

Examination of Teaching and Learning Processes of an Elective Applied Mathematics Course*

Ozlem ALBAYRAKOGLU**

Abdurrahman KILIC***

To cite this article:

Albayrakoglu, O., & Kilic, A. (2021). Examination of teaching and learning processes of an elective applied mathematics course. *Journal of Qualitative Research in Education*, 26, 246-264.
doi: 10.14689/enad.26.11

Abstract: This study aimed to examine the teaching and learning processes of an Elective Applied Mathematics course according to the opinions of mathematics teachers and students. Data was collected through interviews and focus group interviews, and the content analysis method was performed to interpret data. Results revealed that the requirements of the curriculum and student-centered education approach were generally not fulfilled. Therefore, meeting student expectations was not at the desired level. However, some teachers expressed that enriching the course with mathematical modeling and engaging problems would affect students' attitudes towards mathematics, in line with the general idea of the course. In general, the lack of school resources and limited teaching staff was a problem that restrict the instruction. As a recommendation, Elective Applied Mathematics teachers and students should be informed about the aim of the course. Moreover, teachers should be experienced in mathematical modeling.

Keywords: Elective applied maths course, elective course, mathematics education

Article Info

Received: 22 Sept. 2019

Revised: 15 Feb. 2021

Accepted: 20 Feb. 2021

© 2021 ANI Publishing. All rights reserved.

* This article was produced from the first author's master's thesis under the supervision of the second author and presented in IV. International Eurasian Educational Research Congress (EJER) on May 11-14, 2017.

** Correspondence: Duzce University, Turkey, ozlemalbayrakoglu@gmail.com

*** Duzce University, Turkey, abdurrahmankilic@duzce.edu.tr

Introduction

Global changes in socioeconomic and cultural experiences force individuals to improve themselves. The education systems, also affected by the knowledge economy, are arranged and transformed in a way that allows individuals to develop themselves in this way (Canli, 2012). Also, the 21st-century competencies influenced the education paradigms, and the curriculums went in a change intending to provide the knowledge and skills required. Thus, the naturally varies needs of students with different characteristics are met by applying diversified education programs (Ulgen, 1992).

One of the main points of general education is based on the assumption that each individual has unique characteristics. The Turkish education system also supports this purpose. In Article 3 of the National Education Fundamental Law (Official Gazette, 14574): "It is a policy that will prepare students for life by developing their interests, attitudes, and abilities by gaining the necessary knowledge, skills, behaviors and the habit of working together, making them happy and contributing to the happiness of the society. Moreover, it is aimed to ensure that they have a profession".

The curriculum changes in 2018 in Turkey aimed to raise individuals who can adapt to the changing contemporary world, learn to learn, and adopt democratic values by considering students at the center of the education system. The renewed curriculum, based on student-centered education and constructivist approaches, the elective courses that support the main subjects were the focal point. Thus, students could explore areas suitable for their characteristics and needs (Cirakoglu & Saracaloglu, 2009). Besides, the elective courses designed according to the needs and preferences of students are intended to reinforce the main courses. According to Tanhan (2013), elective courses work as a tool that enables the democratization of education, and in this respect, it is crucial to the changing socio-cultural and philosophical viewpoint.

According to the Research on Evaluation of the Selection Criteria of Elective Courses (2008) conducted by the Education Research and Development Department (ERDD), the purpose of the elective courses emerges from the acceptance of individual differences and aims to ensure developing students interests and abilities. Elective courses are given importance in developed countries in terms of exposing different student skills, and providing a basis in various fields (Tas, 2004). The research shows the compulsory education and main courses contribute to the academic development of the students, and the extracurricular activities contribute to their personal and social development, while the elective courses aim the both (Lake, 1989). Also, elective courses, which have become an essential element of the curriculum, are seen as one of the best ways to be acquainted in secondary education (Kristiansen, Sorensen & Stidsen 2011). Elective courses, administered especially at the secondary school level, gain more importance because secondary school is defined as an education phase between primary school and high school. Additionally, the elective courses contribute to the transformation of students from childhood to adolescence.

The Elective Applied Mathematics (EAM) course has been put into practice as an elective course by the Ministry of National Education (MoNE) since the 2012-2013 academic year. Grounding on the student-centered education approach and utilizing conceptual understanding as a leading principle, the EAM was designed as a practice-oriented course that would enable students to discover their interests and abilities and develop a positive attitude towards mathematics. Moreover, based on the mathematical modeling approach, the EAM program has adopted the principle of integration mathematics into daily life situations by establishing mathematical models and generating unique strategies in solving the problems presented in this context. Mathematical thinking is assumed as a part of life, and associations with other lessons are suggested. Furthermore, the Turkish Qualifications Framework (2016) declares eight key competencies including mathematics with values such as sharing, flexibility, and aesthetics, which promote equality and the socio-emotional development associated with appropriate acquisitions (Board of Education [BoE], 2018).

