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AUTHORS: Seçil Bilgin,Derya Gögebakan Yildiz

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Evaluation of the Secondary Education 11th and 12th Grade Mathematics Curriculum[1]

Seçil BİLGİN [2], Derya GÖĞEBAKAN YILDIZ[3]

Abstract

In this study, it was aimed to evaluate the 11th and 12th grade mathematics curriculum implemented in 2018 with the CIPP model, one of the curriculum evaluation models. The research was carried out with a mixed method in which quantitative and qualitative data were used together. In Türkiye, 90 11th grade students, 90 12th grade students and 50 mathematics teachers participated in the study. In order to obtain the quantitative data of the study, the CIPP model and the scale for evaluating the high school mathematics curriculum in terms of process and product dimensions were applied to the students and the questionnaire prepared by the researcher was applied to the teachers. Semi-structured interviews were conducted with 12 teachers to obtain qualitative data. The Cronbach Alpha reliability coefficient of the questionnaire applied to teachers was .938, and the Cronbach Alpha value of the scale applied to students was .94. Content analysis and descriptive analysis were used together in the analysis of qualitative data. As a result, the subjects of the curriculum are sufficient, the physical environment is suitable for the implementation of the curriculum and there are sufficient resources, the learning outcomes of the curriculum are appropriate for the level, the readiness of the students is not appropriate, time cannot be used efficiently due to the spiral system, the curriculum is student-centred, the information learned is difficult to apply in daily life. It was determined that the historical concept of mathematics was not emphasized, teachers used smart board, z book and EBA, the curriculum was carried out in cooperation with the teachers in the department, the curriculum did not provide students with sufficient mathematical skills that they could use in daily and social life, and it was sufficient to prepare them for central exams.

Key Words

Mathematics
Curriculum Evaluation
CIPP model
Secondary school mathematics

About Article

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[2] Teacher, Salihli Necip Fazıl Kısakürek Social Sciences High School, Türkiye, secilbilgin45@gmail.com, https://orcid.org/0000-0003-3544-3007

[3] Assoc. Prof. Dr., Manisa Celal Bayar University Faculty of Education, Türkiye, dgogebakan@yahoo.com, https://orcid.org/0000-0002-8831-8878

Introduction

Education has always been seen as an important element to train individuals who have the knowledge and skills needed in societies and who will adapt to the developments and changes that occur over time (Yüksel, 2010). The importance of brain power is increasing day by day for human beings who have passed from the industrial age to the information age. The aim of education systems is to use brain power in the best way and to reveal new information (Yüksel, Kaya, Urhan & Şefik, 2019). It is seen that the level of development of a society increases depending on the increase in its knowledge level (Erden, 2017). In the information age, societies need individuals who had good mathematics education. Mathematics education develops the ability to solve a problem, to produce alternative solutions to that problem and to develop the ability to interpret (Aydın, 2003). Raising individuals who are suitable for the purpose of education systems depends on the quality of curricula (Yüksel, 2010). Changes in science and technology have also affected education systems and countries have developed new curricula in accordance with the needs of the time (Aktaş, 2013). In our country, as a result of the curriculum development study, changes are made and continue to be made in curricula from time to time (Baki, 2020). In the press release for the 2017 curriculum change, the Board of Education (Turkish: Talim ve Terbiye Kurulu-TTKB) stated that, while making this change, they also took into consideration educational plans, international exams such as the Trends in International Mathematics and Science Study (TIMSS) and the Programme for International Student Assessment (PISA), reports prepared by various institutions, and scientific research on the subject. The first mathematics curriculum in Türkiye was prepared in 1927 (Keskin, 2019). The curriculum, which is still in use in the 2023-2024 academic year, was put into practice in 2018.

The Ministry of National Education (MoNE) revised all curricula in 2017, and the mathematics curriculum was revised again, the number of learning outcomes, the content of some learning outcomes, the order in which some subjects were taught were changed and some subjects were removed from the curriculum. With this revised curriculum, it is aimed to raise individuals who can produce and use knowledge, find solutions to the problems they face, have high self-confidence and are beneficial to society. The curriculum is arranged in a simple and understandable way in a way of taking individual differences into consideration while conveying information. In this curriculum, certain subjects and learning outcomes at different grade levels are given with a spiral structure, while subjects and learning outcomes that are not arranged in a spiral structure are also included (MoNE, 2018).

Secondary education 11th and 12th grade mathematics curriculum is applied in Anatolian high schools that take students with LGS (Turkish: Liselere Giriş Sınavı-High School Entrance Examination) and Anatolian High Schools and Social Sciences High Schools that take students with secondary school grade point average (MoNE, 2018). Secondary school mathematics curriculum 11th and 12th grade subjects and outcomes cover the mathematics subjects and outcomes in the Field Proficiency Test (Turkish: Alan Yeterlilik Testi-AYT), which is the second stage of the Higher Education Institutions Examination (Turkish: Yükseköğretim Kurumları Sınavı-YKS). When the data of the YKS exam in recent years are evaluated, it is seen that the average correct answer of 40 mathematics questions in the AYT exam was 9.96 in 2020, 6.19 in 2021, 7.72 in 2022, and 7.20 in 2023 (ÖSYM, 2020;2021;2022;2023). In the based on light of these data, it was determined that the number of mathematics correct answers of students who graduated from high school and entered the university exam was between 15% and 25% of the questions in the mathematics test. This situation makes it necessary to investigate how effective and efficient this curriculum is. In addition, the Ministry of National Education (2018) stated that it will make the necessary revisions in the mathematics curriculum according to the results of the research on the curriculum. In the literature review, it was seen that there were many evaluation studies related to the curriculum, but no evaluation was made specifically for the Secondary Education 11th and 12th grade mathematics curriculum. Curriculum evaluation is the decision about the suitability, effectiveness and success of the prepared curriculum by using scientific research techniques (Uşun, 2016). Curriculum evaluation studies provide guidance for those who make decisions about the continuation, improvement, modification or termination of the curriculum (Fitzpatrick, Sanders, & Worthen, 2019). In this context, different approaches and opinions on curriculum evaluation have emerged and different curriculum evaluation models have been developed (Demirel, 2021). In this study, Stufflebeam context, input, process and product evaluation model was

used. Stufflebeam (1971) in this model, evaluation is done in four parts: context, input, process and product. It is also called CIPP evaluation model (Stufflebeam, 1971). CIPP consists of the initials Context (C), Input (I), Process (P), Product (P).

