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Action Research on the Development of Curriculum Literacy and Curriculum Modeling Skills of Mathematics Teacher Candidates Through the Socratic Seminar Technique*

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ABSTRACT

The aim of this research is to develop curriculum literacy and curriculum modeling skills of pre-service mathematics teachers through the Socratic seminar technique. The research was designed as action research. The study was carried out with the participation of 13 teacher candidates studying at Muğla Sıtkı Koçman University, Türkiye, in the Faculty of Education, Department of Mathematics Teaching in the spring semester of the 2018-2019 Academic Year. In the study, which was designed using action research, the Socratic seminar technique was applied for a semester within the scope of the Curriculum Development and Instruction course taken by the pre-service mathematics teachers. For the purposes of the research, the data were collected through the Curriculum Literacy Scale developed by Bolat (2017) and the scores obtained as a result of the evaluation of the curriculum development models designed for the teacher candidates by the researcher. Throughout the process, the Curriculum Literacy scores of each teacher candidate participant were measured 7 times, the obtained scores were recorded and analyzed through graphs based on the change that occurred within itself. The curriculum development models designed by the pre-service mathematics teachers were examined throughout the studies carried out during the process, and the development of the participants' skills on this subject was monitored by evaluating them with 3 different scorings. Within the scope of the research, the Curriculum Literacy scores of the pre-service mathematics teachers were analyzed and the effect of the Socratic seminar technique on the change in these scores was examined. The findings obtained in line with the aims of the research showed that there was a desired change and increase in the Curriculum Literacy scores of the mathematics teacher candidates during the teaching process through the Socratic seminar technique. Another finding of the study was that mathematics teacher candidates' ability to create a curriculum model improved through the Socratic seminar technique.

Keywords: Socratic seminar technique, curriculum literacy, curriculum modeling skills, action research.

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Introduction

Curricula are developed and implemented with the aim of guiding learners in order to give direction to their learning experiences, to acquire the needed knowledge, values and skills, and to ensure their development in a holistic way (Yakar, 2016). Curriculum and teaching process are educational components that complement each other. The fact that teachers, who are the designers, implementers and evaluators of education and teaching, analyze these complementary components in appropriate ways and perform planning, implementation and evaluation processes transforms education and teaching into an effective one.

The quality of the objectives, content, learning-teaching process, and evaluation elements, which are the elements of the curriculum, determine the quality of the educational activities during the implementation of the curriculum. In the process of putting the curriculum into practice, it is considered important that teachers, who are experts in their fields, dominate all the components of the curriculum and reflect this dominance in practice for the determination of objectives, the organization of the content, the methods-techniques to be applied and the measurement-evaluation processes to be carried out.

Understanding all the components of a curriculum can be considered as a prerequisite for effective implementation. Curriculum literacy emerges as an important type of literacy that teachers and teacher candidates should acquire. Curriculum literacy is also expressed as programme literacy (Erdem & Eğmir, 2018). Curriculum literacy can be defined as understanding and interpreting the objectives, content, learning-teaching process and measurement-evaluation dimensions, analyzing the relationship between the four dimensions, reaching a synthesis, applying and adapting (Çetinkaya & Tabak, 2019). Curriculum literacy requires having knowledge of the elements of the curriculum (Bolat, 2017). In order for teachers to be able to understand a curriculum, they are expected to have knowledge about that curriculum, in other words, to be curriculum literate. Teachers understand the “what” and “how” of the curriculum from curriculum literacy (Kasapoğlu, 2020). Curriculum determines what is aimed in education, with what content these goals will be achieved, how to reach these goals and how to measure the level of reaching the goals. The most important guide for teachers who will carry out educational activities is curriculum. Teachers should have knowledge of certain subjects, contents, skills, goals, and all elements that make up the content of the curriculum (Çetinkaya & Tabak, 2019; Posner, 1995). An educator's knowledge of the curriculum is related to the choice of other programs and materials suitable for teaching the content, how the taught concepts are interpreted by the students, and the concept development of the student (Shulman, 1986). According to Bolat (2017), "to be able to distinguish which target dimension of the given target behavior relates, to write a target appropriate for the level of the student, to determine the relationship between the content and the targets, to create content suitable for the targets, to design learning-teaching processes, to measure and evaluate appropriate to the target" with curriculum literacy skills. According to Ustabulut (2021), curriculum literacy includes educators' having basic knowledge of the purpose, content, learning-teaching process, and evaluation components of the curriculum, making use of these elements in the teaching process and putting them into practice. According to Akyıldız (2020), there are two dimensions of the concept of curriculum literacy: "knowledge" and "skill". Knowledge dimension, understanding the curriculum, knowing the information about the application and evaluation processes; The skill dimension includes the skills related to the design, implementation and evaluation of the learning-teaching processes related to the implementation of the curricula.

