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Tapping into the art of teaching: Unveiling pedagogical content mastery through a riveting case study

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ABSTRACT

This study aims to examine investigate variations in teachers' perspectives regarding the pedagogical content knowledge acquired through the school experience in the pre-2018 curriculum for elementary mathematics teaching compared to its updated counterpart, now known as teaching practice in the current curriculum. In this direction, six teachers from the department of elementary mathematics teaching at the faculty of education of a university in Western part of Turkey were selected by criterion sampling method. A semi-structured interview form developed by the researchers was used as a data collection tool in the study in which holistic multiple case design, one of the qualitative research methods, was used. The data obtained were analyzed by content analysis. As a result of the research, it was found that the teachers who studied with the old program were inadequate compared to the teachers who studied with the updated program in terms of classroom management, communication with students teaching methods, skills to use techniques.

Keywords: teaching practice courses, mathematics education, teacher education, pedagogical content knowledge

INTRODUCTION

A quality education relies on capable teachers. As outlined in the report by the General Directorate of Teacher Training and Development (GDTTD), an effective teacher achieves qualification through proficiency in three key areas: professional knowledge, skills, and attitudes/values. Such a candidate demonstrates expertise in their subject and curriculum, possesses pedagogical knowledge, adheres to legal responsibilities, manages the teaching-learning process, employs suitable teaching methods, maintains control of the learning environment, communicates effectively with students, prioritizes personal and professional growth, and upholds various values including national, spiritual, and universal principles. This amalgamation of competencies signifies a teacher's overall proficiency according to GDTTD (2017).

The preparation of competent educators hinges on a well-structured and effectively executed teacher training curriculum (Kircicek & Yuksel, 2019). An essential aspect in fostering teaching proficiency among ideal educators lies in the teaching practice courses embedded within teacher training programs (Cetin et al., 2021). These courses within teacher training undergraduate programs aim to cultivate prospective teachers' professional capabilities by engaging them in classroom instruction across various levels in practice schools. This involves assessing educational materials, comprehending subject-specific curricula, implementing assessment methodologies, and overseeing educational processes in collaboration with practice teachers and instructors (Council of Higher Education [CHE], 1998). As a result of the changes and developments in the world, the integration of technology into our lives, the prominence of professional knowledge and skills in teacher training programs as a result of the studies on teacher education in the world, and the changes in the demands and needs of society as a result of the studies on teacher education in Turkey, a program change was made in 2018 and teacher training programs were updated (Cetin et al., 2021).

The former and the new undergraduate programs of elementary mathematics teaching have 146 total credits are for all courses. However, there are notable shifts in credit allocations. The previous curriculum designated 72 credits for field education courses, 40 credits for professional knowledge, and 38 credits for general culture courses. Conversely, the updated curriculum has allocated 69 credits for field education, 50 credits for professional knowledge, and 27 credits for general culture courses. In the pre-2018 teacher education program, the teaching practice course comprised three credits in the seventh semester for school experience and five credits in the eighth semester for teaching practice. In the restructured 2018-2019 academic year, the course was redefined as teaching practice 1 and teaching practice 2, each carrying five credits, spanning two semesters, i.e., the seventh

and eighth semesters. Notably, pre-service teachers in the updated program now engage in active teaching and observation in practice school classrooms concurrently during both semesters, a departure from the previous practice.

This restructuring allows pre-service teachers to actively participate in teaching and observing practices throughout the academic year, enhancing their practical exposure and teaching experiences in authentic classroom settings as part of their teacher training. Upon reviewing studies focusing on teaching practice, it is evident that the allocated time for pre-service teachers in teaching practice is deemed insufficient. Researchers recommend an extension beyond one year for an enriched practical experience. Utilization of teaching materials is advocated as a means to enhance lesson engagement, while pre-lesson preparation significantly contributes to the development of pre-service teachers (Aslan & Saglam, 2018; Basturk, 2010; Budak et al., 2011; Eraslan, 2009; Kocak et al., 2020). These studies reveal pre-service teachers' expectations from mentor teachers to be objective, serve as role models, offer guidance, provide feedback on lesson plans, and collaborate in the teaching process. Additionally, the mentor school is expected to offer adequate resources, empathize with colleagues, and maintain open communication (Aslan & Saglam, 2018; Bektas & Ayvaz, 2012; Ozkilic et al., 2008). Eraslan (2009) noted that the pressure of the public personnel selection examination and the curriculum, along with difficulties in connecting theoretical mathematics knowledge to practical teaching, hampered the efficiency of teaching practice for pre-service teachers. In a study conducted by Budak et al. (2011), it was observed that the implementation of group work significantly enhances students' learning outcomes. Additionally, the incorporation of games and activities in mathematics instruction was found to not only augment student interest but also make the mathematics lessons more engaging. Furthermore, the adoption of inventive teaching approaches was identified as highly effective in facilitating students' discovery of mathematical concepts. These findings underscore the importance of diverse pedagogical strategies in enhancing the effectiveness of mathematics education.

Furthermore, studies combining teaching practice and school experience emphasize pre-service teachers' need for more guidance on teaching methodologies, classroom management, and improved communication from mentor teachers. Instructors are expected to provide comprehensive feedback and detailed explanations. Additionally, mentor teachers and instructors suggest frequent use of innovative methods, teaching materials, active student involvement, educational games, and technology integration to enrich lessons (Kirksekiz et al., 2015; Uzun & Koparan, 2021). Moreover, Kircicek and Yuksel (2019) compared school experience and teaching practice and observed varied perspectives among academics. Some believe that school experience provides valuable insights into the school environment, administration, community, and profession, favoring observation and experience. On the other hand, some argue in favor of teaching practice due to increased practical opportunities for teacher candidates.