Mathematics, considered a frequently used discipline in daily life, is involved in almost every aspect of our lives. Further, it is asserted that being engaged with mathematics could provide a different perspective and interpretation ability by improving the analytical thinking skill of the individual. "Doing mathematics means developing methods for problem-solving, applying these methods, seeing whether they lead to a result, and checking whether your answers are meaningful. "Doing maths" in the classroom should be able to model the act of doing maths in the real world as accurately as possible" (Van de Walle et al., 2010, p13).

Present Study

An efficient applied mathematics course is considered salient for transferring mathematical knowledge into real-life experiences and discovering the application areas. For this reason, an elective course was designed, in which the students could establish the relationship of mathematics with daily life in the mind and strengthen it. EAM, designed as a relevant elective course, would promote the main mathematics course by improving students' problem-solving skills and enabling them to realize real-life applications. However, there are very few studies analyzing EAM teaching-learning processes. It is observed that these studies focus on limited areas related to the EAM. For example, while Coban and Erdogan (2013) focused on the problems faced by teachers; Demirtas et al. (2015) examined teachers' views on the curriculum. On the other hand, Erdem and Genc (2014) and Kesan et al. (2016) researched students' opinions. Also, it is noticed that these studies are generally performed with students at a particular grade level (i.e., 5th-grade students). The present study considered a holistic perspective in examining the teaching-learning processes of the EAM by regarding the opinions of the EAM teachers and students who chose the EAM at various grade levels. Moreover, it was aimed to understand the significant aspects of the EAM which would make it different from the main course and whether it offered the intended contribution to learning mathematics. Also, the present study would draw

attention to the importance of the EAM and improve it. Therefore, the research question of the study is "How is the learning and teaching process of the EAM, and what are the recommendations?".

Methodology

Research Design

The case study design, one of the qualitative research methods, was used in the study. A case study is an approach that involves systematic data collection and in-depth investigation of how a limited system works (Creswell & Poth, 2016; Yin, 2009). In this study, the teaching-learning process of the EAM was considered as the situation to be analyzed, and the views of students and teachers were examined. Accordingly, it has been intended to understand how the learning and teaching process of the EAM takes place in its actual setting.

Study Group

The study group consisted of 84 EAM students and 27 mathematics teachers at public schools in the 2014-2015 academic year, in a city of the Western Black Sea region of Turkey. Since 2012, the mathematics teachers had experienced the EAM teaching-learning process individually and through colleagues. The maximum diversity method, one of the purposeful sampling methods, was used in the selection of the study group. For this reason, 22 secondary schools, two imam-hatip secondary schools, and one boarding secondary school were defined. By choosing different school types, it was intended to increase the possibility of attaining different perspectives (Creswell & Poth, 2016). The students and teachers who gave consent to the interview and had appropriate time were randomly selected. The characteristics of the study group were presented in Table 1 and Table 2.

Table 1.

Study Group-Teachers

Gender	Female- 13	Male- 14
Years of Experience	1-5 years- 11	6-10 years- 10 10-20 years- 4 25 years and above- 2
Major	Mathematics- 22	Other- 5
Graduation	Collage of Education- 23	Other- 4
Employment Status	Permanent- 24	Substitute- 3
Total	27	

Table 2.

Study Group- Students

	Grade Levels			Number of students
	5 th	6 th	7th	
Individual Interviews	4	6	5	15
Focus Grup Interviews	1	7	6	69
	2	5	8	
	3	5	5	
	4	5	-	
	5	-	-	
Total	26	25	33	84

Data Collection and Procedure

The data was collected through interviews with teachers and students and focus group interviews with students. The semi-structured teacher and student interview forms prepared by the researcher were used (Appendix 1). The semi-structured interview forms were preferred since they provided flexibility and fluency during the interview. Besides, in-depth data were collected via probes. Interview forms were developed regarding the relevant literature and formed with expert opinions. Following this, a pilot study was performed with a mathematics teacher and a student. After that, the interview forms were given their final form.

The interviews were recorded with the permission of the interviewees and then transcribed. Teacher interviews lasted at least 6:41 minutes and at most 26:11 minutes. Student interviews lasted at least 2:39 minutes and at most 8:44 minutes. At the beginning of the individual interviews, the students experienced stress due to the interview and gave short and non-detailed answers to the interview questions. Considering that students are individuals of the same age who know each other, focus group meetings were preferred instead of individual interviews when appropriate to reduce the stress. Thus, with the focus group interviews, it was ensured that the students could hear different ideas and be inspired by each other. Accordingly, their answers would be meaningful and varied. The focus group discussions intend to reveal the purpose underlying the group responses by interacting (Bloor, 2001). Individual or focus group interviews were handled according to appropriateness. Also, more students were reached by saving time with focus group interviews. However, individual interviews were conducted in cases where group formation was difficult. The

interviewees selected in the focus group interviews must be experts in the subject field or have experienced the phenomenon (Yildirim & Simsek, 2013)

Within the scope of this study, EAM course students were accepted as living the phenomenon. Furthermore, in the focus group interviews, the interviewees should have information on the subject to be discussed. The students in the focus group were informed in detail about the purpose of the study just before the interview. Focus group interviews lasted at least 6:08 minutes and at most 15:08 minutes. The teachers and students were coded in real names suitable for their gender and sociocultural character.