The fact that teachers transform their knowledge about the implementation of curriculum into skills contributes to both the design, implementation, and evaluation processes. Within the competencies related to objectives and targets, curriculum content, learning-teaching process and measurement-evaluation, there is reflection of knowledge to skill.

The ability to create a curriculum model is proportional to the experience and level of knowledge of individuals on curriculum of all components to be found in a curriculum. In the process of creating a curriculum model, it is aimed to include the objectives, content, learning-teaching process, measurement-evaluation elements of the curriculum and other complements of the curriculum and to develop a model accordingly. According to Maaß (2006), modeling competencies include the knowledge, skills, and abilities necessary to carry out the modeling process appropriately, the desire to realize them, and having metacognitive skills. Modeling skills are the skills that can be considered as technical skills such as understanding the real-life situation, constructing a model and performing operations on the model (Yavuz Mumcu & Baki, 2017).

When related literature is examined, the effect of teacher idealism on curriculum literacy (Yar Yıldırım, 2021), 21st-century critical curriculum literacy (Schroeder & Curcio, 2022), examination of curriculum literacy phenomenon (Erdem & Yücel Toy, 2021), curriculum literacy scale development (Akyıldız, 2020; Bolat, 2017; Kasapoğlu, 2020; Keskin & Korkmaz, 2021; Yıldırım, 2019), determination of curriculum literacy levels of school administrators (Basar & Berilgen, 2021), predictive power of the curriculum literacy levels studies of pre-service teachers (Süral & Dedebali, 2021), teachers' levels of curriculum literacy (Kahramanoğlu, 2019; Saracaloğlu, Madran & Altın, 2019; Saracaloğlu & Gündüz Çetin, 2020; Sarıca, 2021), analysis of classroom teachers' curriculum literacy skills from an administrator's perspective (Erdamar & Akpınar, 2021) studies have been reached. However, most of the studies are aimed at determining the level of literacy in the curriculum. In the literature, no research has been found to develop such an important skill. Within the scope of the research, subjects related to curriculum development, curriculum evaluation, learning, teaching, and measurement-evaluation processes were covered in order to develop curriculum modeling skills. The entire research process focused on "curriculum literacy" and "curriculum modeling skills", which are important features or skills that are thought to be present in teacher candidates and teachers.

Aim of the Research

The aim of this research is to develop curriculum literacy and curriculum modeling skills of pre-service mathematics teachers through the Socratic seminar technique. Research questions within the scope of this purpose:

1. How does the Socratic seminar technique change the curriculum literacy scores of pre-service mathematics teachers?

2. How does the Socratic seminar technique change the scores of pre-service mathematics teachers' ability to build a curriculum model?

Method

Research Model

The research was designed in the action research pattern. According to Mills (2003), action research is a research approach that helps to find solutions to problems that arise in different fields. In this approach, teachers, researchers, administrators, and students etc. in the learning environment. how teaching is done in schools where stakeholders are present and what can be done to make teaching more effective, etc. It is used to determine the existing situations on the issues. According to Uzuner (2005), action research, which is one of the applied qualitative research models according to some classifications, is a pre-planned, organized and collaborative systematic review to improve the quality of life through critical reflection and inquiry. Johnson (2014) defines action research in five steps. Accordingly, the first step of action research is to ask questions, identify a problem situation or define an area of investigation. The second step is to decide which data should be collected, how and how often. The third step is to collect and analyze the data. The fourth step is to describe how the findings can be used and applied, in other words to plan for action. The fifth and final step is to share the findings, report them and carry out the planning with others. According to Glesne (2012), action research is research consisting of observation, reflection and action. Particularly during the reflection phase, researchers or collaborators interpret the data and share multiple perspectives with stakeholders in the process. Discussions on actions to be taken follow this process and include planning, implementation, and evaluation of the next stage of action. According to Yıldırım and Şimşek (2013), Dewey first suggested the use of action research in teaching in the 1930s. Action research can be done by the practitioner himself/herself or by an outside researcher. The researcher, who is a participant observer, cooperates with the practitioners in the research process and can contribute to the practice when necessary due to his field of expertise. Practitioners also contribute to the research by opening their own practices to the researcher. In such a research process, there is an intense interaction and sharing between the researcher and the practitioner (Saracaloğlu, & Eranıl, 2020; Yakar, & Saracaloğlu, 2019).