In an examination of studies comparing the teacher training undergraduate program introduced in the 2018-2019 academic year with the program utilized prior to 2018, Demir et al. (2021) focused their investigation on the renewed teacher training undergraduate program within the domain of elementary mathematics teaching. Their findings indicated that, while the revised curriculum demonstrated adequacy in terms of preparing individuals for the teaching profession, deficiencies persisted in the integration of technology into the courses. Despite an increase in the portion dedicated to teaching mathematics, the aspect related to learning mathematics remained incomplete. Compared to the pre-2018 curriculum, the current curriculum incorporates more technology, thereby offering a potentially greater contribution to the technological pedagogical content knowledge (PCK) of pre-service teachers. The inclusion of additional elective courses, more closely aligned with professional knowledge, was noted, providing increased flexibility for pre-service teachers. The restructuring of certain courses, particularly the history of mathematics course, was deemed an improvement, yet opportunities for further enhancement were acknowledged. Critiques from academics concerning the inadequacy of time and credits allocated to field knowledge courses, and reservations about completing these courses within the stipulated periods, were tempered by a positive view of the updated curriculum. Cetin et al. (2021) corroborated the findings of Demir et al. (2021), asserting that the revision of the teacher training undergraduate program was not solely driven by political motives, but rather aimed at addressing deficiencies in training qualified teachers and rectifying inadequacies stemming from the preceding program. They contended that the overarching goal of the update was to produce teachers who are suited to contemporary needs, pedagogically adept, socially, culturally, and philosophically developed, with augmented professional knowledge and skills. Furthermore, Cetin et al. (2021) recommended additional improvements to the program, including an extension of the teaching practice course to address perceived insufficiencies, an earlier commencement of internships from lower grades, an elongation of the internship duration, an augmentation of field education courses, and a more detailed presentation of course content.

Upon reviewing studies concerning the classroom management of pre-service teachers during teaching practices, it is evident that these individuals encounter challenges in this domain. Identified issues include ineffective time utilization, a perceived inadequacy in voice intonation and emphasis, a struggle to establish authority in the classroom, and a particular demand for improvement in the category of classroom management. Additionally, difficulties arise in maintaining control during activities designed to capture students' interest (Altintas & Gorgen, 2014; Bay et al., 2019; Ozmutlu & Tabak, 2023; Tonga & Erden, 2021). The limited opportunity for practice due to the inexperience of pre-service teachers has been identified as a contributing factor to these challenges. The literature consistently highlights that, across various disciplines, many pre-service teachers encounter significant difficulties in classroom management. Both pre-service teachers and mentor teachers commonly agree that increasing the number of practical experiences is instrumental in addressing these challenges. In studies conducted by Bay et al. (2019) and Kandemir (2022), pre-service teachers acknowledged observable improvements in their classroom management skills through increased practice, thus supporting the notion that practical experience plays a crucial role in enhancing proficiency in this aspect of teaching.

Undoubtedly, an increased engagement in practice by pre-service teachers corresponds to a heightened level of professional experience in their chosen field (Cetin et al., 2021; Degirmencay & Kasap, 2013; Uzun & Koparan, 2021). Research findings indicate that teaching practice courses play a significant role in enhancing PCK of pre-service teachers. Shulman, a prominent researcher

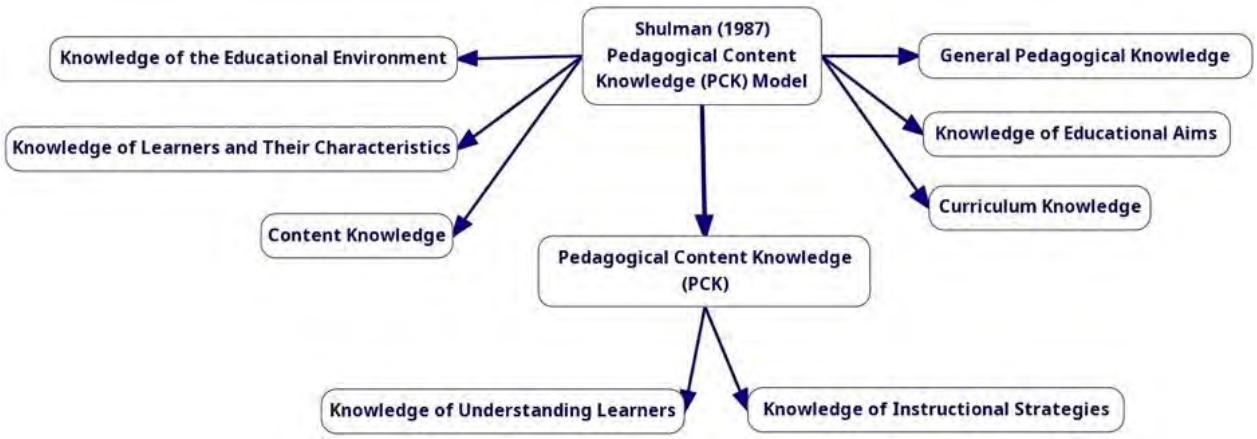

Figure 1. Pedagogical content knowledge model (Shulman, 1987 cited in Sahin, 2016)