Contextual evaluation investigates whether the curriculum to be evaluated responds to the needs, and what the needs and problems of the curriculum implementers are (Fitzpatrick et al., 2019). In addition, a situation analysis of the curriculum is also conducted (Ornstein & Hunkins, 2017).

Input assessment collects information about the resources used to achieve the objectives and how these resources are used. Process evaluation provides information about the implementation phase of the curriculum. It provides information about the deficiencies in the implementation phase of the planned curriculum and how the planned activities are carried out (Ornstein & Hunkins, 2017). Product evaluation investigates now compatible the product resulting from the program is with the expected result. It provides information to decision makers about the future of the curriculum (continuation, modification or abolition) (Fitzpatrick et al., 2019).

The evaluation of the secondary school 11th and 12th grade mathematics curriculum according to Stufflebeam context, input, process and product model is considered important in terms of examining the curriculum in a multidimensional way. It has been seen that there are many thesis and articles about the 2018 mathematics curriculum (Çil, Kuzu & Şimşek, 2019; Demir, 2021; Önal, 2020; Biçer, 2019; Yalçınkaya, 2018; Avcı, Erikçi & Ok, 2021). In the existing studies, it was observed that there was no evaluation specific to 11th and 12th grades. Curriculum evaluation is considered important in terms of obtaining the opinions of groups that are not involved in the curriculum preparation process. (Fitzpatrick, Sanders, & Worthen, 2019). In this study, since it was aimed to evaluate the Secondary Education 11th and 12th grade Mathematics Curriculum, which was put into practice in 2018, according to Stufflebeam (CIPP) model with the dimensions of context, input, process and product, answers to the following problems were sought.

1) What is the level of teachers' opinions about the context, input, process and product dimensions of the curriculum?
2) What are the opinions of teachers about the context, input, process and dimension of the curriculum?
3) What are the views of 11th grade students about the process and product dimensions of the curriculum?
4) What is the level of 12th grade students' views on the process and product dimension of the curriculum?

Method

In this study, mixed method was used in which qualitative and quantitative research methods were used together. In mixed research, the complementarity of qualitative and quantitative data strengthens the study (Uşun, 2016). In addition, a simultaneous design in which quantitative and qualitative data are of equal importance was used. In this study, a questionnaire was applied to teachers and a scale was applied to students to obtain quantitative data. Semi-structured interviews were conducted with teachers to obtain qualitative data. Semi-structured interviews, which are highly preferred in qualitative research, allow the researcher to update the questions and be more flexible during the interview (Sönmez & Alacapınar, 2011). The questionnaire applied to the teachers in the study was prepared by the researcher by taking expert opinion after conducting a literature review. The scale for evaluating the high school mathematics curriculum prepared by (Keskin, 2019) with the CIPP model in the process and product dimensions was applied to the students. The qualitative data of the study was obtained from semi-structured interviews conducted by the researcher with teachers within the framework of the CIPP model.

Study group

The population of the study was determined as high school students in Türkiye. The sample of the study consists of 180 students taking 11th and 12th grade mathematics courses in the 2022-2023 academic year and 50 mathematics teachers. The sample of the study was determined by purposive

sampling in which the most appropriate groups were selected for the purpose of the research (Baştürk & Taştepe, 2013). While determining these groups, attention was paid to have students and teachers from different school types. This was planned to collect more accurate data about the curriculum. The school types participating in the study were determined to be Anatolian High Schools and Social Sciences High Schools. Science High Schools were excluded from the study because they follow the Science High School Mathematics Curriculum.

There were 30 female and 60 male students in Grade 11 and 65 female and 25 male students in Grade 12 participating in the survey. There were Anatolian high school that accepts students by exam 30, 30 Anatolian High School and 30 Social Sciences High School students in Grades 11 and 12, totalling 90 students. Of these students, 48 students in 11th grade are equal weight and 42 students in numerical department, 54 students in 12th grade are equal weight and 36 students in numerical department.

Table 1. Demographic characteristics of the teachers

Demographic Characteristics		
Gender	Female	23
	Male	27
Professional Seniority	1-5 years	None
	6-10 years	2
	11-15 years	8
	16-20 years	7
	21-25 years	20
	25 and above	13
Graduated faculty	Faculty of Education	33
	Science and Literature	17
	Other	None
Education Status	Bachelor's degree	35
	Master's Degree	14
	Doctorate	1
School Type	Anatolian High School accepts students by exam	10
	Anatolian High School	36
	Social Sciences High School	4
Class Level You Teach	11th grade	12
	12th grade	4
	11 and 12th grade	34

As seen in the table, 46% of the researched group are female and 54% are male teachers. In addition, 66% of the group consisted of teachers with over 20 years of experience, 66% were graduates of the faculty of education, and 30% were teachers with master's and doctoral degrees.

The demographic characteristics of the teachers who participated in the interview are given below.

