH) Project. In service of this aim, the research question was "What are the reflections of the elementary school mathematics teaching undergraduate students' experiences within the scope of the mathematicians who left their mark on history project?".

Significance of the Study

On analyzing the textbooks available in many countries, they contain rich content about HoM (Erdoğan et al., 2015; Mersin & Durmuş, 2018). The role and significance of HoM in mathematics education has been emphasized with the renewal of the curriculum designed and implemented in line with the constructivist approach in 2005 by the Ministry of National Education (Ministry of National Education, [MoNE]) for the first time in our country. However, the parts allocated to HoM in mathematics textbooks were reduced in terms of quantity and quality by making them very limited with the curriculum update studies carried out in 2018 (Başıbüyük & Soylu, 2019; İncikabı et al., 2019; Mersin & Durmuş, 2018; Tan-Şişman & Gençkaya, 2021). This shortcoming may be an obstacle to the integration of HoM into lessons and hence, the lack of knowledge/experience that teachers have in this regard (Alpaslan & Işıksal-Bostan, 2016; Başıbüyük & Soylu, 2019; Yıldız & Baki, 2016; Yıldız & Baki, 2017). Indeed, the integration of HoM with mathematics education is considered vital for both teachers and students (Baki & Bütüner, 2018; Dündar & Çakıroğlu, 2014; Fried, 2008; İncikabı et al., 2019). Therefore, raising teachers' and students' awareness is a social need. Considering the literature on the use of HoM in mathematics teaching, secondary school students' attitudes and thoughts towards mathematics are positively affected, their academic achievement increased, their HoM knowledge improved and their meaningful learning is endorsed (Alpaslan & Işıksal-Bostan, 2016; Baki, 2008; Başıbüyük & Soylu, 2019; Bayam, 2012; Bütüner, 2014; Dündar & Çakıroğlu, 2014; İdikut, 2007; Tan-Şişman & Gençkaya, 2021; Tokay, 2019; Wilson & Chauvot, 2000). Along with a large number of studies conducted with students, many studies were carried out with teachers on integrating HoM activities into the teaching process (Baki & Yıldız, 2010; Yıldız & Baki, 2016). Thus, HoM is also essential for teachers to know the history of basic concepts in order to carry out an interactive teaching (Başıbüyük & Soylu, 2019). In line with the studies that Baki and Bütüner (2018) examined in their meta-synthesis survey on the use of HoM in mathematics education, various studies noted that activities with HoM content mainly increase the student's academic achievement and change their attitudes positively and that teachers have positive views regarding the incorporation of activities into content in the lessons, while others emphasized that the presence of historical content that is disconnected from modern mathematics in mathematics lessons hurts students.

The related literature includes several studies conducted on the use of HoM in mathematics teaching with primary school students (Ersoy & Öksüz, 2016; Tokay, 2019) and secondary school students (Alpaslan & Işıksal-Bostan, 2016; Başıbüyük & Soylu, 2019; Bütüner, 2014; İdikut, 2007; Karakuş, 2009; Küçükoğlu & İncikabı, 2020; Tan-Şişman & Gençkaya, 2021; Yıldız & Taşkın, 2011); teachers (Yıldız & Baki, 2016; Yıldız & Baki, 2017; Yıldız, 2021); postgraduate students (Taşkın et al., 2010) and undergraduate students (Baki & Gürsoy, 2018; Burns, 2010; Dündar & Çakıroğlu, 2014; Galante, 2014; Radford & Santi, 2022; Ulusoy & Girit-Yıldız, 2019; Yenilmez, 2011; Yıldız et al., 2010). However, the studies conducted with undergraduate students heavily focus on examining the participants' views on the HoM course and the use of the HoM in mathematics teaching. However, it is of great importance for undergraduate students, who are the teachers of the future, to conduct research on both Turkish-Islamic mathematicians and other mathematicians who have given direction to mathematics by actively participating to work on the problems (historical problems) that these mathematicians deal with, to have the opportunity to share and experience them through concrete experiences and to include HoM in their lessons in their further teaching experiences. Besides, no such study is specifically published on the project carried out by EMT undergraduate students within the scope of the CSP course. Thus, this study will shed light on the literature regarding being conducted with undergraduate students and contributing to raising awareness among teachers, secondary school students, and undergraduate students that HoM and HoM-related activities can be used in lessons through a CSP project.

