

From Examination-oriented Learning to Curriculum-oriented Teaching: Evaluating a Curriculum Reform in Mathematics Teacher Education through a Mixed-methods Study

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Abstract: This study examined the effectiveness of a curriculum-oriented reform implemented in a mathematics teacher qualification course under China's Mathematics Curriculum Standards for Compulsory Education (2022 Edition). The reform aimed to strengthen curriculum literacy and teaching self-efficacy by integrating curriculum standards into theoretical instruction and teaching practice. A mixed-methods design was employed involving 58 pre-service mathematics teachers at a local normal university in China. Quantitative data were collected through pre- and post-course questionnaires measuring curriculum literacy and teaching self-efficacy, while qualitative data were gathered from reflective journals, lesson plans, and semi-structured interviews. Quantitative findings indicated statistically significant improvements in participants' curriculum literacy (particularly standards-based instructional design competence) and teaching self-efficacy following the intervention. Qualitative findings further revealed that standards-based lesson planning, microteaching, and reflective practice promoted a deeper integration of curriculum theory and classroom practice. Participants gradually shifted from examination-oriented learning toward curriculum-oriented instructional thinking. However, they also reported challenges in interpreting core mathematical competencies and applying curriculum standards in authentic teaching contexts. The findings suggest that teacher qualification courses should place greater emphasis on curriculum literacy and practice-oriented teacher education rather than focusing primarily on examination preparation.

Keywords: Curriculum Literacy; Mathematics Teacher Education; Pre-service Mathematics Teachers; Curriculum-oriented Teacher Education

1. Introduction

In recent years, curriculum reform and teacher education reform have become central issues in educational development worldwide. As educational systems increasingly emphasize competency-based learning and student-centered instruction, teachers are expected not only to possess strong subject knowledge but also to demonstrate curriculum understanding, instructional design competence, and reflective teaching ability. Consequently, teacher education programs are facing growing pressure to prepare future teachers who can effectively interpret and implement curriculum standards in classroom practice.

In China, the release of the Mathematics Curriculum Standards for Compulsory Education (2022 Edition) marked a significant shift in mathematics education reform^[1]. The new curriculum standards emphasize core mathematical competencies, interdisciplinary learning, practical application, and integrated understanding of mathematical concepts. Compared with previous curriculum standards, the 2022 version highlights the importance of cultivating students' mathematical thinking, problem-solving abilities, and real-life application skills^[1]. These changes place higher demands on mathematics teachers' professional competence, particularly their ability to understand curriculum standards and transform curriculum requirements into effective teaching practice.

At the same time, reforms in China's teacher qualification system have also reshaped teacher

education. Since 2021, China has implemented a dual-track system for teacher qualification certification: all prospective teachers can take the national unified examination, while normal university students may also participate in qualification assessments organized by their own institutions. Under both pathways, prospective teachers must pass written examinations and demonstrate practical competence through structured interviews and teaching demonstrations. Therefore, teacher education courses must strike a balance between examination-oriented preparation and the cultivation of professional competence.

However, many pre-service mathematics teachers still approach teacher qualification courses from an examination-oriented perspective. They often memorize curriculum standards mechanically without fully understanding their educational implications or applying them in instructional design^[2]. This phenomenon weakens the connection between curriculum theory and teaching practice and limits the development of professional teaching competence.

Although previous studies have emphasized the importance of curriculum literacy and practice-oriented teacher education, limited empirical research has examined the effectiveness of curriculum-oriented reforms implemented within teacher qualification courses for pre-service mathematics teachers, particularly in the context of China's Mathematics Curriculum Standards for Compulsory Education (2022 Edition). Accordingly, empirical evidence is needed to evaluate whether curriculum-oriented reforms implemented within teacher qualification courses can effectively enhance pre-service mathematics teachers' curriculum literacy, instructional competence, and teaching self-efficacy.

To address these challenges, a curriculum-oriented teaching reform was implemented in the Teacher Qualification Theory and Practice course for mathematics majors at a local normal university in China. The reform integrated curriculum standards into course content, instructional activities, and teaching practice through a series of practice-oriented learning activities, including standards-based lesson planning, case analysis, microteaching, peer feedback, and reflective discussions.

The purpose of this study is to evaluate the effectiveness of this curriculum-oriented reform using a mixed-methods approach. Specifically, the study aims to examine whether the reform improves pre-service mathematics teachers' curriculum literacy and teaching self-efficacy.

Accordingly, this study addresses the following research questions:

RQ1. How does the curriculum-oriented reform influence pre-service mathematics teachers' curriculum literacy?

RQ2. How does the curriculum-oriented reform influence pre-service mathematics teachers' teaching self-efficacy?

RQ3. What learning experiences and challenges do pre-service mathematics teachers encounter during the curriculum-oriented reform?

2. Related Literature

2.1 Curriculum Literacy

Curriculum literacy refers to teachers' ability to interpret, evaluate, and implement curriculum standards effectively in practice^[3]. It is closely associated with teacher professionalism, as curriculum implementation depends on teachers' understanding of curriculum goals and competency expectations. Recent research has highlighted the concept of teacher curriculum competence as an amalgamation of theoretical and practical knowledge that enables teachers to act effectively in curriculum making^[4]. In mathematics education, curriculum literacy is particularly important because teachers must connect conceptual understanding, procedural fluency, and competency development.