Table 2. Demographic characteristics of the interviewed teachers

Teacher	Gender	Professional Seniority (years)	Graduated Faculty	Educational Status	School Type
T1	Female	21-25	Science and literature	Bachelor's degree	Anatolian High School
T2	Male	6-10	Science and literature	Bachelor's degree	Anatolian High School
T3	Female	21-25	Science and literature	Bachelor's degree	Anatolian Vocational High School
T4	Male	21-25	Science and literature	Bachelor's degree	Anatolian High School accepts students by exam
T5	Female	21-25	Faculty of Education	Bachelor's degree	Social Sciences High School
T6	Male	21-25	Science and literature	Bachelor's degree	Anatolian Vocational High School
T7	Male	25 and above	Faculty of Education	Bachelor's degree	Social Sciences High School
T8	Male	21-25	Science and literature	Bachelor's degree	Social Sciences High School
T9	Female	25 and above	Faculty of Education	Bachelor's degree	Social Sciences High School
T10	Female	21-25	Science and literature	Bachelor's degree	Anatolian High School
T11	Male	11-15	Faculty of Education	Master's Degree	Anatolian High School accepts students by exam
T12	Female	11-15	Science and literature	Master's Degree	Anatolian Vocational High School

The table shows the data about the gender, professional seniority, graduated faculty, educational status, school type and class level of the teachers who participated in the interview.

Data Collection Process

The data of the study were collected face-to-face by the researcher in September-December during the 2022-2023 academic year. Permission was obtained from Manisa Directorate of National Education for the research. The schools were visited, and the scale was applied to the students in appropriate classes. Scale applications were completed in approximately 20 minutes. For the teacher questionnaire and interviews, teachers were interviewed, and appointments were made for their convenience. The questionnaire was completed in approximately 10 minutes and the interviews in 20-25 minutes. Teachers were informed that the questionnaire and interviews were for the 11th and 12th grade curriculum and that participation was voluntary. Permission was obtained from the teachers to record the interviews, and the interviews were conducted using a recording device. The interviews of the two teachers who did not give permission were conducted by taking notes.

Data Collection Tool

Secondary Education 11th and 12th Grade Mathematics Curriculum Evaluation Teacher Survey

Before preparing the teacher survey, the literature was reviewed and similar studies on the subject and the data collection tools of these studies (Aközbek, 2008; Abat 2016; Önal, 2020; Keskin, 2019) and the Secondary Mathematics Curriculum were examined. 43-items survey including context, input, process and product dimensions are developed by the researcher. The opinions of three mathematics teachers and one curriculum and instruction expert were taken for the content and face validity of the survey. As a result of the evaluations, a 35-item survey was created. The context

dimension of the survey consists of 13 items (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13); the input dimension consists of 7 items (14, 15, 16, 17, 18, 19, 20); the process dimension consists of 7 items (21, 22, 23, 24, 25, 26, 27); and the product dimension consists of 8 items (28, 29, 30, 31, 32, 32, 33, 34, 35).

The teacher survey consists of two parts. The first part includes the Personal Information Form to measure gender, professional seniority, graduated faculty, educational status, type of school, and grade level. The second part is the Teacher Survey for the Evaluation of Secondary School 11th and 12th Grade Mathematics Curriculum, which consists of 35 items in 5-point Likert type.

Scale for Students' Evaluation of High School Mathematics Curriculum in Process and Product Dimension with CIPP Model

For the students, the scale developed by Keskin (2019) to evaluate the high school mathematics program in the process and product dimensions with the CIPP model was used. The scale consists of 24 items in 5-point Likert type. The first part of the scale includes the Personal Information Form in which the students' gender, school type, grade level, and the field from which they will take the university entrance exam are obtained, and the second part includes items related to the process and product dimensions. The scale consists of 24 items, 11 items for the process dimension and 13 items for the product dimension. The eigenvalue of the process sub-dimension is 3.95, the variance explained by it is 36%, and the Cronbach Alpha reliability coefficient is .81. The eigenvalue of the product sub-dimension is 7.05, the variance explained by it is 50% and the Cronbach Alpha reliability coefficient is .92.

Semi-structured Interview Form

The qualitative data of the study were obtained from semi-structured interviews with teachers. Interview is a technique of getting ideas about a subject. Semi-structured interviews provide the flexibility to change the questions during the interview (Sönmez & Alacapınar, 2011). For the semi-structured interview form, the researcher examined similar studies (Abat 2016; Keskin, 2019; Tekalmaz, 2019), the Secondary Mathematics Curriculum (MoNE, 2018) and created an 11-question interview form within the scope of the CIPP model in parallel with the questions in the teacher survey. For this interview form, a program evaluation expert and four mathematics teachers were consulted, and it was determined that the questions were appropriate. The interview form was finalized.

Data analysis

SPSS 25 program was used in the analysis of quantitative data. The Cronbach Alpha reliability coefficient of the questionnaire, in which teachers' opinions about the Secondary 11th and 12th grade Mathematics Curriculum were taken, was found to be .938. In addition, Cronbach Alpha value for the context dimension of the questionnaire was .846; for the input dimension was .678; for the process dimension was .826, and for the product dimension was .908. It was seen that the reliability of the questionnaire was high in sub-dimensions.

In the Analysis of the Scale for Students' Evaluation of High School Mathematics Curriculum in Process and Product Dimension with CIPP Model, Cronbach Alpha value was found to be .94. In addition, normality analysis of the scale was performed to determine the use of parametric or nonparametric tests in data analysis. As a result of the analyses, it was seen that the mean test score of the scale was -.388 and kurtosis was -.284 in the 11th grade. In 12th grade, the skewness value was -.478 and kurtosis value was -.219. Since these values were between -2 and +2, it was accepted that the data were normally distributed (George & Mallery, 2010) and it was decided to conduct parametric tests.

The value ranges used in the interpretation of the arithmetic mean of the scores obtained from the items in the questionnaire in which the teachers' opinions about the Secondary School 11th and 12th grade Mathematics Curriculum and the "Scale for Students' Evaluation of the High School Mathematics Curriculum in the Process and Product Dimension with the CIPP Model" are 1.00-1.79 (Strongly Disagree), 1.80-2.59 (Disagree), 2.60-3.39 (Moderately Agree), 3.40-4.19 (Agree), 4.20-5.00 (Strongly Agree).

Content analysis and descriptive analysis techniques were used together to analyze the qualitative data. For content analysis, codes and categories were created and presented in tables. In

descriptive analysis, teachers' opinions about the questions were directly quoted. The interviews with the teachers were transcribed as data.