Even though it has been a long time since CSP course was included in undergraduate programs, various studies have been carried out in this field (Arcagök & Şahin, 2013; Çetinkaya, 2018; Deliveli, 2021; Demir, 2019; Kesten, 2012; Küçükoğlu et al., 2016; Tanrısever & Yelken, 2011). The relevant literature holds numerous studies on mainly examining the undergraduate students and instructors' views regarding this course (Arcagök & Şahin, 2013; Demir, 2019; Kesten, 2012; Tanrıseven & Yelken, 2011; Uğurlu & Kıral, 2012; Yılmaz, 2011), undergraduate students' social skills and their self-efficacy beliefs related to the course (Çetinkaya, 2018), the knowledge and awareness levels of the undergraduate students about institutions and organizations that can provide social assistance (Arcagök & Şahin, 2013; Boran & Karakuş, 2017; Aykırı, 2017; Çetinkaya, 2018); undergraduate students' feelings and thoughts about social assistance (Akkocaoğlu et al.,2010; Kocadere & Seferoğlu, 2013). However, there is a scarcity of studies carried out with EMT undergraduate students within the scope of the CSP course. Besides, there is no such study specifically conducted on HoM. As Baki and Gürsoy stated, knowing the history of mathematics and how it can be used in the lessons will shed light on the prospective teachers' designing learning environments that include the history of mathematics by developing their horizons (Baki & Gürsoy, 2018).

In this regard, the present study is expected to fill the gap in the relevant literature as it attempts to reveal the undergraduate students' views and experiences about this process includes preparing posters and activities/materials related to the mathematicians determined within the scope of the MWLMH Project and presenting them to secondary school students by examining them through reflective diaries and focus group interviews. In addition, the fact that the project dealt with within the scope of the study includes the integration of HoM with mathematics teaching both allows the pre-service teachers involved in the study to gain experience on this subject and can potentially encourage other researchers in this direction.

Aim of the Study

This study aims at examining the experiences of the second year undergraduate students regarding the MWLMH Project carried out within the scope of the CSP course. EMT undergraduate students prepared a poster and mathematical activity/material about the mathematicians determined within the relevant Project and organized an exhibition to promote these mathematicians in 5 different secondary schools. Hence, the research question was; "What are the reflections of the elementary school mathematics teaching undergraduate students' experiences regarding the MWLMH Project carried out within the scope of the CSP course?". In service of the research question, the sub-problems were identified as follows:

1. What are the reflections of the EMT undergraduate students' experiences in the meetings held within the scope of the MWLMH Project carried out in the CSP course?

2. What are the reflections of the EMT undergraduate students' experiences during the implementation of the MWLMH Project within the scope of the CSP course in schools?

METHOD

Research Design

This study employed the particular case study, one of the qualitative research designs, to analyze the experiences of the EMT second-year undergraduate students regarding the MWLMH Project carried out within the scope of the CSP course. The particular case study method involves the researcher's in-depth examination of a case, activity, process, or individual(s) (Creswell & Creswell, 2021).

Participants of the Study

The participants consisted of 14 EMT undergraduate students, ten girls and four boys, who received a CSP course in the second year at a state university in the Western Black Sea region of Turkey during the spring semester of the 2021-2022 academic year. The students carried out a project called MWLMH within the scope of the CSP course and worked in pairs within the project. In this regard, each group was coded as G1, G2, ..., G7.

Carrying out the Project

The objective of the CSP project, which was carried out by EMT undergraduate students under the supervision of researchers, is to prepare a poster revealing the contributions of mathematicians who left their mark on history and an activity/material that offers the opportunity for secondary school students to experience these contributions concretely and to present these posters and activities/materials to the secondary school students. In this vein, each group initially identified a mathematician who left a historical mark. The Turkish-Islamic

Mathematicians were prioritized when selecting the mathematicians. Since the project was designed for secondary school students, considerable attention was paid to ensure that the contributions made by the mathematicians were congruent with the secondary school learning outcomes and that the activities/materials were of the type that secondary school students could make sense of prior knowledge. Therefore, including mathematicians from different civilizations and Turkish-Islamic mathematicians was deemed appropriate. Afterward, all groups prepared a poster and an activity/material revealing the contribution of the mathematician within the scope of the project and introduced these posters and activities/materials to the secondary school students and teachers through exhibitions in 5 different secondary schools. Table 1 depicts the mathematicians that the groups selected within the project's scope.

Table 1. The Mathematicians that the Groups Selected within the Scope of the Project

Groups	Mathematicians	Contribution of the Relevant Mathematician to the Activity/Material
G1	Omar Khayyam	Khayyam's Triangle
G2	Pyhtagoras	Proof of the Pythagorean Theorem
G3	John Napier	Napier's Bones
G4	Birunî	Chess Problem
G5	Eratosthenes	Sieve of Eratosthenes
G6	Ali Kuşçu	Equation solution by guessing
G7	Hârizmî	Solution the equation of the x2+10x=39

Weekly meetings were held with EMT undergraduate students throughout the entire process. The whole process of the project lasted a total of 14 weeks. The activities carried out with EMT undergraduate students are as in Table 2.