The use of the action research design in this research stems from the aim of developing teaching practices. The researcher, within the framework of scientific and ethical principles, was involved in the whole research process both as a teacher/practitioner and made in-depth examinations while making participatory observations. In addition, in order to ensure the validity of the research, methods such as long-term interaction, in-depth data, expert review, long-term observation, researcher participation, second observer, continuous questioning and supervision, detailed description, purposeful sampling were used. In addition to these studies, more than one researcher (observer) in order to ensure the reliability of the research, confirming the results with another researcher in data analysis, storage of raw data, clarity of researcher role, detailed description of participants, definition of data collection method and data collection. Methods such as the definition of analysis were applied.

Study Group

The study was carried out with the participation of 13 teacher candidates studying at Muğla Sıtkı Koçman University, Türkiye, Faculty of Education, Department of Mathematics Teaching in the spring semester of the 2018-2019 Academic Year. In the study, which was designed using action research, the Socratic seminar technique was applied for a period (14 weeks) within the scope of the Curriculum Development and Instruction course taken by the pre-service mathematics teachers.

Table 1. Information of the study group of the research

Participants	Age	Gender	Average Weekly Study Time for Curriculum Development and Instruction Course	Studying Areas of Interest
1	22	Female	1 Hour	Mathematics, Physics
2	21	Female	1 Hour	Mathematics, Physical Education
3	22	Female	1.5 Hour	Mathematics, English, Music
4	22	Male	1.5 Hour	Mathematics, Chemistry
5	23	Male	1 Hour	Mathematics, Music, Biology
6	22	Female	1 Hour	Mathematics, Literature
7	22	Male	1 Hour	Mathematics, Physical Education, Music
8	22	Female	1.5 Hour	Mathematics, Painting, Literature
9	22	Male	1.5 Hour	Mathematics, English
10	21	Male	0.5 Hour	Mathematics, Physical Education
11	22	Female	1.5 Hour	Mathematics, Music
12	22	Female	1 Hour	Mathematics, Painting
13	22	Female	1.5 Hour	Mathematics, Literature

Instruments and Data Collection

For the purposes of the research, the data were collected through the Curriculum Literacy Scale developed by Bolat (2017) and the scores obtained as a result of the evaluation of the teacher candidates curriculum development models by the researcher and experts. The Curriculum Literacy Scale consists of two factors called “reading” (15 items) and “writing” (14 items). The Cronbach Alpha internal consistency coefficient of the entire scale is .94. The validity and reliability of the scale was ensured by confirming that the two-factor structure of the scale consisted of 29 items in total (Bolat, 2017). As a result of this research, the Cronbach Alpha internal consistency coefficient of the scale was calculated as .92.

The curriculum development models designed by the pre-service mathematics teachers were examined throughout the studies carried out during the process, and the development of the participants' skills on this subject was monitored by evaluating them with 3 different scorings. For the curriculum model building skill scores used in the research, the participant teacher candidates were asked to design a curriculum development model at the beginning, middle and end of the process, and these models were scored by the researcher. Scoring was made by a team of 5 experts together with the researcher, and their averages were taken and reflected on the graphs. Within the scope of the research, the subjects related to curriculum development and teaching were handled and the data were collected during the 14-week teaching process.