in teacher education, posits that teachers should possess three distinct types of knowledge: PCK, curriculum knowledge, and teacher content knowledge (Shulman, 1987). Curriculum knowledge pertains to understanding how to effectively utilize the curriculum designed for teaching subjects, considering grade levels and instructional resources such as textbooks and materials. Content knowledge encompasses a teacher's understanding of the facts, concepts, and structural aspects of the subject, including the ability to defend the validity of facts and concepts in relevant contexts. PCK delves into the nuances of teaching the content of a particular subject (Ball, 1991; Bingolbali et al., 2016; Leinhardt & Smith, 1985; Shulman, 1986). PCK model developed by Shulman (1987) based on the three types of knowledge, including the types of knowledge that a teacher should have, is summarized in the concept map in **Figure 1** (as cited in Sahin, 2016).

Shulman (1986, 1987), the originator of the concept of PCK, delineated PCK into two distinct subcomponents: knowledge of understanding students and knowledge of teaching strategies. Knowledge of teaching strategies encompasses the teacher's proficiency in imparting content knowledge to students, devising learning processes to rectify misconceptions and errors, and possessing knowledge of methods and techniques aimed at enhancing students' academic achievement (Cochran et al., 1993; Magnusson et al., 1999; Shulman, 1986, as cited in Sahin, 2016). Conversely, knowledge of understanding students entails the capacity to identify students' misconceptions and errors, discern the underlying reasons for these misconceptions and errors, determine which concepts students are more likely to comprehend easily, and comprehend students' individual learning styles.

With the curricular revisions implemented in 2018, the school experience course was revamped and rebranded as teaching practice 1 and teaching practice 2, extending the duration of lectures originally designed for one semester to span two semesters. The impact of this modification has not been extensively explored in existing literature, prompting an investigation into its effects. This study aims to contribute to the scholarly discourse by evaluating the influence of the curriculum update, which affords pre-service teachers increased practical experience in school settings, on PCK of candidates at the practical level. The research seeks to analyze the consequences of this practice update and is envisioned to introduce an innovative perspective by addressing teaching practice within the framework of Shulman's (1987) PCK model. Moreover, this study is anticipated to offer a distinctive viewpoint to the academic field by comparing two distinct groups: those educated under the pre-2018 curriculum and those under the revised curriculum. By contrasting the opinions of these two cohorts, the research endeavors to provide insights into the differential impacts of the two curricula. In light of these objectives, the study seeks to investigate variations in teachers' perspectives regarding PCK acquired through the school experience in the pre-2018 curriculum for elementary mathematics teaching compared to its updated counterpart, now known as teaching practice in the current curriculum. Aligned with the research objectives, the sub-problems of the study have been delineated, as follows:

1. What are the perspectives of elementary mathematics teaching graduates, specifically those who underwent the teaching practice course, regarding the impact of teaching practice on their PCK?
2. How do graduates of elementary mathematics teaching, who participated in the school experience course, perceive the contributions of school experience to their PCK?
3. What disparities exist in terms of PCK when comparing scenarios, where teaching practice involves active participation by the teacher candidate across both semesters versus active participation limited to a single semester?

METHOD

Research Model

The study employed a holistic multiple case design, a qualitative research method that involves collecting detailed information from participants and presenting it through case themes (Creswell, 2013). Case study research, as defined by McMillan (2000), entails an in-depth exploration of events, programs, social groups, environments, or interconnected systems.

This research aimed to investigate disparities in teachers' perspectives on PCK, comparing the renewal of the school experience in the pre-2018 curriculum of elementary mathematics teaching with the teaching practice in the current curriculum. Accordingly, a holistic multiple case study design was adopted.

Study Group

Six teachers participated in interviews: three who pursued the current curriculum in elementary mathematics teaching at a university in Western Anatolia, completed the teaching practice course, and graduated in the 2021-2022 academic year. Conversely, three teachers studied under the pre-2018 curriculum at the same university, undertook the school experience course, and graduated in the 2018-2019 academic year. The criterion sampling method was employed to select participants. Teachers who completed the teaching practice course and graduated under the revised curriculum were designated with codes P1, P2, and P3. In contrast, teachers who underwent the school experience course and graduated under the pre-2018 curriculum were assigned codes P4, P5, and P6.

Data Collection Tools & Procedure

Semi-structured interviews were conducted to compare teachers who undertook the teaching practice course in both curricula. Interview forms, containing four questions each, were developed following a literature review and validation by two field experts. Interviews were recorded with participants' permission, lasting approximately 15-20 minutes each. The recordings were transcribed into written documents for analysis.

Data Analysis

Deductive content analysis, one of the qualitative data analysis methods, was used to analyze the data obtained through interviews. In the data analysis phase, the data were first coded by the researchers, and the codes obtained were categorized and tabulated in terms of their common characteristics. As a result of the inferences made from these codes, sub-themes and main themes were formed. Direct quotations were given from the opinions of the participants regarding the codes and themes used in the study, and the findings were interpreted and reported.

Validity & Reliability

Presenting the results of the research as accurately as possible is defined as the validity of the research. Validity in studies using qualitative research designs is that the researchers observe the phenomena under investigation as they are and as unbiased as possible (Yildirim & Simsek, 2011). In order to ensure the internal validity of the study, two expert opinions were taken, and the data were transcribed after obtaining the permission of the teachers. Similarly, in order to ensure external validity, similar studies were examined to see whether the results supported each other.