Table 2. The Activities Carried Out with EMT Undergraduate Students

Weeks	Activities
Week 1 and 2	Determining the subject of the project
Week 3 and 4	Identifying the mathematician to be addressed
Week 5 and 6	Preparing and finalizing the posters for the related mathematician
Week 7, 8 and 9	Designing activities/materials to reveal the contribution of the mathematician to mathematics
Week 10 and 11	No events were held due to mid-term exam and public holiday.
Week 12 and 13	Clarifying the implementation schedule and reporting the needs for implementation by meeting with the determined secondary school administrators
Week 13 and 14	Implementing the project designed for secondary school students

Data Collection Tools

This study employed reflective diaries and focus group interviews as data collection tools. The students were expected to highlight what they did within the scope of the CSP course, what kind of difficulties they encountered and how they overcame these difficulties, the success they achieved and their views on CSP course for the relevant week in the reflective diaries used to reveal their reflective thoughts and experiences in the process. Therefore, they were requested to write a reflective diary for the relevant week after each meeting. Reflective diaries were collected weekly and individually as word documents over a classroom created on the Google Classroom platform. As the students were working as a group, the quoted sentence was expressed with the code of the group belonging to the member of the group while the excerpts were presented in the findings section. The present study also used focus group interview technique conducted with a specific subject and group (Yıldırım&Şimşek, 2008). Focus group interviews conducted online with each group lasted approximately 10-15 minutes and they were recorded. These interviews included questions about the students' positive/negative views on the project, their suggestions for the development of the project, whether it met their expectations, the challenges they experienced during its implementation and how they overcame these difficulties, the success they achieved within the scope of the Project and their views on the use of HoM in mathematics teaching.

Data Analysis

Content analysis was used during data analysis. The recorded focus group interviews were transcribed. Afterwards, both the documents of the focus group interviews and the reflective diaries were coded simultaneously by the researchers and the codes were finalized with consensus. Similarly, themes were created by categorizing similar codes by the researchers simultaneously. The codes and themes obtained as a result of the content analysis were presented in tables in line with the related sub-problems and supported with direct quotations. Hence, Yıldırım and Şimşek's (2008) expert review method was used to provide reliability of the research. In terms of protection of personal rights and scientific ethics, the names of schools and teachers were coded and expressed.

FINDINGS

The findings were presented in line with the sub-problems. In this regard, Table 3 displays the findings regarding EMT undergraduate students' views on the project they carried out within the scope of the CSP course.

Table 3. EMT Undergraduate Students' Views towards the Project

Theme	Code	Group
Positive Views	Experiencing a more efficient/successful project process than expected	G2, G3, G4, G5, G6, G7
	Engaging students	G3, G4, G5, G6, G7, RD3, RD7
	Being fun	G1, G3, RD1
	Being a different project from other CSP projects / serving as a model	G2, G4, RD1
	Contributing to students' learning about HoMat an early age	G4, G5, RD7
	Allowing students to have different experiences	G2, G5
	Helping students understand the subject	G2, G6
	No negative view	G1, G6
	Being socially beneficial	G2, G4
	Influencing the views of school administrators/teachers/students positively	G2, RD2
	Pre-service teachers take an active role in each process	G2
	Giving students a different perspective	G3
	Contributing to students' love of mathematics	G4
	Providing permanent learning	G2
Negative Views	Schools are not well set up	G3, G5
	The mathematician they are dealing with does not attract as much attention as other mathematicians	G3
	Compression of application time	G7
Suggestions	More systematic planning of implementation	G1, G5, G6
	Longer application time	G1, G7
	Development of material and/or expression	G3
	Choosing a mathematician suitable for designing game material	G3
	More visualization of poster content	G4
	Contacting teachers instead of administrators	G1
	Preferring more ergonomic materials	G1
	Preference for materials adaptable to levels	G6

*RD1: Reflexive diary Group 1, RD2: Reflexive diary Group 2, …

As in Table 3, EMT undergraduate students shared their positive and negative views as well as various recommendations regarding the project. EMT undergraduate students mostly stated that the project was much more successful and productive than they expected. For instance, G4 emphasized in the focus group meeting that the project was more productive than expected with the following statement:

"It was beyond my expectations. I did not expect that they would be so interested in mathematics historians and materials. [...] In the beginning, we did not believe that it would be so effective, and even as we went on the first day, we had a question mark in our minds. However, it was very productive and we started to continue more enthusiastically. At first, I thought the students would be bored, unwilling to count the grains and would find counting simple. When a student counted to 2048 at the first school we went to, we started to continue with more enthusiasm."