Findings

In the study evaluating the 2018 Secondary Mathematics 11th and 12th Grade Curriculum, the Teacher Questionnaire for Evaluating the Secondary Mathematics 11th and 12th Grade Curriculum was applied to teachers and the Scale for Evaluating the High School Mathematics Curriculum in the Process and Product Dimension with the CIPP Model was applied to students. Additionally, semi-structured interviews were conducted with teachers. Quantitative and qualitative research findings are presented below.

Findings on Evaluation in Context Dimension

The question of what the level of teachers' views on the context dimension of the 11th and 12th grade mathematics curriculum were investigated and the findings are presented in Table 3.

Table 3. Teachers' views on context dimension

Item	Items related to the context dimension	N	$\bar{X}$	Sd
1	Mathematics curriculum meets the mathematics education needs of students	50	3.48	.81
2	The mathematics curriculum enables students to make connections between mathematics and other subjects	50	3.38	.88
3	Weekly class hours (duration) are sufficient for the implementation of the mathematics curriculum.	50	3.50	.93
4	The outcomes of the curriculum form the basis for students' future mathematics experiences.	50	3.42	.78
5	The time allocated in the curriculum according to the level of difficulty and ease of the subjects is sufficient.	50	3.22	.91
6	The curriculum prepares students for central exams.	50	3.22	.76
7	The curriculum is designed in accordance with the individual differences of the students.	50	2.58	.70
8	The conceptual information contained in the curriculum is sufficient.	50	3.80	.64
9	The curriculum is designed taking into account students' prior learning.	50	3.64	.80
10	In the curriculum, the subjects are arranged from simple to difficult and as a continuation of each other.	50	3.64	.94
11	Recommended resources for the implementation of the curriculum are available.	50	3.60	.83
12	The spiral structure of some topics in the curriculum facilitates learning.	50	3.38	.78
13	The curriculum has features that will help students gain mathematical thinking skills.	50	3.28	.70

It was seen that the mean of the items belonging to the context dimension of the Secondary Mathematics Curriculum was $\bar{X}$=3.39 (between 2.60-3.39-Moderately Agree). The item that the teachers agreed with the most in the items related to the context dimension in the questionnaire was "The conceptual information contained in the curriculum is sufficient. $\bar{X}$ =3.80 (between 3.40-4.19-Agree), the item they agree with the least is "The curriculum was created in accordance with the individual differences of the students." $\bar{X}$ =2.58 (1.80-2.59-Disagree).

Regarding the question of what the teachers' views are on the context dimension of the 11th and 12th grade mathematics curriculum, the findings obtained from the following questions asked to the teachers are given in Table 4.

1) Are the school facilities (physical environment, resource supply, smart board, number of students, etc.) suitable for the implementation of the curriculum?

2) What is your opinion on the adequacy of the topics in the curriculum for the 11th and 12th grade level?

Table 4. Teacher interview findings on the context dimension

Theme	Category	Code	Teachers
Context	Physical environment	Suitable	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12
	Source and material	Sufficient	T1, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12
		Insufficient	T2
	Smart board	Available	T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11, T12
		Suitable for level	T1, T2, T3, T5, T6, T7, T8, T10, T11
	Topics	Should be simplified	T12, T6
		Should be combined	T7, T9
		Shouldn't have been simplified	T4

Teachers stated that the physical environment is suitable for implementing the curriculum, resources and smart boards are available. T5: "It is suitable, we do not have any problems." One of the teachers stated that the subjects in the 11th and 12th grade curriculum were sufficient and appropriate for the level as follows. T1: "The curriculum of 11 and 12 is good. We don't have time problems, and the children understand it."

Findings Related to Evaluation in Input Dimension

The question "What is the level of teachers' opinions on the input dimension of the 11th and 12th grade mathematics curriculum?" was investigated, and the findings are presented in Table 5.

Table 5. Teachers' views on the input dimension

Item	Items Related to Input Dimension	N	$\bar{X}$	Sd
14	The learning outcomes of the curriculum are at an achievable level.	50	3.66	.66
15	The time allocated to learning outcomes in the program is sufficient.	50	3.48	.81
16	Learning outcomes of in the curriculum are related to each other.	50	3.74	.72
17	Students' attitudes towards the course are positive.	50	2.90	.76
18	Students' level of readiness is sufficient for the implementation of the curriculum.	50	2.78	.89
19.	The topics in the curriculum are of interest to students.	50	2.86	.70
20.	Teachers are adequately equipped to implement the curriculum.	50	4.04	.88

The mean of the input dimension of the teachers' views on the 11th and 12th grade Mathematics Curriculum was $\bar{X}$=3.35 (between 2.60-3.39-Moderately Agree). In the opinions of the teachers about the input dimension, the opinion they agree with the most is "Teachers are sufficiently equipment to implement the curriculum. $\bar{X}$=4,04 (3.40-4.19-Agree) and the least agreed opinion was "Students' readiness levels are sufficient for the implementation of the curriculum. $\bar{X}$=2,78 (between 2.60-3.39-Moderately Agree).

Regarding the question of what the teachers' views are on the input dimension of the 11th and 12th grade mathematics curriculum, the findings obtained from the questions asked to investigate this are given in Table 6.

1) What do you think about the appropriateness of the objectives in the curriculum according the level and readiness level of the students?

2) What do you think about the time allocated to the subjects for the implementation of the curriculum and the weekly course hours?

3) Do you find the textbook sufficient to implement the curriculum? Do you use different books as a source?

4) What are the positive and negative aspects of the curriculum?