Data Analysis

In this study, the content analysis method was used in analyzing and interpreting the data in detail. The data that are similar to each other are collected within the framework of themes and sub-themes, arranged, and interpreted reasonably (Fraenkel & Wallen, 2012; Merriam, 2009). During the data analysis, the subsequent steps were followed in the light of the principles suggested by Miles and Huberman (1994), explained below.

Creating text from recordings; the records taken during the interviews were listened to and transcribed to text. *Coding;* early in the study, the researcher scanned recorded data and developed categories of codes. Coding continued with temporary codes and keywords that emerged during repeated analysis. The data obtained from each interviewee were coded independently. To maintain the connection of the encoded data with the original data the sources were noted. The codes were recorded as raw data, and no conceptualization was made at the beginning of the analysis process. *Secondary coding;* to strengthen the reliability of the research, after four months from the first coding, the researcher performed another coding procedure. *Agreement between consecutive codings;* the data collected from the first and second encodings were semantically matched, and the correspondence between the codes was examined by eliminating the repeated codes. The agreement between two coding process was determined via Miles and Huberman (1994) method; $[\text{Consensus} / (\text{Consensus} + \text{Disagreement})] \times 100$. The agreement percentage obtained from the teacher, student, and student focus group interviews were respectively 83.87%; 77.5%; 84.4%.

Analysis process-Theming; the teacher and student data were analyzed separately. Repeated analysis and revisions were made by taking expert opinion. Furthermore, to maintain the connection of the codes with the original data, the process was recorded step by step. At the end of the second coding, the data were collected in themes. *Theme-code comparison;* throughout the design of themes from codes, cross-comparisons were made and the consistency of the data was checked and the created themes were unified or rearranged. *Obtaining sub-themes and themes;* the data collected under themes were transformed into sub-themes, and finally, the data were

conceptualized in main themes. The teacher and student view differentiation were removed, so the data obtained from all data collection tools were united.

Tabulation and presentation of data; findings were revealed via tabulating themes and sub-themes and constructed theme names selected as the table title. *Explanation and interpretation of tables;* tables were summarized and interpreted. Additionally, comments were supported by direct quotations taken from the interviews.

Validity and Reliability

In qualitative research, validity and reliability are redefined within the concepts of credibility, transferability, consistency, and confirmability (Maxwell, 1996; Merriam, 2009; Yildirim & Simsek, 2013). Accordingly, the present study examined the concept of validity under the specifications of credibility and transferability. The credibility, as internal validity, was ensured via different perspectives and experiences in the research setting by triangulation. Teachers and students were varied data sources, and interviews and focus group discussions were varied data collection tools. The findings obtained from different data sources and data tools were combined to create a holistic view. Besides, to strengthen the credibility, the data obtained from different interviewees were checked for authenticity. For transferability, as external validity, the entire research process, the research model, study group, data collection tools, and data analysis steps were explained in detail.

The reliability was examined under the terms of consistency and confirmability. To ensure consistency, the interviews were handled in the same vein, and the recorded interviews were listened again and crosschecked with transcribed documents. Additionally, direct quotations were given not to strip the data at hand from the context in which they occurred. For confirmability, the driven results were confirmed with the collected data and presented in a logical framework. The collected data and obtained codes were reserved by the researcher and were open to researchers' review.

Findings

In this section, findings that are themed under research questions are presented. The themes, inspired by the interviewee's expressions in the research data, were formed as ***Inadequate Teaching***, ***Adequate Teaching***, and ***Teacher Suggestions***. The theme of ***Inadequate Teaching***, with sub-themes *planning*, *teaching-activities*, and *assessment-evaluation*, is displayed in Table 3.

Table 3.

Inadequate Teaching

Sub-theme	Codes
Planning	Not using curriculum
	Planning is not considered
	Planning as a continuum of the main course
	Plans adapted from online sources
Teaching-Activities	Not conducted as planned
	Instructed as a continuum of main course
	Preparation for central exams
	Conducted as a different course
	Solving routine problems
	Solving problems similar to main course
Assessment-Evaluation	Irrelevant activities such as playing chess, map review, outdoor playing
	Traditional approaches-not suitable with the program recommendation
	Evaluation related with the main course performance
	Using rating points for correct answers
	Using standard exams

The *inadequate teaching* theme revealed that the EAM was not designed according to curriculum, yet some teachers were unaware of the curriculum. Furthermore, planning was not separated from the main course, and adapted plans were used from online sources. The following opinion was stated by teacher Omer:

I do the planning as follows: search Google, find a lesson plan, and write down it. However, sometimes we make a difference. Like how? If there is an activity associated with the subject I am dealing with in the main course, I do the related activity on that day. But the planning remains the same as on the internet source.