The repeatability of research results is defined as the reliability of the research (Yildirim & Simsek, 2011). In order to ensure reliability in the qualitative study in terms of the research design, the research schemes and methods were given in detail, the participants who were the data source were defined in detail, the coding made in data analysis was controlled, the collected data were reported in detail, direct quotations were included while interpreting the data, and the raw data of the research were kept in a way that can be examined by others. In the process of analyzing qualitative data, Miles and Huberman (1994) reliability formula (reliability=consensus/[consensus+disagreement]) was used and the agreement between the researchers was determined as 91%. A reliability value above .70 indicates that the research is reliable (Miles & Huberman, 1994). Therefore, the value obtained shows that the results obtained are reliable.

FINDINGS

Shulman's (1987) PCK model served as the primary theme, with the types of knowledge within the model considered as sub-themes. The study findings were analyzed through four codes: opinions about their teacher education program, knowledge of understanding learners, knowledge of instructional strategies and knowledge of learning environment, respectively. The flow of findings related to the main theme, sub-themes, and codes is summarized in the concept map presented in **Figure 2**.

Opinions About Their Teacher Education Program

Teachers who completed the teaching practice course under the updated curriculum share a common opinion that both field education courses and teaching practice significantly enhance a prospective teacher's PCK. Specifically, two of the teachers highlighted the importance of increasing the duration of field education courses without reducing the hours dedicated to practical field experiences:

> "The reduction of field courses (such as the analysis course) from six hours to two hours led to a deficiency in equipping us teachers. There were gaps that we attempted to address ourselves. Shifting time from one aspect to another creates an imbalance" (P1).

> "I strongly disagree with the notion that the information learned in field courses will not be used in the student groups I'll be teaching. Why learn it otherwise? The more knowledge we acquire, the broader our perspective becomes ... I believe field education courses should be extended without reducing their duration. For instance, in the pre-2018 program, the

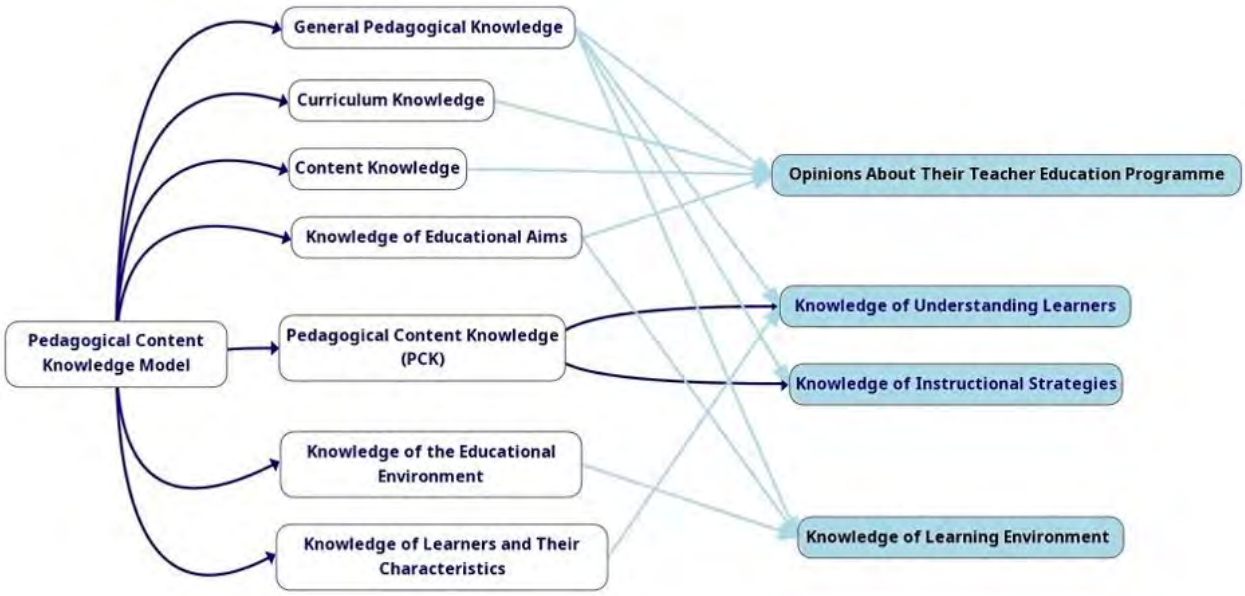

Figure 2. Main theme, sub-themes, & codes of study (adapted from Shulman, 1987)

> analysis course lasted six hours, whereas in the updated program, it was reduced to two hours. Consequently, critical aspects were omitted in the field courses. Therefore, I think the field courses were lightened more than necessary" (P3).

Teachers hold the belief that engaging in field courses will elevate their level of mathematical knowledge. They consider these courses crucial for their personal development.

Overall, all three participants emphasized the significance of field education courses in cultivating a critical perspective, facilitating comprehension of students from diverse backgrounds, and essential in achieving the expected qualifications of a competent teacher:

> "During the field education courses, we engaged in simulations, identified diverse outcomes, and developed teaching materials. Even before entering the classroom or having direct communication with students, these experiences guided us in understanding how to approach students effectively. It's a crucial preparation for prospective teachers. Mathematics teaching goes beyond simply solving problems or teaching fractions and triangle areas. With the shift to modern education, the goal is to nurture curious and critical students. I believe this transformation begins with the teacher. As individuals educated in a traditional approach, we need to embrace contemporary education methods. Hence, I find that these courses provide us with diverse perspectives and contribute significantly to our ability to deliver contemporary education" (P1).