Tablo 6. Teacher interview findings on the input dimension

Theme	Category	Code		Teachers
INPUT	Learning Outcome	Suitable for level		T5, T8, T9, T10, T11
		Spiral structure is not suitable		T4, T6
		Readiness is adequate		T2
		Readiness is not enough		T3, T6, T7, T8, T9, T12
		The learning outcomes of Turkish/Mathematics and The Science/Mathematics fields should be separate		T1, T2
	Duration	For 12th graders	Enough	T1, T2, T3, T4, T5, T7, T8, T9, T10, T11
			Insufficient	T6, T12
		For 11th grade	Enough	T1, T2, T4, T7, T8, T10, T11
			Insufficient	T3, T5, T6, T9, T12
	Textbook	Theoretically enough		T1, T4, T5, T10
		Insufficient in terms of question types		T2, T3, T4, T5, T7, T11, T12
		Theoretical and question type is enough		T9, T10
	Positive aspects of the curriculum	Curriculum simplification		T1, T5, T8, T11, T12
	Negative aspects of the program	Spiral system		T2, T3, T4, T6, T7, T8
		Geometry not being a separate course		T6, T11
		Inability to relate to daily life		T5

One teacher stated that the learning outcomes were appropriate for the level, but the students' readiness was insufficient as follows. T8: "Although the learning outcomes are appropriate, readiness varies according to the students' work. They cannot transfer what they learned in 10th grade to 11th grade, sometimes they forget, they may need a short repetition. Readiness is weak.

Teachers stated that the time allocated to implement the curriculum is sufficient, but the Social Sciences High School 11th grade mathematics course durations are 5 hours per week, while in other high schools it is 6 hours per week. One teacher's views on the subject are as follows. T9: "Normally 6 hours is enough, but in 11th grades we have 5 hours and other schools have 6 hours, then, it is not enough, an hour is missing, we teach the same curriculum, they teach 6 hours, we teach 5 hours, "the course time has to be increased to 6 hours."

They stated that the textbook was prepared theoretically well, but it was insufficient in terms of question types. The opinions of a teacher on the subject are as follows. T4: "The textbook is theoretically adequate, they give the definitions, formulas very well, they give the proofs, and I use them a lot. In logarithm, it does not only give the property, but it also gives the reason why it is so, it is very good."

Teachers stated that the negative aspects of the curriculum were that the subjects were given in a spiral system, that geometry was not a separate course, that the subjects could not be associated with daily life, and that the same curriculum was applied for every student. They found the simplification of the curriculum positive.

Some of the teachers' opinions about the positive and negative aspects of the curriculum are presented below.

T3: "The spiral structure is sometimes not positive for our students. They come to a certain topic and leave it halfway, and when they see it again next year, they have forgotten that topic and we have to go back to the beginning again, and I honestly do not see this as very positive for our students."

T8: "The simplification of the curriculum was good, at least the students started to think about the subjects more deeply and logically. In other words, they try to learn the core of the subject rather than memorizing. When there was a lot of information, we always tried to memorize, so it is good that it was simplified...."

Findings Obtained from Teachers' Views on Process Dimension

The question "What is the level of teachers' views on the process dimension of the 11th and 12th grade mathematics curriculum?" was investigated and the findings are presented in Table 7.

Table 7. Teachers' views on the process dimension

Item	Items related to the process dimension	N	$\bar{X}$	Sd
21	In the implementation of the curriculum, students actively participate in the lessons.	50	3.38	.78
22	Information and communication technologies are used in the implementation of the curriculum.	50	3.92	.66
23	The curriculum is student-centered.	50	3.54	.79
24	During the implementation of the curriculum, sufficient practice and exercise solutions are made for each subject.	50	3.26	.94
25	Different learning and teaching techniques are applied during the implementation of the curriculum.	50	3.58	.83
26	While implementing the curriculum, activities are associated with real life problems.	50	3.54	.73
27	The curriculum is implemented in cooperation with the teachers.	50	3.94	.74

It was seen that the mean of the teachers' opinions about the process dimension of the 11th and 12th grade mathematics curriculum was $\bar{X}$=3.59 (3.40-4.19-Agree). The opinion that the teachers agree with the most is "The curriculum is implemented in cooperation with the teachers of the department. $\bar{X}$=3.94, (3.40-4.19-Agree), and the least agreed opinion was "There are enough practice and exercise solutions for each subject while the curriculum is being implemented. $\bar{X}$=3.26 (between 2.60-3.39 - Moderately Agree).

To investigate the question “What are the teachers' views on the process dimension of the 11th and 12th grade mathematics curriculum?”, semi-structured interviews were conducted with teachers and the following questions were asked.

1) What are the problems you encounter at implementing the curriculum? What would you suggest overcoming these problems?

2) Do you make changes while implementing the curriculum? If so, can you explain what kind of changes they are?

3) Do you use information and communication technologies while implementing the curriculum? Can you explain how you use them?

The findings obtained from the interviews are presented in Table 8.

Table 8. Findings from the interviews on the process dimension

Theme	Category	Code	Teachers
Process	Problems Experienced	Abstractness of the subjects	T2, T11
		Inadequacy of readiness levels	T1, T3, T11
		Spiral education	T4, T6, T12
	Changes made	Early completion of 12th grade subjects	T1, T2, T11
		Repetition old topics	T4, T5, T6
	Use of information and communication technology	Using the smart board	T1, T2, T3, T4, T5, T6, T7, T8, T9, T11, T12
		Dynamic math software or digital tools	T4, T12, T11
		Using the z book	T3, T5
		Using the EBA and OGM materials	T5, T6, T10, T12

As problems encountered during the implementation of the curriculum, it was stated that 11th and 12th grade mathematics topics were more abstract than the lower grades, students' readiness was not sufficient and there were problems due to the spiral system. When teachers were asked about the changes they made while implementing the curriculum, they stated that they completed the 12th grade subjects early due to the university exam, and that they had to repeat the subjects in the lower grades because the parts of the subjects in the lower grades were forgotten due to the spiral system. Teachers stated that they used the smart board and EBA (Turkish: Eğitim Bilişim Ağı- Educatıın Information Network) materials while implementing the curriculum. The opinions of some teachers are as follows.

T12: "The fact that the curriculum is given in a spiral disrupts the integrity of the subject. Since students forget most of the subjects they learned a year ago, they have difficulty in acquiring the follow-up learning outcomes."