As is seen in Table 3, EMT undergraduate students also expressed positive views regarding the project such as attracting their attention, allowing them to learn about HoM at an early age and having different experiences as well as being fun. To illustrate, G2 emphasized during the focus group meeting that "*I think it is beneficial for students because they have the opportunity to see and discover something different and learn by exploring and reinforce with our own narratives*.". G5, on the other hand, stated "*At first, I didn't think the material would attract attention, but after going to schools, I saw that the children were engaged."* Similar views emerged in the students' reflective diaries. Indeed, G3 explained that the project attracted the students attention in most schools, "*I noticed that there was at least one child who always came to us and tried to take care of us, even during breaks."*; while G7 stated the contribution of the project to the students' acquisition of knowledge about HoMat an early age with such words: *"We started to learn Turkish-Islamic mathematicians at the university. I think students learned about these issues at an earlier age."*. G4 reflected their happiness to be a part of this project in their reflexive diaries as

such, *"We have experienced a teaching practice which we felt valuable. I am very happy that we have made such a practice within the scope of this course."*.

EMT undergraduate students also expressed some negative views about the project process. Only G3 shared a negative opinion that the mathematician they dealt with did not attract as much attention as the others. The determination of schools and the implementation period were among the most common negative views on the project. To exemplify, G5 stated that they experienced a negativity due to school with the following sentences:

"Some schools did not take us seriously, which was a negative experience. Yet, I think we have closed this gap with schools that behaved well. It was a negative aspect for us to give reasons for students to prepare for the exam in A class. Therefore, we lost our enthusiasm, and we could not be very productive. We waited throughout the whole lesson, but we were only able to practice in 10 minutes of break time. The students did not have much time. With the presence of another teacher and the CSP group that day, the limited amount of time was limited even more."

EMT undergraduate students also provided some suggestions regarding the project process. It is remarkable that most of them are consistent with the negative views, namely, they are related to the implementation process of the project. In this regard, G1 recommended that *"If students are divided into groups, it may be good for each student to try and not be confused."*; G5 said, *"There should be a place, table, etc. in schools for this project. It will be better if it is arranged and the lessons are planned accordingly - like 2 classes in each lesson."* and G6 stated, *"Actually, if they can plan which school and which day we will go by communicating with the schools in advance, the confusion we experience can be reduced to a great extent."* These suggestions indicate more systematic planning of the project process. G3 emphasized before the implementation that *"Voluntary and willing schools can be preferred by making a list of which schools will welcome us for the implementation of such a project. Therefore, there won't be any problems for either side."*

EMT undergraduate students were asked about their challenges during the project process. Table 4 demonstrates the students' views on the challenges they encountered during the process.

Table 4. Challenges faced by EMT Undergraduate Students during the Project Process

Theme	Code	Group
Nature of the Project-Related Challenges	Difficulty in determining mathematician and material	G3, G4, G5, RD3
	Difficulty due to narrow scope of the subject	G2
Teacher-Related Challenges	Some teachers are reluctant	G2, G4, RD2
	Being inquisitive	G4
Administrator-Related Challenges	School administrators are unwilling / uninterested	G1, G2, G4, G5, RD1, RD2, RD4, RD7
	Trying to push things hard	G4, G5
Student-Related Challenges	Low academic achievement of students	G5, G7, RD2, RD5, RD7
	Negative student behaviors	G2
	Reluctance of students	G2, RD2
Pre-service Teacher-Related Challenges	Having difficulty in designing materials	G1, G2, G3, G5, G6, G7, RD1, RD2, RD3, RD5, RD6, RD7
	Low motivation due to negative attitudes in schools	G2, G4, G6, G7
	Experiencing concerns arising from instructional activities	G2, G7, RD2
	Facing unexpected questions (lack of knowledge)	G4
	Disagreement in deciding the subject	G6
Other	Unable to cope with the reluctance of administrators/teachers/students	G2, G4, G5
	Difficulty in transferring materials to schools	G2
	Difficulty in acting together	G4
	Having a large number of students	G1, RD1
	Thinking that they do not have much difficulty	G5

Table 4 shows that the challenges faced by EMT undergraduate students during the project were grouped under the themes of challenges related to the nature of the project, the teacher, the administration, the student, the pre-service teacher and other reasons. EMT undergraduate students were determined to mostly mention pre-service teacher-related challenges during the focus group interviews. To exemplify, G1 explained the challenges they

experienced while designing the material: "*While we were preparing the material, we had difficulty in finding a material that would appeal to the level of the students and attract their attention."*

Most EMT undergraduate students pinpointed that the school administrators were unwilling/indifferent. For instance, G2 wrote in the reflective diary, *"We became more and more reluctant when the administrator thought we were doing something aimlessly even though we had repeatedly explained our purpose."* Besides, G5 indicated that when faced with an adverse reaction from a school principal, they were greatly affected and could not overcome it. Here is an excerpt supporting this view:

"We couldn't do anything as the principals were too harsh. The principal's speech made a great impression on us 'This school is not like other schools, this is a successful school, so we cannot give lessons.' etc.. However, I couldn't do anything to overcome that challenge."