> "In teaching, effective communication is as vital as possessing knowledge. Field education courses play a pivotal role in this aspect. They enable us to comprehend different viewpoints, recognizing that diverse students may grasp concepts in various ways. There's no one-size-fits-all teaching method, technique, or strategy for every student. I believe field education courses greatly aid in transferring our knowledge effectively and accurately analyzing the needs of our students on the other side" (P3).

In addition to all these, one of the teachers said,

> "Applications such as GeoGebra, Cabri, etc. attract students' attention a lot. We are now in the age of technology and screen addiction has increased in students. When you design a GeoGebra application or a different material and show it in the classroom, the attention is completely directed there. It is no longer interesting for the child to say, 'Look at the board, here is the solution to the problem.'"

P1 emphasized that technology cannot be ignored in today's education system, and that the effective use of technology is an undeniable fact for the quality of education and to train qualified teachers.

Knowledge of Understanding Learners & Knowledge of Instructional Strategies

Participants highlighted that engaging in teaching practice notably enhanced their communication skills with students and empowered them to apply various teaching methods and techniques in real-world scenarios. Regarding the impact on classroom management, the teachers expressed the following opinions:

> "The internship itself is a practice that significantly contributes to classroom management. Conducting one-to-one lessons places you as the teacher in the classroom, where you learn necessary actions through doing and experiencing. The classroom environment is not always predictable, as situations can emerge unexpectedly" (P1).

> "Teaching without a smart board was challenging. I had to take on a more active role as a teacher, generating different materials and posing various questions to engage the students. As they could not visualize shapes, I had to create these visuals myself. Additionally, I needed to offer more real-life examples. Working in such a school environment posed challenges but also forced me to enhance my lesson planning strategies" (P2).

> "Engaging in teaching practice significantly contributed to my classroom management skills. Working with diverse class groups exposed me to various class sizes and student behaviors. I found it easier to manage students who talked or disrupted the class's harmony. This experience demonstrated that I could maintain control and capture their attention without resorting to shouting or reprimanding. I believe the prospective teacher's approach to the lesson and introducing the subject plays a pivotal role. Presenting information in a repetitive manner can lead to student disengagement over time" (P3).

Two teachers highlighted their usage of the 5E lesson plan, emphasizing the notable increase in student participation during lessons, where this plan was implemented. Additionally, they pointed out that employing gamification techniques significantly enhanced student engagement, as it captured their attention effectively. Here are some of the opinions related to these practices:

> "I personally developed a 5E lesson plan and put it into practice in my classroom. As a result, I noticed a significant increase in student participation during the lesson. Introducing gamified activities within the plan motivated students to voluntarily come to the board and engage in these activities. They actively wanted to partake in the lesson, eagerly seeking solutions and forming groups to collaborate" (P3).

> "I employ diverse strategies, methods, and techniques, particularly utilizing various applications within the 5E-based lesson plans. Incorporating shapes and interactive games played a pivotal role in enhancing student engagement throughout the lesson" (P2).

Knowledge of Learning Environment

In general, all three participants acknowledged the significance of the teaching practice, highlighting its effectiveness in enhancing their time management, material design, and lesson planning skills. They expressed that the practice provided them with the invaluable opportunity to put theoretical knowledge into practical application. Participant 3 (P3) succinctly summarized this experience, stating,

> "We had the chance to personally apply the principle of learning by doing that we acquired in our academic studies."

Additionally, two teachers expressed feeling somewhat inadequate during their initial lectures in the fall semester. However, by the spring semester, they reported feeling more competent and confident due to increased experience. They emphasized that the more teaching experiences they gained, the more confidence and expertise they developed. Here are some of the opinions related to these experiences:

> "During the spring semester, we experienced a significant shift towards comfort and confidence. We improved in time management, classroom management, utilizing boards and screens, and overall teaching techniques compared to our performance in the first semester. Even within just one month of observation and actively attending lessons, a prospective teacher's perspective and attitude towards students undergo significant changes" (P1).

> "I felt highly enthusiastic in the classroom during the fall semester, but I learned to manage this excitement over time. My approach towards students evolved, and I became more accustomed to their presence. The first semester provided numerous lessons, and this accumulation of experience made me feel more knowledgeable, better prepared, and experienced in the subsequent semester. Internship undoubtedly contributes to gaining valuable experience" (P2).

Furthermore, one teacher,

> "Our mentor teacher provided us with encouragement to engage in more teaching opportunities, instilling trust in us. This support made me truly feel like a teacher."

P2 emphasized that the mentor teachers' backing during this process significantly contributed to the development of their self-confidence.

Overall, the participants found the adjustment of conducting teaching practice across two semesters to be beneficial. One teacher even advocated for initiating teaching practice from the second year of the undergraduate program, stating:

> "In my opinion, one semester of teaching practice is not enough. I believe that it should be extended to two semesters or even more. Teacher candidates should be sent to schools from the second grade onwards, even if they are not teaching. This will allow them to observe, solve questions, communicate one-to-one with students, and get a feel for the school atmosphere. Being in a school as a teacher is a very different experience. When teacher candidates start teaching practice in the fourth grade, it may be too late for them to realize whether they are suitable for the teaching profession or not. For instance, I had many doubts about whether I was suitable for the teaching profession, but when I entered the classroom

> and taught, I realized that I was in the right profession. If teaching practice starts at an earlier grade, it will motivate prospective teachers and give them the opportunity to question whether this profession is suitable for them or not" (P1).