Results revealed that, instead of modelling activities as expected in curriculum, teachers conducted the lesson as a continuum of the main maths lesson, a make-up lesson, or preparation for central exams, even as a different lesson. Additionally, it was understood that some teachers found the EAM challenging to perform. Ayse teacher expressed her opinion on this issue as follows:

Low achieving students do not like mathematics and get bored quickly. Sometimes absenteeism is inevitable, and it is a down trip to teach such students. However, when we look at our practice on EAM, my colleagues and I mostly use this lesson as the main math lesson to go over the

topics or solve routine tests. It is an elective course but not conducted as it must be. Instead, it is a bit like exercise time. I do not think we are implementing it adequately.

The students also stated that the EAM was conducted without a differentiation from the main maths lesson or the curriculum was not implemented adequately. For instance, the teacher wrote questions on the chalk-board which were chosen from the test books rather than introducing challenging problem situations. In some situations, the teacher delivered a test and left the class alone. In the focus group interview, Beril stated her views as follows:

I like maths, but I don't like the elective because we always do a test. The teacher delivers some tests meanwhile, he does some stuff on the computer.

The EAM curriculum proposed an integrated assessment and evaluation approach, yet not considered in practice. For instance, students were assessed via a written exam or rating points from a right solution on chalkboard. The teachers explained that the school administration demanded a concrete criterion such as a written exam. Besides, for some teachers, it was not likely to give a grade separately from the main course. Ahmet and Hatice teacher expressed their views as follows:

The assessment-evaluation is like classical math writing. Yet, the questions are a little different. We deliver the test the students solve it. I never thought of a different assessment technique. We have an evident criterion to show when demanded. Honestly, we are restricted at this point. Show the exam papers and get clear. That is our logic (Ahmet, Teacher).

I can not dissociate the main course performance from the elective (Hatice, Teacher).

The findings revealed that some teachers tried to apply the curriculum and plan independently from the main course, and the EAM was perceived as an engaging lesson. Furthermore, some teachers organized the content suitable to the student level or student needs. The theme of **Adequate Teaching** is displayed in Table 4.

Table 4.

Adequate Teaching

Sub-theme	Codes
Planning	Planning according to curriculum
	Planning differentiated from the main course
	Organize the content at student level or for student needs
Teaching-Activities	Engaging activities-problem based learning
	Discovery learning
	Real-life/every day problems
	Activating all students

	Cooperative learning-peer educating
	One to one communication
	Mathematical games, intelligence puzzle questions, origami
Assessment-Evaluation	Active participation
	Research projects

According to the findings in **adequate teaching** theme, some teachers developed engaging activities, presented problem situations from daily life, tried to make all students active, and used activities selected from the course-book. Furthermore, group work, cooperative learning, and peer education were used, and activities were designed according to student needs. Expressed views are displayed as follows:

We are a little more independent in EAM. Students design problem situations and try to solve them. Research and application are priorities (İbrahim, Teacher).

We use daily life problems and usually seek out ideas to make the whole students active in the lesson. In the maths (main course), the student who does not understand the topic cannot participate very much, while in EAM, a daily life problem engages a half-hearted or a low achiever (Aygun, Teacher).

In classroom activities, some teachers used mathematical modeling methods and materials (geometric objects, geometry sticks, blocks), designed activities fostering psychomotor skills, and introduced games such as mathematical puzzles, sudoku, and origami. Furthermore, students were encouraged to design stories, poems, or plays about mathematical concepts. Some of the opinions expressed on this subject are displayed below:

We design our own math game with my friends, one day. We wrote beautiful poems and stories about numbers in our way (Seyma)."

We draw a leaf and tried to find how many square units it had (Merve).

The student performance was evaluated according to the formative assessment approach. The research projects and active participation in the group work were the main objectives. Some of the opinions expressed on this issue are presented below:

I do not use the typical tests to assess students. Instead, I observe students, try to understand their contribution to group work, and take notes for their grading (Burcu, Teacher).

I do not want anyone to have lower grades in elective mathematics because this could lead to a lower self-efficacy for learning math. My students would say I am not good at the main course but I am pretty well in elective. Finally, he would be more passionate to succeed. That's why I try to assess according to active participation (Ali, Teacher).

My teacher considers my effort and grades my work (Berra).