T5: "No, we do not make changes, we apply the order in the curriculum. But I revise old topics to remind them."

Findings Obtained from Students' Views on Process Dimension

1) In order to evaluate the program in the process dimension, their opinions were taken with the scale applied to the students.

2) What is the level of 11th grade students' views on the process dimension of the 11th grade mathematics curriculum?

What is the level of 12th grade students' views on the process dimension of the 12th grade mathematics curriculum? The questions were investigated, and the findings are presented below.

Table 9. Arithmetic mean and standard deviation values of 11th and 12th grade students' level of participation in the items in the process dimension

		GRADE 11			GRADE 12		
Item	Items Related to Process Dimension	N	$\bar{X}$	Sd	N	$\bar{X}$	Sd
1	I actively participate in mathematics lessons	90	3.50	1.10	90	3.62	1.11
2	I interact with my teacher in math class	90	3.68	1.12	90	3.83	1.07
3	The activities in mathematics lessons interest me.	90	3.23	1.28	90	3.36	1.14
4	I can easily apply the knowledge I have learned in mathematics in daily life	90	2.74	1.30	90	2.77	1.22
5	The teacher takes class participation into account when grading.	90	4.06	.95	90	3.98	1.08
6	The concepts in mathematics course are discussed with their historical development.	90	2.61	1.28	90	2.80	1.30
7	Mathematics is taught through inquiry and discovery	90	2.97	1.40	90	3.06	1.24

Table 9. Arithmetic mean and standard deviation values of 11th and 12th grade students' level of participation in the items in the process dimension (Continued)

Item	Items Related to Process Dimension	GRADE 11			GRADE 12		
		N	$\bar{X}$	Sd	N	$\bar{X}$	Sd
8.	I ask my teacher without hesitation what I do not understand in class	90	3.98	1.15	90	4.02	1.12
9.	In mathematics, we are provided to reach generalizations based on sample problems.	90	3,60	1.26	90	3.66	1.12
10	I associate my existing knowledge in mathematics with the new information I learn in the lesson	90	3.50	1.30	90	3.60	1.12
11	I can express my results in mathematical language	90	3.14	1.28	90	3.41	1.15

11th grade students' mean agreement with the views on the process dimension was $\bar{X}$=3.36 (between 2.60-3.39-Moderately Agree). 11th grade students' opinions on the process dimension of the mathematics curriculum, the opinion they agree with the most is "The teacher takes participation in the lesson into consideration when giving grades. $\bar{X}$=4.06 (3.40-4.19-Agree). The opinion that they agree with the least is "The concepts in the mathematics course are handled together with their historical development. $\bar{X}$=2.61 (between 2.60-3.39-Moderately Agree).

The 12th grade students' mean agreement with the views on the process dimension was $\bar{X}$=3.46 (3.40-4.19-Agree). In 12th grade students' opinions on the process dimension of the mathematics curriculum, it was determined that the opinion they agreed with the most was "I ask my teacher without hesitation about the places I do not understand in the lesson." $\bar{X}$=4.02 (3.40-4.19, Agree), and the opinion they agreed with the least was "I can apply the information I learned in mathematics lessons in daily life." $\bar{X}$=2.77 (between 2.60-3.39-Moderately Agree).

Findings Obtained from Teachers' Views on Product Dimension

To evaluate the curriculum in the product dimension, a questionnaire was applied to the teachers and interviews were conducted.

The question 'What is the level of teachers' opinions on the product dimension of the 11th and 12th grade Mathematics Program?' was investigated, and the findings are presented in Table 10.

Table 10. Teachers' views on the product dimension

Item	Views on the Product Dimension	N	$\bar{X}$	Sd
28	The curriculum provides students with mathematical thinking skills.	50	3.48	.76
29	The curriculum contributes to students' problem-solving skills.	50	3.48	.76
30	The curriculum develops students' analytical thinking skills.	50	3.52	.76
31	The curriculum forms the basis for students' subsequent mathematics learning.	50	3.78	.76
32	At the end of the curriculum, students have achieved all the learning outcomes.	50	3.34	.80
33.	The curriculum enables students to achieve the desired success in central exams.	50	3.24	.89
34.	The curriculum provides students with mathematical skills that they can apply in real life.	50	3.18	.87
35.	Students can benefit from their achievements in other courses.	50	3.30	.97

The mean of the product dimension of the teachers' views on the 11th and 12th grade mathematics curriculum was $\bar{X}$=3.42 (3.40-4.19-Agree). In the opinions of the teachers about the product dimension, the opinion they agree with the most is “The curriculum forms the basis for students' next mathematics learning. $\bar{X}$=3.78 (3.40-4.19, Agree), and the least agreed opinion was “The program provides students with mathematical skills that they can apply in real life. $\bar{X}$=3.18 (between 2.60-3.39-Moderately Agree).

To investigate the question, 'What are the opinions of teachers about the product dimension of the 11th and 12th grade mathematics curriculum?', interviews were conducted with the teachers, and the following questions were asked.

1) What are your views on the 11th and 12th grade mathematics curriculum in terms of preparing students for central exams?

2) What are your suggestions for improving the 11th and 12th grade mathematics curriculum?

The findings obtained from the interview questions related to the product dimension are presented in Table 11.

Table 11. Findings from the interviews on the product dimension

Theme	Category	Code	Teachers
PRODUCT	Central exams Preparation	Enough	T1, T2, T3, T4, T5, T6, T9, T11, T12
		Insufficient	T8,
		Insufficient for next generation questions	T7, T9

11th and 12th grade Mathematics Curriculum is sufficient to prepare students for central exams: T4: "When the curriculum is fully implemented, it is sufficient for students, of course it meets all the subjects that will appear in the exams..... but normally when we look at it in terms of learning outcomes, when we look at it in terms of resources, it is sufficient for preparation for exams."