A teacher raised concerns regarding the potential downside of teaching practice within the context of updating teaching methodologies.

> "If students become overly familiar with us as teachers, we might face situations, where they display diminished respect in lessons, become disengaged, fail to pay attention, or lack their initial dedication to the lesson" (P3).

This pre-service teacher expressed concern about a potential decrease in the level of respect shown to the student teachers because the students might become overly accustomed to the trainee teachers.

The teachers who completed the school experience course under the pre-2018 curriculum share a collective belief that both field education courses and the school experience significantly enhance a prospective teacher's PCK.

Two teachers highlighted the necessity of subject-specific courses in enhancing their level of mathematical knowledge.

One stated,

> "Subject-specific courses indeed brought me to a certain level, improved me" (P5),

while another emphasized,

> "Subject-specific courses are really valuable; knowledge is needed" (P6).

Particularly, one teacher expressed the view that

> "Field education courses should definitely be increased, but this should not be done by reducing subject-specific courses. The knowledge in subject-specific courses is necessary, but interacting with students is a whole different dimension" (P6).

This statement suggests the necessity of increasing the hours of field education courses without reducing the hours of subject-specific courses, emphasizing the importance of communication with students.

On the other hand, another teacher shared the opinion that,

> "Subject-specific courses indeed brought me to a certain level, improved me, but field education courses are more important. Because we enter grade 5-grade 8, and we do not tell these groups anything from our subject-specific courses" (P5).

This viewpoint revolves around the belief that due to teaching within the grade 5-grade 8 level, the mathematical knowledge gained from subject-specific courses cannot be applied to these age groups, thus emphasizing the increased importance of field education courses.

Two teachers expressed a sense of inadequacy in classroom management and using various teaching methods and techniques due to the absence of field education courses. However, they found opportunities to address these deficiencies through practical experience gained while working in the institutions they were appointed to. Here are some of the opinions concerning this situation:

> "The absence of field education courses negatively impacted my classroom management skills at the school, where I was appointed. Had the field education courses been more intensive, they would have contributed significantly to my development. During our education, we lacked guidance on when and where to apply specific teaching methods and techniques. I believe that with a greater emphasis on field education courses compared to conventional field courses, I would have gained a better understanding of which methods and techniques to employ and where to use them effectively in my lessons" (P5).

> "When I initially began teaching, I sensed the need to enhance my expertise within my field of education. I realized the necessity for more extensive reading and studying in this domain. Although we had field education courses, I felt that they were insufficient for our professional advancement. Consequently, I had to put in additional effort to self-develop. Upon commencing my career, I gained a deeper comprehension of the significance of teaching strategies, methods, and techniques. While the knowledge gained from field courses is essential, establishing effective communication with students represents an entirely distinct aspect. Throughout my professional tenure, I've observed that correctly advancing in teaching strategies, methods, and techniques, and appropriately engaging age groups yield notably different outcomes. It has led me to wish for a more comprehensive educational background"(P6).

Hence, all participants advocate for an increase in field education courses.

All three participants collectively agreed that school experience significantly benefitted prospective teachers in various aspects. This included preparing lesson plans and materials, refining and implementing teaching methods and techniques, enhancing classroom management skills, improving communication with students, and recognizing the diversity in students' learning styles. Notably, two teachers underscored the school experience's role in eradicating mathematics bias among students.

> "Most of the students come to school with prejudice because math is a difficult subject. They think, 'I cannot do math anyway, I should not listen to the lesson. Therefore, the more a pre-service teacher gives lectures, the more fun the lesson can be, and the more students can participate in the lesson'"(P5).

> "During the misconceptions in mathematics lesson, when we introduced sets concept to the students, we observed instances, where students could drift towards entirely different areas or concepts. It's crucial always to confirm students' understanding and receive feedback from them … The school experience plays an important role in many factors such as students' prejudices and disconnections due to the age groups we teach" (P6).

Also a teacher,

> "The school experience offers prospective teachers the chance to put theoretical knowledge gained at the faculty into practical application, enhancing their professional experience. The time spent in schools and the relationships developed with students foster increased interest and passion among prospective teachers for the profession. this experience will imbue prospective teachers with school culture" (P4).

The teacher candidates expressed that the school experience provided them with the chance to put theoretical knowledge into practical use. Additionally, they noted that this practice contributed to instilling school culture within prospective teachers.

In general, the participants highlighted that increased lectures and practical experience would significantly enhance PCK of pre-service teachers. One of the teachers,

> "According to the theoretical-practical approach in teacher training, it was argued that real learning takes place through experience. Therefore, I think pre-service teachers should be provided with more opportunities to practice in practice schools to learn and develop their knowledge and skills" (P4).

One participant expressed the opinion that the school experience should be updated to span across both semesters. However, another participant noted that while this update could bring both positive and negative aspects.

> "The practice course, which allows teaching for a single term, first involves observation, then involves teaching. Actually, this is a good thing. We have the chance to observe and experience just one teacher. This can be negative ... Because we only observe in one term and teach in the other term, it falls short compared to the practice course that involves teaching in both terms. In the practice occurring as teaching in both terms, the teacher candidate finds more opportunities to teach. In this way, they actually experience it twice. I believe this has a more positive impact on the prospective teacher's PCK" (P5).