The EAM teachers' opinions about the improvement of the course were collected under the theme of *Teacher Suggestions*, presented in Table 5. The results revealed that teachers' suggestions were on a great variety of topics. The suggestions were united under the sub-themes of *foundation* and *teaching-learning*.

Table 5.

Teacher Suggestions

Sub-theme	Codes
Foundation	The number of EAM lessons per week should be increased and the lessons should be held at efficient hours
	Class sizes should be reduced
	Students should be diversified according to grade levels
	There should be a math lab or a special setting
	Information technologies should be used
	Teachers should share their work-experience on digital information platforms
	Proposed activities should be diversified and qualified
	Course materials should be provided
	The number of mathematics teachers should be increased
	There should be specialized teachers for EAM
	Seminars-trainings should be provided to raise awareness about EAM
	Pilot projects should be carried form curriculum reforms
	Teaching-Learning
Mathematical studies should be employed	
The EAM should be handled with engaging activities	
There should be no grading	
There should be a grading scheme	
A holistic assessment approach should be considered	
There should be project assignments, material designing and math challenges	

The *foundation* sub-theme revealed that the EAM curriculum should be reformed via pilot designs, the number of EAM lessons per week should be increased, the lessons should be held at efficient hours, and class sizes should be reduced. Furthermore, students should be diversified according to grade levels. There also should be enough labs-course materials, and information technologies to increase student engagement.

Additionally, recommended activities should be qualified and teachers should share their work-experience on digital information platforms. Finally, the number of mathematics teachers should be increased or specialized. Some of the viewpoints expressed on this subject are presented below:

It has probably been researched, but it's applicability to our country should be analyzed via pilot projects. The EAM should be developed in the light of the findings, but not done in this sense, as I know (Huseyin).

For example, there is no lab or math class in our school. As a suitable environment and foundation are provided, the importance of the lesson will be notified. Because of the lack of materials, this cannot be achieved at the desired level. It is quite inefficient (Burcu).

First of all, let me say that elective courses should be included in the student's weekly calendar with different planning rather than being an after-school activity. As the elective courses were placed for the last hours, the efficiency and the participation rates are very low, so the lesson does not go as planned (Musa).

If information technologies are used, I think it can be a more engaging lesson, students will attend the lesson without getting bored (Hatice).

It is necessary to create a common sharing digital platform similar to the EIN (Education Information Network) (Metin).

In this area, teachers should take special workshops at some point to develop appropriate skills. The EAM should be considered as a specific field. In other words, the teacher should be able to devote all his time (Ahmet).

If they can, they should do as follows, the Ministry of National Education will determine specialized teachers working in one school one day and another school the next. Otherwise, how can we perform the EAM when there is no permanent math teacher in our school. (Metin)

The *learning-teaching* sub-theme showed that the efficiency of the EAM could be improved by using engaging activities and mathematical studies, on the contrary to some suggestions such as using class hours for remediate education or central exam. Some teachers supported the grading system with an exam because this made the lesson valuable for the students, hence increased attendance. However, some teachers supported grading yet with a holistic assessment approach since an exam did not correspond with the curriculum goals. Instead, there should be project assignments, material designing, and math challenges. Some of the opinions expressed on this subject are presented below:

"I lecture four hours elective, but I would prefer six additional course hours in a week. Why? Because I am doing something relevant here, preparing the eighth graders for central exams (Ali)."

"When there is no grading, the students will grow the idea of cutting the lesson so, I need to have an ace in the hole. The more effort you put, the more valuable it is (Hasan)."

In my opinion, a written exam is an unsound method of assessment anyway. You teach an applied course and use a test full of definitions, matching activities, and routine problems (Burcu).

Sometimes, I saw math experiments on the internet, and I would like children to do them, to get grades by doing something they will never forget. I wish they could manage such an experimental process or deliver presentations to discover a different side of mathematics (Alper).

Conclusion and Suggestions

The present study revealed that in most cases, the learning-teaching processes of the EAM were handled in a way that contradicted the purpose of the curriculum. For instance, some teachers did not have adequate knowledge or willingness to perform curriculum objectives. Furthermore, the student-centered approach, a principal requirement of the curriculum, was not considered in in-class activities. As a result, the EAM might not provide a significant contribution to mathematical reasoning. According to the findings, most of the teachers thought that EAM should be lectured with engaging activities as aimed in the curriculum yet, in practice, a teacher-centered approach dominated class activities, revealing a negative tendency to internalize the curriculum objectives. Research shows that teachers' views about the curriculum are not directly reflected on their classroom practices (Gunes, 2008; Seferoglu, 2007). In Birgin and Baki's (2012) study, it was observed that there were inconsistencies between the discourse of some classroom teachers and their classroom practices. Similarly, learning-teaching process of elective courses are held in traditional methods rather the student-centered ones (Coskun, 2016; Tas, 2004). As a result, no matter how well the curriculum is developed and extensive needs analysis has been managed, the teachers as practitioners in the field should adopt a student-centered approach for educational efficiency (ERDD, 2007; Cohen, Raudenbush & Ball, 2003). On the other hand, results depicted that there were teachers who differentiated their teaching and tried to perform student-centered learning environments, and students found mathematics engaging. Hence, this displayed the fact that EAM could change students' attitudes towards mathematics. For example, Inam and Unsal (2017), Saban (2019), and Korkmaz (2016) stated that students' mathematics literacy scores were positively affected in learning environments where EAM was formed with appropriate activities.