As suggestions for the improvement of the curriculum, teachers suggested that the spiral structure should be revised, the subjects should be associated with daily life, the resources of the Ministry of National Education should be increased, the course hours should be equal in all kinds of schools, and the subjects at the undergraduate level should be removed. Some of the teachers' opinions are as follows: T1: "I think that if there is subject integrity, if it is given from the simplest to the end of the subject, it will sit better in the child..." T11: "Embodiment can be done. Since not all students are at the same level, some parts of the curriculum are too academic.

Findings Obtained from Students' Views on Product Dimension

In order to investigate the questions “What is the level of 11th grade students' views on the product dimension of the 11th grade Mathematics Curriculum?” and “What is the level of 12th grade students' views on the product dimension of the 12th grade Mathematics Curriculum?” the scale was applied to the students and the following findings were obtained.

Table 12. Arithmetic mean and standard deviation values of students' level of participation in the items of the product dimension

		11 GRADE			12 GRADE		
Item	Items Related to Product Dimension	N	$\bar{X}$	Sd	N	$\bar{X}$	Sd
12	What I learn in math class is the basis for the next math class	90	3.96	1.23	90	3.94	1.00
13	My inference-making skills have improved in mathematics lessons	90	3.31	1.27	90	3.51	1.15
14	My problem-solving skills in mathematics have improved.	90	3.48	1.22	90	3.55	1.30
15	I learned enough math at school	90	3.44	1.32	90	3.50	1.19
16	I believe that I will be successful in national selection exams with what I have learned in mathematics	90	2.86	1.29	90	3.12	1.34
17	I use the language of mathematics correctly and effectively with what I have learned in mathematics lessons	90	3.00	1.27	90	3.36	1.08
18	My interest in mathematics increased with the mathematics course	90	3.38	1.40	90	3.17	1.31
19	I can easily access the documents I need about mathematics	90	3.62	1.25	90	3.75	1.16

Table 12. Arithmetic mean and standard deviation values of students' level of participation in the items of the product dimension (Continued)

Item	Items Related to Product Dimension	11 GRADE			12 GRADE		
		N	$\bar{X}$	Sd	N	$\bar{X}$	Sd
20	I believe that I will be successful in mathematics even after math class	90	3.30	1.34	90	3.35	1.24
21	What I learned in mathematics contributed to daily life	90	2.55	1.23	90	2.90	1.36
22	The knowledge I learned in mathematics enabled me to contribute to social life	90	2.38	1.21	90	2.76	1.38
23	I use the knowledge I gained in mathematics in other courses	90	2.88	1.34	90	3.42	1.19
24	Mathematics course positively affects my success in other courses at school	90	3.07	1.40	90	3.42	1.23

11th grade students' mean agreement with the views on the product dimension was $\bar{X}$=3.17 (between 2.60-3.39-Moderately Agree). The opinion that 11th grade secondary school students agree with the most in the product dimension of the Mathematics Curriculum is “What I learned in the mathematics lesson is the basis for the next mathematics lesson. $\bar{X}$=3.96 (3.40-4.19,-Agree) and the least agreed opinion was “What I learned in the mathematics course contributed to social life. $\bar{X}$=2.38 (between 1.80-2.59-Disagree).

The 12th grade students' average of the product dimension ($\bar{X}$=3.36) was found to be "Moderately agree". It was determined that the most agreed opinion of the 12th grade secondary school students on the product dimension of the Mathematics Curriculum was "What I learned in the mathematics course is the basis for the next mathematics course" ($\bar{X}$=3.94) and the least agreed opinion was "The information I learned in the mathematics course enabled me to contribute to social life" ($\bar{X}$=2.76).

Discussion, Conclusion and Suggestions

In the study in which the 11th and 12th grade mathematics curriculum was evaluated, teachers' views on the items in the context dimension were examined. In the quantitative dimension of the study, it was seen that the teachers' participation in the context-level opinions was positive. Interviews with teachers supported this view. As a result, it was stated that the program related to the context dimension was sufficient in terms of subject and conceptual knowledge and appropriate for the level, and that the physical conditions for the implementation of the program were sufficient. Önal (2018) concluded that the theoretical knowledge in the 9th grade mathematics curriculum is sufficient. In a similar study, Abat (2016) stated that the environmental issue is suitable for the implementation of the program. In their study evaluating the secondary school mathematics curriculum, Ojimba, Gogo and Simeon (2022) concluded that the amount and quality of resources available did not contribute significantly to the implementation of the curriculum. Teachers stated that the curriculum does not take individual differences into account. As a matter of fact, in the 2018 Secondary Mathematics Curriculum, it is stated that individuals have differences arising from environment, heredity and culture and that the curriculum is structured by considering differences (MoNE, 2018). It is thought that the reason for this difference between the curriculum and the teachers' opinions is that teachers apply the curriculum in the most appropriate way to the general without taking individual differences into account in order to complete the curriculum within the specified time.

When the level of teachers' participation in the items related to the input dimension was examined, it was seen that the participation was at a moderate level. It was determined that teachers had sufficient equipment in the implementation of the program. Dursun and Dede (2004) stated that teacher's being equipped is the level of field knowledge, pedagogical knowledge and general culture knowledge. In their study where Quadriah, Wicaksono et al. (2022) evaluated the mathematics curriculum in primary school with the CIPP model, they said that the learning objectives in terms of input dimension, students, teachers and materials, were in good condition. In addition, from the findings obtained from quantitative and qualitative data, it was concluded that students' readiness levels were not sufficient for the implementation of the 11th and 12th grade mathematics curriculum. In particular, it was determined that

the lower grade levels of the topics in the spiral structure were forgotten and had to be repeated every time. Yalçınkaya (2018) concluded in her study that one of the most common problems faced by teachers during the implementation of the curriculum was the low level of students' readiness. In addition, teachers stated that the time allocated for the learning outcomes was sufficient. However, in the findings obtained from qualitative data, teachers stated that the same curriculum in 11th grades is applied 5 hours a week in Social Sciences High Schools and 6 hours a week in Anatolian High Schools. In 11th grades, it was determined that the time allocated to the program was different. According to the findings obtained from qualitative data, it was concluded that the textbook is theoretically good, but the number and type of questions are low. Similar to this study, Temizkalp (2019) found that the textbook was liked by teachers, but the number of exercises was low.