Table 2. Topics covered and studies done in the teaching *(data collection)* process

Week 1	Curriculum, Features of Curriculum and Curriculum Literacy Reading: General Characteristics of the Curriculum Related to the Field
Week 2	Curriculum Development Models and Fundamentals of Programs Reading: Model and Fundamentals of the Curriculum Related to the Field
Week 3	Philosophical Movements and Educational Philosophies – Curriculum Design Approaches Reading: Philosophy and Design Approach of the Curriculum Related to the Field
Week 4	Program Development Process and Elements of Programs Reading: The Development Process and Elements of the Curriculum Related to the Field
Week 5	Objectives and Content in Curriculum Development Process Reading: Objectives of the Curriculum Related to the Field, Skills It Aims to Gain, Learning Areas and Topics
Week 6	Educational Situations and Assessment-Evaluation in the Curriculum Development Process Reading: Learning-Teaching Process and Assessment-Evaluation Approach of the Curriculum Related to the Field
Week 7	Curriculum Evaluation Models and Curriculum Development in the 21st Century Reading: 21st Century Skills, Qualifications for Teachers Today and in the Future
Week 8	Developing a Lesson Plan for Teaching a Selected Subject Related to the Field
Week 9	Developing a Lesson Plan for Teaching a Selected Subject Related to the Field
Week 10	Examination of Curriculum Development and Teaching Research Related to Field Teaching
Week 11	Examination of Curriculum Development and Teaching Research Related to Field Teaching
Week 12	Developing a Curriculum Development Model for the Field
Week 13	Developing a Curriculum Development Model for the Field
Week 14	Evaluation of Developed Lesson Plans and Curriculum Development Models

Data Analysis and Interpretation

The data obtained in the study were interpreted by analyzing the changes in each participant's own curriculum literacy scores. Throughout the process, the Curriculum Literacy scores of each teacher candidate participant were measured 7 times, the obtained scores were recorded and analyzed through graphs based on the change that occurred within itself. The curriculum development models designed by the pre-service mathematics teachers were examined throughout the studies carried out during the process, and the development of the participants' skills on this subject was monitored by evaluating them with 3 different scorings. For the curriculum model building skill scores used in the research, the participant teacher candidates were asked to design a curriculum development model at the beginning, middle and end of the process, and these models were scored by the researcher. For the reliability of this evaluation, the models scored by the researcher were evaluated by 4 experts working in the fields of mathematics (2) and curriculum and instruction (2), and these scores were averaged, and objectivity was tried to be increased. In the study, the development of these scores obtained by the pre-service teachers was examined through graphs, and the development of their curriculum modeling skills was revealed and interpreted together.

Results

The findings obtained after the data analyzed for the purposes of the research were revealed through the score changes of both the curriculum literacy and curriculum modeling skills of the participants.