As regards the student-related challenges, the EMT undergraduate students implicated the students' low academic achievement. In this context, G5 mentioned that *"While I expected students to know mathematicians/materials at the beginning, I saw that it was not. The 8th graders didn't know Pythagoras, so only successful students were familiar."*

EMT undergraduate students noted that the pre-service teachers had the most difficulty in designing materials amongst the challenges arising from the pre-service teachers. G7 expressed the complexity they experienced while choosing the material in the reflective diary with such a statement *"The challenge we faced was how we would design the material, what it would look like. We had a hard time deciding what to use as a material."*

EMT undergraduate students pointed out that they could not overcome the reluctance of administrators/teachers/students, which they stated as another challenged, they faced. For instance, G2 mentioned that *"A teacher in a school said, 'You are not a teacher.' and 'This school is not like others.' and we did nothing. We thought that such negative situations might be reflected on the students as well due to our negative moods."*. In addition, G1 concluded that they had to work hard due to the large number of students with such a statement, as *"It was sometimes difficult to address the crowd in the class. Confusion arose because the students had to try one-on-one for the duration and it was too much. We got them to line up."*

EMT undergraduate students were asked for their views regarding the contribution of the MWLMH project. The students' views on the contribution of the project are displayed in Table 5.

Table 5. EMT Undergraduate Students' Views on The Contribution of the Project

Theme	Code	Group
Pedagogical Knowledge	Thinking that it contributes to knowing the student	G3, G6
Field Knowledge	Learning more about HoM	G1, G2, G3, G4, G5, G6, G7, RD7
Field Teaching Knowledge	Gaining experience in teaching the subject	G2, G4, G6, G7
	Pondering on gaining prior experience for teaching lessons	G2, G4, G5, RD4
	Realizing the usefulness of concrete materials	G2, G3
	Having experience on how to integrate HoM into lessons	G1
Social Skill	Developing communication with students	G2, G4, G5, G6, G7, RD2, RD4
	Gaining experience in communicating with teachers and administrators	G1
Teaching Experience	Aiding to develop teaching strategies	G1, G3, G4, G6, RD2, RD3, RD4
	Gaining experience in communicating with students	G1, G5, G6, RD1, RD3
	Having experience with the school environment	G1, G5, RD1
	Realizing that s/he likes the teaching profession	G1, G7, RD7
	Thinking that s/he has knowledge about the teaching profession	G1, RD1
	Observing the teacher-student relationship	G1
Other	Realizing that HoM should be attached more importance in lessons	G1, G6, G7
	Observing that HoM can be used in lessons	G5, G6, G7
	Realizing that students have prejudices against mathematics	G1, G3, G7
	Observing students' negative attitudes	G1, G6
	Realizing that it contributes to changing students' bias	G1
	Realizing that use of HoM in lessons is not boring for students	G1
	Thinking that it is the first step to teaching	G6

As in Table 5, EMT undergraduate students stated their views on the contribution of the project under the themes of pedagogical knowledge, field knowledge, field teaching knowledge, social skills, teaching experience and other. It was noteworthy that EMT undergraduate students mostly stressed the contributions to their field knowledge, field teaching knowledge and teaching experience. For instance, G3 expressed that their knowledge of HoM increased thanks to this project with such a statement *"Mathematicians and materials in other groups also reinforced our own knowledge. I knew only Matrakçı Nasuh in the lattice diagram, I also learned about John Napier and Napier's bones thanks to this project."*. Although they received the HoM course, which is among the EMT first-year courses, G7 stated in the following sentences that they gained more permanent knowledge about the mathematicians who shaped the development of mathematics with this project:

"We, too, learned new things about mathematicians and their contributions. Even though we took HoM as a lesson last year, we forgot all about it, still I think that the permanence of this project has increased by giving lectures for a long time and learning by being a part of it for six days."

EMT undergraduate students expressed their views on gaining experience in subject teaching among the contributions of the project to field teaching knowledge. To this end, G2 stated their concern about how to explain the material they designed about Pythagorean Theorem in the first days they went for practice, but this situation changed in the following days: *"Even if we don't give lectures, I think it is an experience for us to tell what we know. When we had to teach the area of the rectangle, etc., we hesitated about how to teach in the first days. But I saw that our narration and diction improved in the following days."*. G4, on the other hand, said that the project contributed in terms of pre-experience for teaching courses with such words *"It was a good experience and experience for all of us and a preliminary preparation for our teaching courses."*.