In the interviews with the teachers, their opinions on the positive and negative aspects of the program were obtained. It was concluded that the negative aspects of the curriculum are that some subjects are structured with a spiral system, geometry is not given as a separate course, and the same curriculum is applied to every student. Eroğlu (2019) stated in his study that the spiral system approach was prominent in the mathematics curriculum at all grade levels and due to this situation, the subjects were frequently divided, and it was necessary to go back to the beginning each time. The result of this study is in parallel with the result of Eroğlu (2019). It was concluded that teachers see the simplification of the curriculum as a positive aspect.

When the level of participation of the teachers to the items related to the process dimension was examined, it was seen that the level of participation was at the level of “agree” and the level of participation of the students to the opinions was at a medium level. According to the findings obtained from the quantitative data in the process dimension, it was concluded that the curriculum was carried out in cooperation with the teachers of the department. This result is in line with the curriculum. As a matter of fact, in the MoNE (2018) curriculum, it is stated that while preparing teaching materials, mathematics department teachers should cooperate among themselves and with the teachers of other departments. Since it is necessary to prepare and implement common departmental exams in the process of evaluating students in schools, it is thought that the joint action of departmental teachers leads to this result. According to the findings obtained from qualitative data, it was concluded that teachers actively used the smart board during the implementation of the program and benefited from EBA and OGM (Turkish: Ortaöğretim Genel Müdürlüğü- General Directorate of Secondary Education) materials. In the MoNE (2018) curriculum, it is stated to benefit from information and communication technologies. In similar studies conducted by Biçer (2020) and Özüdoğru (2016), it was determined that teachers used smart boards and computer-aided instruction applications during the lesson process. In the findings obtained from quantitative data, teachers stated that they could not make enough practice solutions for the subjects. In the findings obtained from qualitative data, it was concluded that teachers had to make flashbacks to remind the previous learning outcomes due to the insufficient readiness of the students, the abstract nature of the subjects and the spiral system. For this reason, it is thought that in order to complete the subjects on time, they could not make enough activity and exercise solutions suitable for the level of each student.

According to the findings obtained from 11th grade students, it was concluded that teachers took into account the participation in the lesson while evaluating students. In addition, in the opinions of the teachers, it was determined that they made student-centered practices while implementing the curriculum. The 2018 mathematics curriculum states that the education process takes place with the participation of the teacher and the student. The result was found to be compatible with the curriculum. In a similar study, Özüdoğru (2016) found that the curriculum was student-centered, but teachers implemented the curriculum in a teacher-centered manner. In their study where they evaluated the upper secondary school mathematics curriculum in Nigeria, Zalmon, Ojimba and Adauko (2020) found that the use of traditional and innovative teaching methods while implementing the curriculum did not contribute to the advancement of the mathematics curriculum. In addition, in their study where Ghahrouie and Nourabadi (2019) evaluated the teaching methods recommended for the sixth-grade mathematics course according to teachers' opinions, they found that there was a moderate level of interest in the teaching methods. It was found that 11th and 12th grade students can communicate easily with their teachers, ask questions to the teacher without hesitation, and interact with the teacher in the

lesson. It is thought that this result may be due to the fact that 12th grade students are more interested in the mathematics course because they are in the university preparation process and ask where they do not understand. Ayten and Hayırsever (2019) concluded in their study that teachers are interested in their students and that students communicate easily with their teachers, which is similar to this study. In the findings obtained from 11th grade students' opinions, it was concluded that teachers did not emphasize the historical development of concepts in mathematics lessons. The reason why the history of mathematics is not covered in the lessons is the anxiety of not being able to train due to the intensity of the program, not being asked in central exams, and the student's lack of motivation (Yıldız & Baki, 2016). It was concluded that 11th and 12th grade students could not apply the information they learned in mathematics lessons to daily life. This result may be due to the fact that 11th and 12th grade subjects are abstract and therefore difficult to apply to daily life. When the teachers' level of agreement with the items related to the product dimension was examined, it was seen that the level of agreement was at the level of "agree". When the findings obtained from teachers and students were analyzed, it was concluded that the information learned in the course formed the basis for the next course. The subjects in the curriculum are interrelated and complementary to each other. This result was found compatible with the curriculum.

Teachers and students said that the curriculum laid the foundation for their next learning. The findings obtained from teachers and students support each other. Missing or unlearned knowledge in mathematics makes it difficult to learn new knowledge. Each learning outcome and topic is the foundation for the next mathematics topics. These views shared by students and teachers show that the topics in the curriculum are interrelated and are a continuation of each other. In addition, it was concluded that the knowledge learned in the mathematics course does not contribute to social life and daily life. It is thought that this result may be due to the fact that 11th and 12th grade subjects are more abstract and cannot be applied in daily life. Learning mathematics by associating it with daily life is effective for students to love mathematics and be successful (İlgar & Gülten ;2013). According to the qualitative and quantitative findings obtained from the teachers, it was concluded that the program prepares students for the central exams. However, this conclusion is not supported by the fact that the average score of the students in the 40-question mathematics test in the AYT exam, which includes 11th and 12th grade subjects, has been seven net in the last three years (ÖSYM, 2021, 2022, 2023).

The following suggestions were presented to improve the 11th and 12th grade mathematics curriculum.

1) Topics that can be learned at university level such as limits, derivatives and integrals can be reviewed.

2) Students can be enabled to concretize and use mathematics by including activities related to daily life.

3) MoNE resources can be increased, and equal time should be allocated to the curriculum in all types of schools.

4) The curriculum can be arranged in accordance with individual differences.

5) It should be ensured that similar studies are carried out after the curriculum changes.

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