A salient point arising from results is, teachers had different views on the assessment system, particularly on the grading, and in most cases, the formative or holistic assessment was not practiced. Relevant literature states that holistic assessment methods are considered complicated, not suitable for every learning context, time-consuming, and challenging to use in overcrowded classes (Arseven, 2013; Erdal, 2007; Kapucu, 2016b; Toptas, 2011). Though teachers have an understanding of new methods, they neglect them in practice (Bal, 2008; Gelbal & Kelecioğlu, 2007). The findings of this study are also in line with the relevant literature. For instance, some views stated that a routine test was not appropriate for an applied course, but the

procedures and the administrators' claim to present a shred of concrete evaluation evidence constrained teachers. Furthermore, grading was seen as a necessity to ensure attendance. A similar result is stated by Bozdogan et al. (2014), that students cannot maintain their motivation towards the elective course in default of grading.

Results revealed that the EAM teachers had notable suggestions for educational effectiveness. For instance, curriculum reforms, reduced class sizes, diversified grade levels, equipment support, modeling activity source books, specialized classroom settings, efficient weekly schedule, and vocational training were prominent ones. Bozdogan et al. (2014) state that the elective courses are held in adverse hours. In Turkey, the reason arises from the MoNE's (2012) legislation which declares that applied courses should be in the afternoon hours. Furthermore, schools are faced with the dilemma of meeting a wide variety of student needs; hence, school administrators are forced to create a complicated weekly program (Merenbloom & Kalina, 2012). Lack of equipment, need for specialized classroom settings, and vocational education for teachers are also expressed in studies related to elective courses (Bozdogan et al., 2014; Coskun, 2016; Cavus & Oztuna Kaplan, 2013; Esbahoglu, 2015; Kapucu, 2016a; Ozut, 2014; Uysal, 2015; Yakar & Saracaloglu, 2016). These studies suggest that schools should be supported in terms of equipment, resources, and qualified teachers to meet the expectations of a wide variety of students in elective courses (ERDD, 2008; Seferoglu, 2007). In brief, school conditions and the foundation problems might be dominating factors affecting the learning and teaching process of EAM; and hence, limiting educational effectiveness.

In the light of the research findings, some suggestions are developed. First of all, the EAM curriculum should be improved with the help of math teachers. In this context, real-life analogies and modeling examples proper with grade levels should be integrated into the curriculum. Furthermore, a flexible and holistic assessment system should be introduced. The schools should be supported in terms of materials, classrooms, and information technologies. Research findings show that teachers are unwilling to lecture EAM because of high course loads, since they need time to put in research and preparation. The schools could demand contract teachers in case of teacher shortage, and those teachers could work only for the EAM. Furthermore, micro-teaching practices could allow teachers to observe and improve themselves. The vocational education and workshops on mathematical modeling could also be supportive for teachers.

The present study did not use participant observation as a data collection method because of time and legislation constraints, which could be considered a limitation. Further studies, with participant observation, could provide relevant data about the learning-teaching process of the EAM, so they could contribute to a more explicit understanding. Furthermore, the study group of the research is limited to a specific province. Studies with extended study groups (in different geographic regions) could present a more comprehensive perspective on EAM learning-teaching process.