EMT undergraduate students mostly concentrated on helping to develop teaching strategies of all the contributions of the project in terms of teaching experience. To illustrate, G1 underlined the change they made between the primary secondary school where they practiced and the other schools with their own expressions "*I observed that we get much better results when we motivate and stimulate students. We asked the students to take only the puzzle pieces in the primary school, while we had a competition by keeping time in other schools."*. G3 pointed out that *"It allowed us to experience how it should be explained according to students and their levels."*, while G6 stated *"We made transfers by making arrangements according to the incoming student group and their levels such as the process and/or only the mathematician, his life and contributions."* These groups identified the teaching strategies they used while teaching through making inferences according to the level of the student group. G2 included the following sentences in the reflective diary related to their views that the MWLMH project provides information about the teaching profession:

"We realized that we need to be balanced in our behavior. We have seen that sometimes the seriousness that should be when we want to be close to the students can be broken, and we tried to be friendly at the same time by staying a little serious from time to time. Today, I realized how effective the behavior and body language are in teaching."

According to Table 5, EMT undergraduate students announced that the project contributed to their teaching experience in terms of having experience in communicating with students. To give an example; G2 regarded the improvement of their communication with students as: *"We had the opportunity to improve ourselves in terms of lectures and communication with students in six different schools."* AndG6 stated thattheir self-confidence increased, "*My self-confidence increased while teaching. It was an opportunity to overcome the situation of not being able to reflect what I know to the students."*

EMT undergraduate students marked the project contributed to observing that HoM could be used in mathematics lessons. For instance, G6 experienced that it was likely to incorporate HoM into the curriculum so as to hinder students from memorizing *"I believe that mathematicians and their contributions can be included in the curriculum in a way that will not be based on rote learning and that can be put into practice thanks to this project."* Highlighting the contributions of using HoM in mathematics lessons, G7 implied that *"After explaining these, I realized that they should be used since it makes what students do become more meaningful as they get to know mathematicians, it makes learning easier and it is memorable."*

EMT undergraduate students also shared their views on HoM after the project. Table 6 depicts the students' views on HoM.

Table 6. EMT Undergraduate Students' Views towards HoM

Theme	Code	Group
Positive Views	Thinking that it attracts the attention of the student	G1, G2, G3, G4
	Thinking it will increase memorability	G2, G5, G7
	Thinking it will help to understand the basics of mathematical concepts	G4, G5, G6
	Thinking it helps to realize the necessity of mathematics	G2
	Thinking that students love mathematics	G4
	Thinking it helps students to break their bias against mathematics	G4
	Realizing that the use of HoMin lessons is not boring for students	G1
	Thinking that it motivates students	G1
	Thinking that Turkish-Islamic mathematicians should be prioritized	G6
Negative Views	Thinking that it is difficult to teach all the subjects	G7
	Thinking that the priority subjects will be different	G7
	Unsure about whether they can include HoM	G7

As is observed in Table 6, EMT undergraduate students expressed their positive and negative views on HoM at the end of the project; however, many views were found to be positive. Besides, they expressed a positive view about HoM, if it attracted students' attention at the most level. For instance, G3 argued, "*I think it tells a good story and provides a good introduction. In other words, by whom and how it was found rather than directly dealing with numbers, which draws more attention."*

EMT undergraduate students proved that HoM would help them understand the basics of mathematical concepts. At that point, G4 pinpointed that HoM would be beneficial for students by emphasizing the use of mathematics in daily life and where mathematical concepts come from with such words: *"I think it can be helpful because it shows that we can use many things in our daily lives thanks to historians of mathematics. When I was a student, I used to wonder where a subject came from. Likewise, I think that it will be effective in understanding the concepts as the students are also curious."* G5, on the other, expressed that HoM will be beneficial for mathematics teachers in terms of observing the development of mathematics. "*I think that HoM is a significant course for mathematics teachers. It is crucial in terms of learning that everything emerged in simpler state thousands of years ago such as the currently used formula etc. We can observe how much and how mathematics has developed."*

EMT undergraduate students stated that they would include HoM in their teaching lives since they thought it would increase students' memorability at the end of the project. For example, G2 mentioned that *"I would like to mention it in a way that will attract the attention of the students and stick in their minds."* Assuming that it both facilitates the narration and enhances its permanence, G5 shared the following expression: ,

"I think it can be used in lessons. It can be considered as extra information that can be associated. For example, when Pythagoras is explained, it may not be immediately understandable, but when it is explained together with HoM, it is useful in terms of memorability. I would like to tell stories in break times to be informative and increase memorability."

Upon analyzing Table 4, some EMT undergraduate students expressed negative views on integrating HoM as it would be difficult to teach all mathematics subjects. G7 expressed that *"I have doubts if HoM can be included when it's a bit difficult to teach normal subjects. I think that's why current teachers don't teach through including HoM."*. Similarly, G7 emphasized that *"I think HoM will stay behind as there will be more preferred subjects. In other words, because the students were told 'You read the orals anyway..*

DISCUSSION & CONCLUSION

The present study, which examines EMT undergraduate students' experiences within the scope of the MWLMH Project carried out in CSP course, revealed that the students mostly had positive views about the project. The participants also highlighted that the project carried out with EMT undergraduate students was more productive than expected and held various contributions such as attracting secondary school students' attention and offering them a different experience, helping to make sense of the relevant subject, giving a different perspective, improving their knowledge about HoM and their love of mathematics.