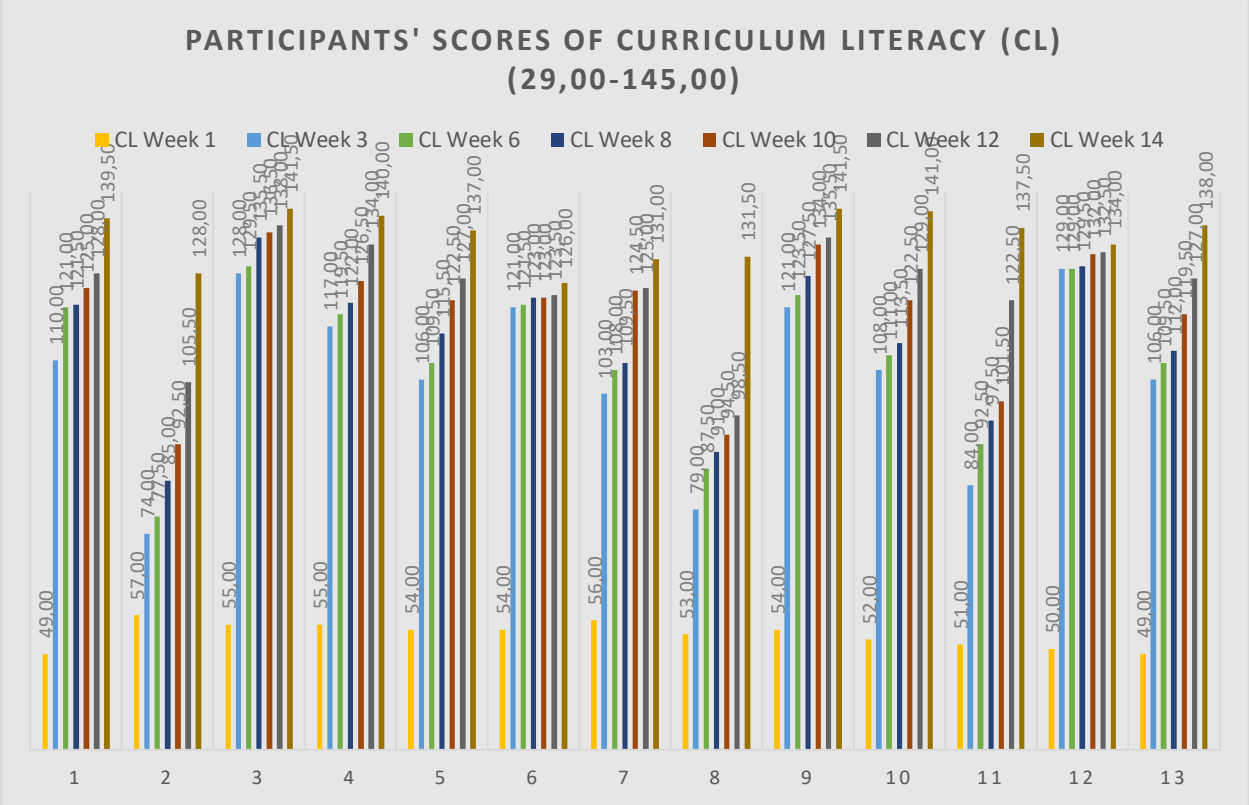

Figure 1. Graphs regarding the change in the curriculum literacy scores of the mathematics teacher candidates

When the 7 points of each participant regarding the curriculum literacy and the change of these scores were examined, it was determined that all of the participants increased the curriculum literacy score in the desired direction in the process. Changes in score and level considering initial and final data: +90.50 for participant 1 (Very Low --> Very High); +71.00 (Low --> Very High) for 2nd participant; +86.50 (Low --> Very High) for 3rd participant; +85.00 (Low --> Very High) for participant 4; +83.00 (Low --> Very High) for 5th participant; +72.00 (Low --> Very High) for 6th participant; +75.00 (Low --> Very High) for participant 7; +78.50 (Low --> Very High) for participant 8; +87.50 (Low --> Very High) for participant 9; +89.00 (Low --> Very High) for the 10th participant; +86.50 (Low --> Very High) for participant 11; +84.00 (Low --> Very High) for the 12th participant and +89.00 (Low --> Very High) for the 13th participant. Only one of the participants started the process with "very low level" curriculum literacy and reached "very high" curriculum literacy at the end of the process. It is noteworthy that during the implementation process, the other participants reached from "low level" curriculum literacy to "very high" curriculum literacy. According to the findings, it is seen that the literacy of the education program has improved considerably during the practices carried out using the Socratic seminar technique, in which the participants actively participated in the 14-week teaching process.