References

- Arseven, Z. (2013). *A study on the adequacy of primary school maths teachers in the application of alternative assessment approaches included in the primary school maths curriculum of 2005*. [Unpublished master's thesis]. Uludag University, Bursa.
- Bal, P. (2008). The evaluation of new mathematic curriculum in term of teachers' perspectives *Journal of Cukurova University Institute of Social Sciences*, 17(1), 53-68.
- Birgin, O., & Baki, A. (2012). An investigation of the purposes of the measurement and assessment practice of primary school teachers within the context of the new mathematics curriculum, *Education and Science*, 37(165).
- Bloor, M. (Ed.). (2001). *Focus groups in social research*. Sage.
- Board of Education [BoE] (2018). *Middle and imam-hatip schools elective applied mathematics course curriculum for grades 5-8*. Turkish Ministry of National Education.
- Bozdogan, B., Bozdogan, A.E., & Sengul, U (2014). Examination of teacher views about implementation science course with regard to different variables. *Mersin University Journal of the Faculty of Education* 10(3), 96-109.
- Canli, G. (2012). *The student-centered education and knowledge economy*. [Unpublished master's thesis]. Bogazici University, Istanbul.
- Cavus, R., & A. Oztuna Kaplan. (2013). *Science teachers' opinions about the middle school 5th grade science applications lesson*. [Conference presentation]. 22nd Educational Sciences Congress, 5-7 September, Eskisehir.
- Cirakoglu, M., & Saracaloglu, A., S. (2009). The effect of the multiple intelligence theory applications on the academic achievement of students in primary school. *The Journal of Turkish Educational Sciences*, 7 (2).
- Coban, F. N., & Erdogan, A. (2013). Difficulties encountered by the teachers in fifth grade applications of mathematics course *Turkish Journal of Computer and Mathematics Education (TURCOMAT)*, 4(3).
- Cohen, D. K., Raudenbush, S. W., & Ball, D. L. (2003). Resources, instruction, and research. *Educational Evaluation and Policy Analysis*, 25(2), 119-142.
- Coskun, U. (2016). *Investigating the effect of elective science application course to the scientific literacy and scientific attitude of the students, and perceptions of teachers' opinions about the lesson*. [Unpublished master's thesis]. Selcuk University.
- Creswell, J. W., & Poth, C. N. (2016). *Qualitative inquiry and research design: Choosing among five approaches*. Sage.
- Demirtas, Z., Arslan, S., Eskicumali, A., & Civan, E. (2015). Teachers' evaluations about elective mathematic applications for 5th and 6th grade curriculum. *Procedia-Social and Behavioral Sciences*, 174, 4074-4082.
- Education Research and Development Department. [ERDD] (2007). *Student centered education application model*. Turkish Ministry of National Education.
- Education Research and Development Department. [ERDD] (2008). *A survey of the evaluation of selection criteria for elective courses*. Turkish Ministry of National Education.
- Erdal, H. (2007). *The investigation of measurement and evaluation parts in the new elementary school mathematics curriculum (case of Afyonkarahisar)* [Unpublished master's thesis]. Afyon Kocatepe University.

- Erdem, A. R., & Genc, G. (2014). The students who choose elective applications of mathematics lesson at 5th secondary school to course opinions. *Journal of Qualitative Research in Education-JOQRE2*(2), 9-26.
- Esbahoglu, F. (2015). *The problems and solutions encountered in the process of selection of elective courses in the fifth and sixth grades in secondary schools*. [Unpublished master's thesis]. Istanbul Aydin University.
- Fraenkel, J. R., & Wallen, N. E. (2012). *How to design and evaluate research in education* (8th ed.). McGraw Hill.
- Gelbal, S., & Kelecioğlu, H. (2007). Teachers' proficiency perceptions about the measurement and evaluation techniques and the problems they confront. *H. U. Journal of Education*, 33(33).
- Gunes, G. (2008). *Reflection on new primary school mathematics curriculum on the teaching and learning environment*. [Unpublished master's thesis]. Karadeniz Technical University.
- Inam, A., & Unsal, H. (2017). Evaluation of the effect of teaching web-based applications of maths subject on 5th grade students' performance and motivation through students' views. *HAYEF: Journal of Education*14(1), 203.
- Kapucu, M. (2016b). The evaluation of science applications course curriculum according to the views of the teachers. *Journal of Qualitative Research in Education*, 4(1), 26-46, <http://dx.doi.org/10.14689/issn.2148-2624.1.4c1s2m>.
- Kapucu, M. S. (2016a). Evaluation of selective course of science application according to the views of middle school students (5th, 6th and 7th grades). *Journal of Theory and Practice in Education* 12(1), 17-40.
- Kesan, C., Cosar, M. C., & Erkus, Y. (2016). Views of secondary school students about elective application of mathematics course. *The Western Anatolia Journal of Educational Sciences (WAJES)*7(14), 33-44.
- Korkmaz, T. (2016). *Effects of mathematical applications course on the students' mathematical literacy*. [Unpublished master's thesis]. Eskisehir Osmangazi University.
- Kristiansen, S., Sorensen, M., & Stidsen, T. R. (2011). Elective course planning. *European Journal of Operational Research*, 215 (2011) 713–720.
- Lake, S. (1989). *Exploratory and elective courses in the middle level school. Practitioner's monograph #8*. ERIC.
- Maxwell, J.A. (1996). *Qualitative research design: An interactive approach*. Thousand Oaks, CA: Sage.
- Merenbloom, E. Y., & Kalina, B. A. (2012). *Creative scheduling for diverse populations in middle and high school: maximizing opportunities for learning*. Corwin Press.
- Merriam, S.B. (2009). *Qualitative research: A guide to design and implementation*. Jossey-Bass.
- Miles, M., & Huberman, A.M. (1994). *Qualitative data analysis*. Sage Publications.
- Ministry of National Education [MoNE] (2012) *Elective courses curricular*. http://tegm.meb.gov.tr/meb_iys_dosyalar/2012_08/31022530_secmeliders.pdf
- Official Gazette. 24.6.1973. Number: 14574. <http://www.resmigazete.gov.tr/arsiv/14574.pdf>.
- Ozut, A. (2014). *Evaluation of primary school levels elective lessons evaluation criterias to teachers and school managers*. [Unpublished master's thesis]. Firat University.
- Saban, O. (2019). *The investigation of the effects of the applications of mathematics course on middle school students' mathematical literacy and attitudes towards mathematics*. [Unpublished master's thesis]. Hacettepe University.