While some participants acknowledge the usefulness of the school experience conducted within a single semester as it allows pre-service teachers to observe, they highlight its inadequacy due to limiting observation to only one practice teacher. These participants advocate for an update in the form of two-semester lectures. However, in contrast, one teacher holds a differing perspective, preferring to retain the current structure of observation in one semester followed by lectures in another. This teacher argues that the existing practice, offering observation in one semester and teaching in the next, proves more beneficial for pre-service teachers. This particular teacher believes that a single-semester observation enhances the pre-service teacher's PCK more effectively. Moreover, they suggested that observing all mathematics teachers within the practice school, rather than solely one, would be more advantageous.

> "I believe it's more beneficial to listen and observe in the first semester and then proceed to teaching in the second semester. This approach allows us to step into the classroom, observe how the mentor teacher conducts lessons, and shapes the content. However, what appeared less beneficial to me was the restriction to a single mentor teacher. I wish we had the chance to observe each of the mathematics teachers in that school during the first semester, rather than only one mentor teacher. It would have been advantageous to observe weekly with different mentor teachers and subsequently teach a lesson in the second semester. In my opinion, a combination of observation and teaching is more advantageous for prospective teachers. I believe it would not have been as effective if we had only taught across two semesters. Observation can be incredibly beneficial. It would be more advantageous to observe multiple teachers, examining their attitudes toward students, observing diverse teaching methods and techniques employed by each teacher, and understanding how these methods are applied in practice" (P6).

Teachers who graduated with both the pre-2018 and updated curriculum share the belief that field courses are essential as they elevate a prospective teacher's understanding of mathematics to a certain level. However, they advocate for an increase in hours for field education courses without reducing the hours dedicated to field courses. While some teachers who graduated with the pre-2018 curriculum place less significance on field courses due to teaching within the grade 5-grade 8 level, some teachers who graduated with the updated curriculum disagree with this perspective. They assert that field courses hold significant importance in attaining a certain level of knowledge, irrespective of the specific student group being taught.

The notable contrast between teachers who graduated with the pre-2018 curriculum and those who graduated with the updated curriculum is evident in their proficiency levels. Teachers with the pre-2018 curriculum exhibited more inadequacy in areas such as classroom management, teaching methods, and utilization of techniques, attributed to the less comprehensive nature of their field education courses. To address these shortcomings, teachers with the pre-2018 curriculum endeavored to

compensate by practicing extensively in their assigned schools and through additional personal efforts. Here are some opinions expressed by teachers with the pre-2018 curriculum regarding this matter:

> "The absence of comprehensive field education courses had a detrimental impact on my ability to manage classrooms effectively in the school, where I was assigned. Our educational curriculum lacked sufficient guidance on the application and appropriateness of various teaching methods and techniques. Presently, I am acquiring this knowledge through practical experience at the school, where I am employed. Effective classroom management necessitates familiarity with diverse methods and techniques to accommodate various students and learning styles. However, due to the limited exposure to these practices during our education, I faced deficiencies in this aspect" (P5).

> "At the onset of my teaching career, I sensed the need to enhance my knowledge within my field of education. Despite having field education courses, I felt it was insufficient to establish a professional foundation. Consequently, I dedicated extra efforts to self-improvement. Upon entering the teaching profession, I gained a deeper appreciation for the significance of employing effective teaching strategies, methods, and techniques. While the knowledge gained from field courses is crucial, I realized that engaging with students requires a wholly different skill set. Throughout my professional experience, I observed that employing appropriate teaching strategies, methods, and techniques, tailored to specific age groups, yields distinct outcomes. This observation has led me to desire more comprehensive training in these areas" (P6).

An observation reveals that teachers who graduated under the pre-2018 curriculum, having undergone less intensive field education courses, exhibit insufficient PCK compared to their counterparts who graduated with the updated curriculum.

DISCUSSION, CONCLUSIONS, & RECOMMENDATIONS

When examining the contributions of teaching and school experiences to PCK of elementary mathematics teachers, two distinct curricula were considered: the pre-2018 curriculum and the updated curriculum. Results revealed that teachers from both curricula agreed on several positive impacts of teaching practice. They concurred that it enhances PCK, improves communication with students, fosters the development of teaching methods and techniques, aids in the preparation of lesson plans and materials, enhances time and classroom management, and boosts self-confidence. These findings correspond to the knowledge components of understanding students and instructional strategies outlined in Shulman's (1986, 1987) PCK model. These findings are consistent with numerous studies in the literature. Research by Aslan and Saglam (2018), Basturk (2009, 2010), Bay et al. (2019), Budak et al. (2011), Cetin et al. (2021), Degirmencay and Kasap (2013), Kandemir (2022), Kocak et al. (2020), Ozmutlu & Tabak (2023), and Uzun and Koparan (2021) supports the notion that teaching practices enhance PCK, improve communication with students, refine teaching methods and techniques, and bolster classroom management skills.