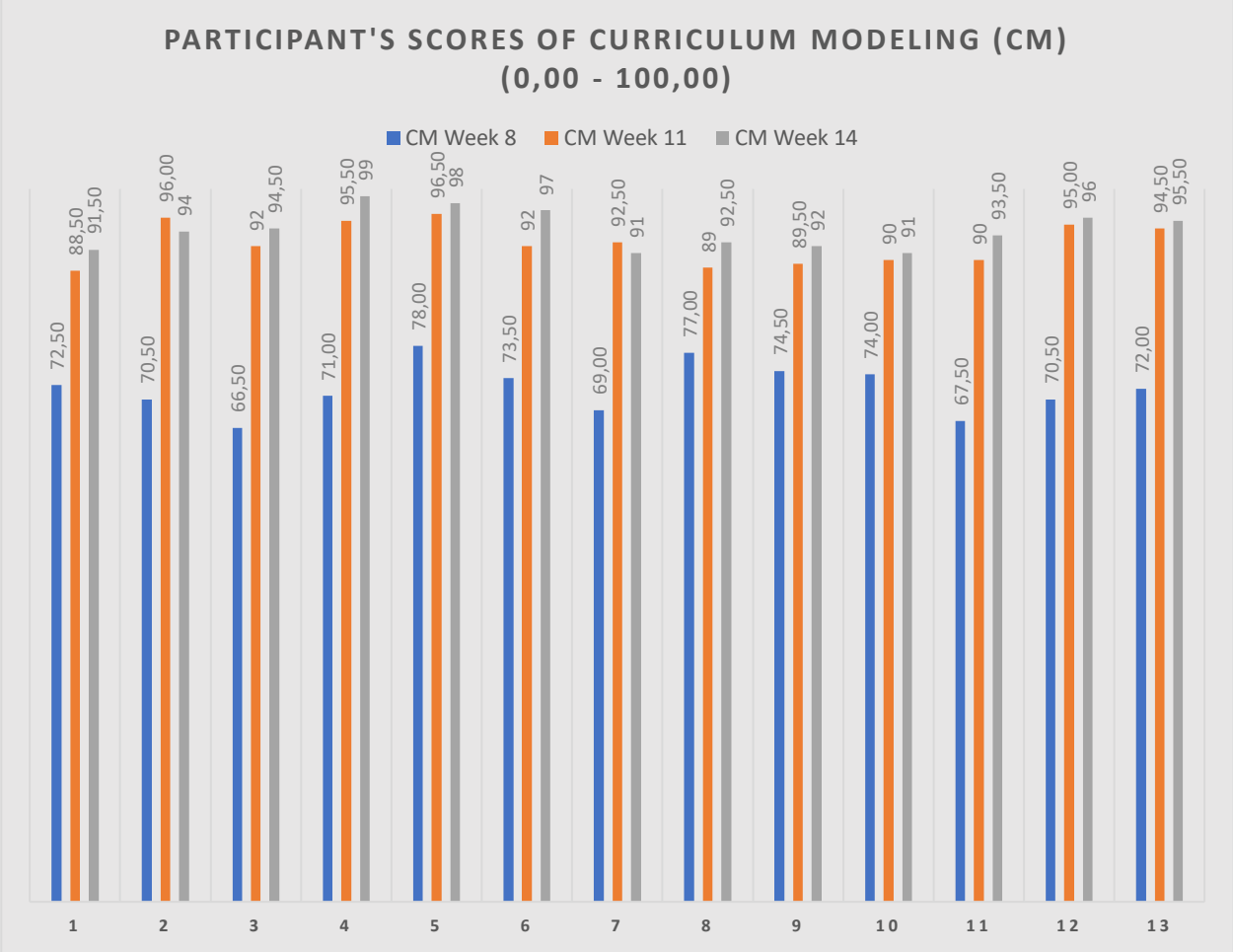

Figure 2. Graphs related to the changes in the scores of the mathematics teacher candidates in building a curriculum model

When the 3 points of each participant regarding the skills of creating a program model and the change of these points are examined, it has been determined that all of the participants have increased their curriculum model building skills score in the desired direction, even if there are small fluctuations. Changes in score and level considering initial and final data: +19.00 for participant 1 (High --> Very High); +23.50 for 2nd participant (High --> Very High); +28.00 for 3rd participant (High --> Very High); +28.00 for the 4th participant (High --> Very High); +20.00 (High --> Very High) for the 5th participant; +23.50 for 6th participant (High --> Very High); +22.00 (High --> Very High) for participant 7; +15.50 (High --> Very High) for participant 8; +17.50 (High --> Very High) for the 9th participant; +17.00 for 10th participant (High --> Very High); +26.00 for participant 11 (High --> Very High); +25.50 (High --> Very High) for the 12th participant and +23.50 (High --> Very High) for the 13th participant. All of the participants started the process with "high level" curriculum model building skills and at the end of the process, they reached "very high level" curriculum model building skills. It is seen that all participants achieved "very high level" curriculum model building skills scores during the implementation process. According to the findings, it was revealed that the participants developed their curriculum modeling skills during the practices carried out using the Socratic seminar technique, in which the participants actively participated in the 14-week teaching process.