EMT undergraduate students had negative views regarding the selection of schools and the inadequacy of the implementation period for CSP project. This result is congruent with the challenges experienced by undergraduate students due to administrators. The CSP course directive indicates that the cooperation protocols between the Rectorate and the Governorship will be followed in the practices planned at the local level (within the

province) (CSP Course Directive, 2011, p. 2). In this regard, the schools for CSP course project were selected by the undergraduate students, who were the project consultants and coordinators, and were clarified through obtaining the necessary permissions from the Provincial Directorate of National Education within the scope of cooperation protocols between the Rectorate and the Governorship. Besides, the implementation date and the environment were prepared by negotiating with the school administrators. However, as revealed in Küçükoğlu et al.'s (2016) study, undergraduate students had difficulties in the implementation process due to the negative attitudes of some school administrators. EMT undergraduate students stated that school administrators' negative attitudes towards the project adversely affected both teachers' and students' approaches to the project and their own motivation. Moreover, school administrators' negative attitudes affected both teachers' and students' perceptions towards the project, which also decreased their motivation. However, undergraduate students implicated that the school principal they first went to practice with was interested in the project, and teachers and students were also interested.

On the contrary, the school principal considered the project as a waste of time due to exam-oriented perspective in another school; furthermore, s/he did not create a suitable environment for the exhibition of the project and guide the teachers and students to the project exhibition area for similar reasons. These two attitudes affected the EMT undergraduate students' motivation, which could be observed in their reflective diaries and focus group interviews. Thus, it is of utmost importance for the voluntary schools to apply to the Ministry of National Education in advance during the implementation of CSP projects and to design the project process systematically with voluntary schools to carry out the project and ensure the undergraduate students' motivation. In addition, it is remarkable that the school principal has an exam-oriented perspective and hence believing that this project, in which the poster and the concrete material/activity for the contribution of the relevant mathematician to mathematics are designed, will not contribute to the student's development. Likewise, in the study conducted by Arcagök and Şahin (2013), the instructors noted that they encountered many problems related to the institutions and organizations where CSP course was conducted and that the representatives or administrators of institutions and organizations had a low level of awareness regarding the significance of the course. Even though official permissions were obtained, it is vital to determine the schools that are willing to participate voluntarily in CSP course projects and to inform the administrators of the schools where the implementation will be made about the scope and importance of the course before the implementation of the projects. In addition, undergraduate students indicated that communicating with teachers rather than administrators would help the process to work more effectively. This may be due to the perspectives of school administrators and teachers on using HoM in mathematics teaching. Yıldız and Baki (2016) concluded that the integration of HoM in lessons positively and negatively affected the teaching process. The negative reasons that teachers mentioned mostly which prevent them from using HoM in lessons were identified as teachers' anxiety about teaching all the subjects, lack of self-confidence, lack of knowledge and experience about HoM (Fauvel, 1991; Panasuk & Horton, 2012; Yıldız & Baki, 2016). This may be interpreted as an indication that HoM is still underestimated. However, teachers can use HoM in lessons for many different purposes such as alerting students, increasing their attention and making lessons interesting. Teachers will also likely feel self-confident and more experienced for using HoM in their lessons (Clark, 2012; Yıldız & Baki, 2016).

EMT undergraduate students had the most difficulty in deciding which material to prepare and designing the material (suitability of the material for the level of the student, the utensils to be used in the design of the material, ergonomics, etc.). The students affirmed that the discussion environments and the studies they carried out in CSP course meetings helped to overcome these difficulties. Fauvel (1991) noted that HoM played a significant role in coping with the problems by encouraging research. In this regard, weekly meetings with students and discussion environments that offer an opportunity to exchange ideas may help students overcome their difficulties. Similarly, Çetinkaya (2018) investigated the effects of CSP activities on social skills and self-efficacy belief levels of pre-service teachers with a total of 135, 30 of whom were science teachers, 31 primary school teachers, 40 mathematics teachers and 34 pre-school teachers. As a result, they confirmed that the regular exchange of ideas between the advisor and the students would increase the effectiveness of the course.