Furthermore, teachers found practice course valuable as they provide opportunities to apply theoretical knowledge gained in schools into practical scenarios, aligning with research by Degirmencay and Kasap (2013) and Uzun and Koparan (2021). Teachers graduating from the updated curriculum underscored the significance of technology in teacher training programs. They emphasized the effectiveness of using 5E lesson plans and gamification activities to engage students in lessons. This emphasis aligns with studies advocating for teaching innovation to increase student engagement, such as Basturk (2009, 2010), Budak et al. (2011), and Uzun and Koparan (2021). However, studies including Cetin et al. (2021), Demir et al. (2021), and Uzun and Koparan (2021) identified inadequate integration of technology in teacher training programs, suggesting the need for program updates. Particularly, Uzun and Koparan (2021) emphasized the importance of supporting lessons with educational games, Web 2.0 tools, dynamic software, interactive boards, and other technologies. Demir et al. (2021) suggested that increased technology integration in the updated curriculum compared to the pre-2018 curriculum could enhance technological PCK. Teachers universally stressed that ignoring technology in today's education system is not feasible. They agreed that effective technology utilization is indispensable for quality education and the training of proficient teachers. Acknowledging these findings from both the study and existing literature, it's evident that enhanced PCK leads to improved teaching methods, techniques, lesson plans, dynamic software usage, and concrete material application, catering better to students' interests, needs, and levels, consequently enhancing subject retention.

The third sub-problem of this study explored the differences in PCK between teaching practice conducted over both semesters, where pre-service teachers are actively involved compared to a single semester. Some academics criticize the removal of courses like elementary number theory and geometry from teacher training programs, citing a lack of field courses in mathematics (Demir et al., 2021). The study's findings align with these concerns, as teachers stress the significance of field courses in elevating their mathematical knowledge to a certain level. The finding that field education courses for the profession should be increased is also found in the literature (Cetin et al., 2021; Demir et al., 2021). Both teacher groups emphasize that increased practice and more lectures by pre-service teachers would enhance their PCK (Aslan & Saglam, 2018; Basturk, 2009, 2010; Cetin et al., 2021; Eraslan, 2009; Uzun & Koparan, 2021). Specifically, teachers enrolled in the school experience course believe that the current time allocated to teaching practices is insufficient and advocate for additional practice opportunities, suggesting a transition from one semester of practice to two. This perspective aligns with the findings of various studies (Aslan & Saglam, 2018; Basturk, 2009, 2010; Cetin et al., 2021; Uzun & Koparan, 2021).

Teachers who graduated under the updated curriculum believe that updating the teaching practice as lectures in both semesters is a beneficial decision. In the study by Kircicek and Yuksel (2019), some academicians indicated that the updated teaching practice, which is more active for prospective teachers and involves more practice, is more beneficial. Some even believe that this practice should commence in earlier grades for prospective teachers to explore their attitudes towards the profession.

Similarly, in the literature, academicians have similar opinions, suggesting that teaching practices should commence from lower grades, the course contents should be more detailed, field education courses should be more intensified, and there are similar thoughts on prospective teachers' attitudes towards the profession (Basturk, 2009; Cetin et al., 2021). Regarding the school experience, teachers who graduated with the pre-2018 curriculum have divided opinions on updating it to lectures in both semesters. Some favor this update, while others oppose it. Those against the update argue that observing for a single semester could improve PCK of pre-service teachers. They propose reorganizing this observation to include all mathematics teachers in the practice school rather than observing a single practice teacher. This stance resonates with opinions in Kircicek and Yuksel's (2019) study, where some academics find the school experience with intensive observation beneficial as it allows getting acquainted with the school, mentor teachers, administrators, and has more positive effects on pre-service teachers.

Conclusively, a key distinction between the two cohorts of teachers in this study was the disparity in practical exposure and the intensity of field education courses between those educated under the old curriculum and those under the updated curriculum. Consequently, the former group faced shortcomings in areas such as classroom management, communication with students, and proficiency in employing teaching methods and techniques. To compensate for these deficiencies, teachers resorted to personal efforts and practical experience gained from their assigned institutions. A substantial majority of teachers express disapproval of reducing the hours allocated to field courses and advocate for increased hours and intensified content in field education courses. They firmly assert the indispensability of field courses for personal development and attaining a requisite level of mathematical knowledge. Moreover, they stress the necessity of augmenting field education courses without diminishing the hours dedicated to field courses. Overall, both cohorts of teachers acknowledge the beneficial impact of teaching practice and field education courses. They affirm that these practices enhance their PCK, refine their skills in classroom and time management, bolster their communication with students, and amplify their proficiency in employing teaching methods and techniques. Consequently, both groups advocate for pre-service teachers to have more extensive and intensive field education courses. Consequently, they assert that updating the teacher training program to include two semesters of lectures is a judicious decision.

The study suggests the pivotal role of teaching practices within teacher training programs and advocates for their augmentation. It proposes an increase in the hours dedicated to field education courses, aiming to enhance the professional competence of prospective teachers by intensifying their course content. Additionally, restructuring teacher training programs to initiate teaching practice activities from earlier academic levels can aid in early recognition of prospective teachers' inclinations towards the profession. Furthermore, it emphasizes the need to amplify the content of field courses focusing on mathematical knowledge without diminishing their duration to accommodate an increase in field education courses. It's important to note that the study was confined to the insights of six elementary mathematics teachers who underwent teaching practice courses. As a recommendation, future studies should encompass a broader cohort of educators from diverse educational programs to validate and address similar issues effectively. In this context, in order to enhance the effectiveness of teaching practice, it is recommended to conduct observations in practice schools in addition to teachers' opinions. The study was constrained within the framework of Shulman's (1987) PCK model. To expand the scope, future research could integrate viewpoints on technological PCK, considering the profound influence of technology in contemporary life.

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