- Seferoglu, S. S. (2007). Primary school computer curriculum: A critical evaluation and problems faced during implementation. *Eurasian Journal of Educational Research*, 29, 99-111.
- Tanhan, F. (2013). *An evaluation of elective course practices in the context of psychological counseling and guidance: student-centered education* [Conference presentation]. Symposium on Elective Courses in the Discrete 12-Year Compulsory Education Model. Van.
- Tas, B. S. (2004). *The evaluation of the curriculum of elective courses, at primary school 6th, 7th and 8th grades, direction of teachers and students' opinions*. [Unpublished master's thesis]. Cukurova University.
- Toptas, V. (2011). Classroom teachers' perceptions about the use of alternative assessment and evaluation methods in mathematics courses. *Education and Science*, 36 (159), 205-219.
- Turkish Qualifications Framework [TQF]. (2016). www.myk.gov.tr/TYC .
- Ulgen, G. (1992). Elective courses on 6,7 and 8th grades *Hacettepe University Journal of Education* 8(8).
- Uysal, B. (2015). *Evaluation of the elective courses in the middle school according to the opinions of the students, teachers and school administration*. [Unpublished master's thesis]. Ankara University.
- Van de Walle, J. A., Karp, K. S, & Williams, J. M. B. (2010). *Elementary and middle school mathematics: Teaching developmentally*. (7th edition). Pearson
- Yakar, A., & Saracaloglu, A. S. (2016). The evaluation of secondary school 5th grade science applications curriculum implemented in 2013 according to metfessel-michael curriculum evaluation model (Mugla sample). *Journal of Theory and Practice in Education* 12(3), 769-796.
- Yildirim, A. & Simsek, H. (2013). *Qualitative research in social sciences*. (9th edition). Seckin.
- Yin, R. K. (2009). *Case study research design and methods*. (4th edition). Sage.

Authors

Contact

Dr. Ozlem ALBAYRAKOGLU completed her Ph.D. at Bolu Abant Izzet Baysal University, Mathematics Education Department in 2019. Her scientific interests include mathematics achievement, achievement emotions, educational equality, elective courses and values education.

Dr. Ozlem ALBAYRAKOGLU
E-mail: ozlemalbayrakoglu@gmail.com

Dr. Abdurrahman KILIC is a professor at the Curriculum and Instruction department at the Education Faculty of Duzce University. He gained his Ph.D. degree in the field of Curriculum and Instruction at Hacettepe University in 2000. His academic interest areas are program development, needs analyses, democracy, values education, student-centered education, instructional models.

Prof. Dr. Abdurrahman KILIC
Educational Sciences, Faculty of Education
E-mail: abdurrahmankilic@duzce.edu.tr

APPENDIX 1

Elective Applied Mathematics Course Teacher Interview Questions

1. What are your opinions about the EAM curriculum?
1. Does it fulfill the need? What are its weaknesses? Is it appropriate for the student level? How it differs from the main math course. What is your opinion about the objectives?
2. How do you plan EAM? What are you doing to differentiate from the major course(mathematics)?
3. What are the differences in the teaching-learning process from the major course(mathematics)? Which activities are used? What are your opinions on the activities in the guidebook? Are they suitable for the student level?
4. To what extent do schools have specific arrangements for the requirements of EAM lessons? Do the teachers have /design course materials?
5. How do you evaluate the students' attitudes and motivations towards the lesson? What is their level of attendance?
6. How the assessment-evaluation performed? What is your alternative assessment and evaluation suggestion?
7. What are the advantages/gains of the EAM course for the students?
8. Do you have any comments or suggestions?

Elective Applied Mathematics Course Student Interview Questions

1. What is your reason for choosing the EAM? What are your expectations from this course?
2. What kind of activities designed during the class hours? Problem situations, games, experiments, etc. What are the course materials?
3. What are the activities or projects you did with your friends in this lesson?



4. How does your teacher evaluate your performance?
5. Written exam, performance assignment, projects, etc.
6. What are the differences between the EAM and the main course?
7. How did the EAM affect your attitude towards mathematics?