Discussion, Conclusion and Suggestions

Within the scope of the research, the scores of mathematics teacher candidates' curriculum literacy and curriculum modeling skills were analyzed and the effect of the Socratic seminar technique on the change in these scores was examined. The results obtained in line with the aims of the research show that there is a desired change and increase in the curriculum literacy scores of the mathematics teacher candidates throughout the teaching process through the Socratic seminar technique. Another result of the research is that mathematics teacher candidates' skills in building a curriculum model were improved through the Socratic seminar technique. It was observed that there was a positive and desirable change in the curriculum literacy scores and curriculum modeling skills of the pre-service mathematics teachers throughout the teaching process carried out through the Socratic seminar technique.

One of the important types of literacy for teachers and teacher candidates is curriculum literacy (Schroeder & Curcio, 2022). According to Yar Yıldırım (2021) teachers must possess knowledge on the curricula, the ability to use this information and a positive attitude towards the process. This in turn, is related to teachers' curriculum literacy. On another study, according to Keskin and Korkmaz (2021) in the studies conducted in the field, it is understood that teachers make evaluations in the context of skills/proficiency while examining their understanding and application status of the curriculum, but the teachers' "valuation" dimension related to the implementation of the curriculum is neglected. Teachers' ignorance of the curricula may lead to the deterioration of the application unity of the program, and the emergence of a learning-teaching process that differs from its aims and application principles (Kahramanoğlu, 2019). Therefore, it is considered important that teachers have this skill. According to Sarıca (2021) the implementers of the current curriculum and the ones who bring the curriculum into effect are the teachers. Therefore, it is thought that it is important to investigate the curriculum literacy of teachers. Because the success of the education programs in particular and the entire education system in general is closely related to the effective implementation of the curriculum by the teachers. According to Yıldırım (2019) the fact that a teacher is literate in the curriculum related to her/his field will undoubtedly contribute greatly to the quality of teaching and student success. According to Erdem and Yücel Toy (2021) teachers' curriculum literacy skills are of great importance in terms of achieving the objectives of the curricula and increasing the quality of education curriculum literacy ensures that the difference between the official curriculum prepared and the curriculum in practice is reduced as much as possible by affecting teachers' reading, understanding and implementation skills, so makes it possible to achieve curriculum objectives and increase the quality of education (Aslan, 2019). Additionally, about curriculum literacy, according to Süral, and Dedebali (2021) further studies on pre-service teachers or teachers are needed to reach performance indicators that can determine the real competencies in the curriculum literacy and new studies based on qualitative data should be conducted to provide an in-depth examination.

In the action research conducted, the curriculum literacy and curriculum modeling skills of the participants were developed through the Socratic seminar technique. According to Wiggins (2004) the Socratic seminar technique is a collective inquiry into questions and issues that are often uncovered and animated through a reading activity or experience sharing. It also aims to develop each person's self-understanding through speaking, testing ideas, and reflection. In a comprehensive Socratic inquiry seminar, strategic decisions are made repeatedly on the continuation of the inquiry (Bahtiyar, 2019). Through reflection, reasoning and inquiry, the

participants contributed to the development of curriculum literacy and curriculum modeling skills. Thus, it was concluded that strategies for modeling a curriculum and developing literacy skills on this issue were used, and a decision was reached with the help of these strategies. In addition, Polite and Adams (1996) concluded that Socratic seminars are effective in developing higher-order thinking and, in general, Socratic seminars increase individuals' cognitive and social functions. Bozer Özsaraç (2019) found that the Socratic inquiry method is an effective method in developing students' higher-order thinking skills (Aktaş, 2022). In terms of developing higher-order thinking skills, it can be said that Socratic seminars improve literacy in a curriculum in both cognitive and social contexts. At the same time, it can be deduced that the Socratic seminar technique improves curriculum modeling skills through its effect on higher-order thinking skills.

As a result of this action research, it was determined that the Socratic seminar technique improved the curriculum literacy and curriculum modeling skills of mathematics teacher candidates. It is recommended that a similar study be carried out in an experimental design with a control group and repeated in different teacher education programs and at different grade levels. It is thought that conducting research and studies on such important skills in the teaching profession will contribute both professionally and in the context of creating a source of inspiration for future research.

Conflict of Interest

There is no conflict of interest for the study.

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