The results also suggested that the project contributed to the EMT undergraduate students in terms of their field and pedagogical knowledge of mathematics (and HoM), social skills as well as teaching experience. In this vein, the related project activates the undergraduate students in the whole process and directs them to research both about mathematicians and materials; moreover, it contributes to their experience in designing materials and how to integrate HoM into lessons. There are studies stating that integrating HoM in teacher training contributes to the development of pre-service teachers' content knowledge and pedagogical content knowledge (for example Clark, 2012; Galante, 2014; Fauvel, 2007; Panasuk & Horton, 2012). In addition, EMT undergraduate students

emphasized that they were happy to be involved in the project, that they had fun and efficiency, and that their social skills increased. Similarly, some studies showed that CSP course contributes significantly to increasing social sensitivity, improving social and individual skills and professional development (Çetinkaya, 2018; Kesten, 2012). As in Çetinkaya's (2018) study, the present study also demonstrated that CSP course project provided undergraduate students the opportunity to be familiar with the school, the environment, students, institutions, and their future professions and to gain experience. Following the project, EMT undergraduate students expressed positive views about using HoM in mathematics teaching. Accordingly, they emphasized that the activities/materials they developed were useful, interesting and entertaining for students and contributed to their awareness towards HoM. They were also found to develop ideas that they could include HoM in their lessons to make mathematics fun for students, to motivate students to love mathematics, to increase memorability, to eliminate bias against mathematics and to help make sense of mathematical concepts. The relevant literature shows that pre-service teachers having experience with HoM and its use in lessons have developed similar ideas (Burns, 2020; Clark, 2012; Dündar & Çakıroğlu, 2014; Ulusoy & Girit-Yıldız, 2019). For example, in the study conducted by Burns (2010), undergraduate students emphasized that it is important to integrate HoM in the high school curriculum to establish relationships between concepts, draw attention to the subject, and enable students to look at mathematics from a different perspective. Ulusoy and Girit-Yıldız (2019) concluded that the pre-service teachers could benefit from HoM in order to strengthen their teaching processes, to support and motivate students emotionally towards mathematics after HoM course, which included pedagogical experiences with EMT candidates.

Similarly, Dündar and Çakıroğlu (2014) conducted a study with pre-service classroom teachers and found that the pre-service classroom teachers supported the use of HoM in the lessons as it helped students to increase their motivation, display positive attitudes towards mathematics, realize their own skills, actively participate in the problem solving process, increase their tendency towards mathematics, enrich their knowledge, gain a different perspective on problems and think mathematically along with arousing curiosity. Therefore, this study revealed that the CSP project named MWLMH, which is carried out with a focus on HoM, helps undergraduate students to gain awareness and develop a positive perspective on the use of HoMin lessons. Hence, Burns (2010) also stated that the reason for the positive change in the views of pre-service teachers is that they examined some mathematicians and examples of how the history of mathematics could be incorporate in the lessons and had the opportunity to prepare a lesson plan accordingly. Briefly, they gained an appreciation of how they may be able to incorporate HoM in their teaching. In that context, as Clark (2012) stated, we need vigorous examples of how using history in teaching mathematics enables future teachers to both understand mathematics more deeply and to recognize the role of history of mathematics in developing that understanding (p. 81). Finally, a pre-service teacher stated that he thought he couldn't use HoM in his future mathematics teaching, since lack of time and there may be subjects that need to be given priority. It is thought that the reason for this thougt is test anxiety in our country. Hence, as mentioned above there are findings in the literature that lack of time and test anxiety negatively affect teachers' inclusion of MT in their teaching (Panasuk & Horton, 2012; Yıldız & Baki, 2016).

RECOMMENDATIONS

Based on the research findings, various recommendations were provided:

• Pre-service teachers should be offered the opportunity to participate in more projects in which they will take an active role during the undergraduate education process.

• Pre-service teachers should be provided environments to interact more with the school and students.

• For CSP projects where the target organization is schools to be carried out more efficiently, it is of great importance to pre-determine the schools that are willing to participate in the project and sign the relevant protocols by the Provincial Directorate of National Education in each province, just like in the "School Experience" and "Teaching Practice" courses. Besides, informing the institutions and organizations that will participate in the CSP project about the purpose and scope of the course may help school administrators give the projects the necessary attention and importance in terms of the effective functioning of the process.

• The theoretical part of the CSP course is as significant as the practical part. In this regard, weekly meetings with students, the guiding role of the counselor in this process and peer discussions should be highlighted.

• Practical courses should be included in the undergraduate education process so that they can understand the significance of using HoM in lessons and gain experience on this subject. HoM course hours in EMT undergraduate programs are believed to be insufficient. In this respect, the course hours can be increased so that the HoM course can be carried out in two stages, theoretical and practical.

• As many of the contributions of the MWLMH project listed above were observed because of the study, including more HoM in the lessons is recommended. Thus, in-service seminars may be provided for teachers who lack knowledge of how HoM can be used in lessons.

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Researchers' Contribution Rate

The authors contributed equally to the study.

Conflict of Interest

The authors of this article declare that there is no personal conflict of interest within the scope of the study.

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