Shulman's^[5] Pedagogical Content Knowledge (PCK) framework complements curriculum literacy by emphasizing that effective teaching requires integrating subject matter knowledge, pedagogical knowledge, curriculum knowledge, and knowledge of learners. Ball, Thames, and Phelps^[6] further extended this framework to include mathematical knowledge for teaching, such as understanding student misconceptions and curriculum progression. However, many pre-service teachers struggle to connect mathematical knowledge with curriculum requirements, often treating curriculum standards as examination content rather than practical instructional frameworks^[2]. Teachers with higher levels of curriculum literacy are better able to translate curriculum standards into standards-based lesson planning, instructional decision-making, and classroom implementation. Therefore, curriculum literacy is increasingly regarded as a key indicator of teacher professionalism in competency-oriented curriculum

reform.

2.2 Curriculum-oriented Teacher Education and Examination-oriented Learning

In China, the implementation of the national teacher qualification system has placed increasing emphasis on standardized assessment of prospective teachers' professional knowledge and teaching competence. Although these reforms aim to improve teacher quality, researchers have argued that high-stakes examinations may inadvertently encourage examination-oriented learning and superficial engagement with curriculum documents^[7]. Rather than developing the ability to interpret and implement curriculum standards, some pre-service teachers focus primarily on memorizing curriculum terminology and examination content.

This tension between examination preparation and professional competence development is particularly evident in mathematics teacher education^[8], where curriculum standards require teachers to translate competency-based learning goals into effective classroom practice. Consequently, teacher education programs have increasingly advocated curriculum-oriented approaches that integrate curriculum literacy, standards-based instructional design, and reflective teaching into teacher preparation. Zhang and Li^[2] argued that helping pre-service teachers move from examination-oriented learning toward competency-oriented teaching requires sustained engagement with curriculum documents in authentic teaching contexts rather than isolated examination preparation.

2.3 Practice-oriented Teacher Education

Practice-oriented teacher education is widely recognized as an effective approach to narrowing the gap between educational theory and classroom practice. Darling-Hammond^[9] and Zeichner^[10] argued that opportunities for authentic teaching experiences and systematic reflection are essential components of teacher preparation. In mathematics teacher education, a range of practice-based activities—including lesson study, microteaching, case analysis, and reflective journaling—has been associated with improvements in pre-service teachers' teaching self-efficacy, instructional adaptability, and reflective capacity^[11]. Evidence from Medina et al.^[12] further illustrates these benefits. Their study of microteaching lesson study (MLS) showed that repeated cycles of lesson planning, classroom enactment, peer observation, feedback, and revision encouraged pre-service teachers to move beyond teacher-centered lesson planning toward more student-centered instructional approaches. The authors argued that this collaborative process created supportive learning opportunities in which participants continuously refined both their instructional decisions and their professional understanding.

2.4 Reflective Practice and Teacher Self-efficacy

Reflective practice is a core component of professional development. Schön^[13] distinguished reflection-in-action and reflection-on-action. In mathematics teacher education, reflective activities help pre-service teachers evaluate instructional decisions, identify learning difficulties, and develop professional confidence^[14].

Teacher self-efficacy—beliefs in one's ability to organize and implement effective teaching—is influenced by mastery experiences, peer feedback, and reflective learning^[15]. Research by Makhubele and Tshabalala^[16] investigated high school pre-service teachers' self-efficacy in teaching mathematics, finding that while participants demonstrated good personal mathematics teaching efficacy, there remains a general need to enhance self-efficacy through coursework, field experiences, and peer mentoring. Microteaching and standards-based lesson planning play important roles in building such confidence.

Taken together, previous studies have highlighted the importance of curriculum literacy, practice-oriented teacher education, and reflective learning in supporting pre-service teachers' professional development. However, relatively little empirical research has investigated how curriculum-oriented reforms implemented within teacher qualification courses influence pre-service mathematics teachers' curriculum literacy and teaching self-efficacy under the context of China's 2022 Mathematics Curriculum Standards. This study addresses this gap through a mixed-methods evaluation of a curriculum-oriented teacher qualification course.

3. Methodology

3.1 Research Paradigm and Mixed-methods Design

This study adopted a mixed-methods design to examine the effectiveness of a curriculum-oriented reform in a teacher qualification course for pre-service mathematics teachers. Quantitative and qualitative data were collected concurrently to provide complementary evidence regarding both the outcomes of the reform and participants' learning experiences. While the quantitative strand assessed changes in curriculum literacy and teaching self-efficacy before and after the intervention, the qualitative strand explored how participants interpreted curriculum standards, engaged in practice-oriented learning activities, and reflected on their professional development.

The study was informed by two complementary theoretical perspectives: Shulman's Pedagogical Content Knowledge (PCK) framework^[5] and curriculum literacy theory^[3]. Shulman argued that effective teaching depends on teachers' ability to transform disciplinary knowledge into forms that are accessible and meaningful for learners, rather than relying solely on subject matter expertise. Curriculum literacy theory extends this perspective by emphasizing teachers' capacity to interpret curriculum standards, translate curriculum intentions into instructional decisions, and respond to curriculum reform in classroom practice. Together, these perspectives provided the conceptual foundation for the research design and data interpretation. The overall framework of the study is illustrated in Figure 1.

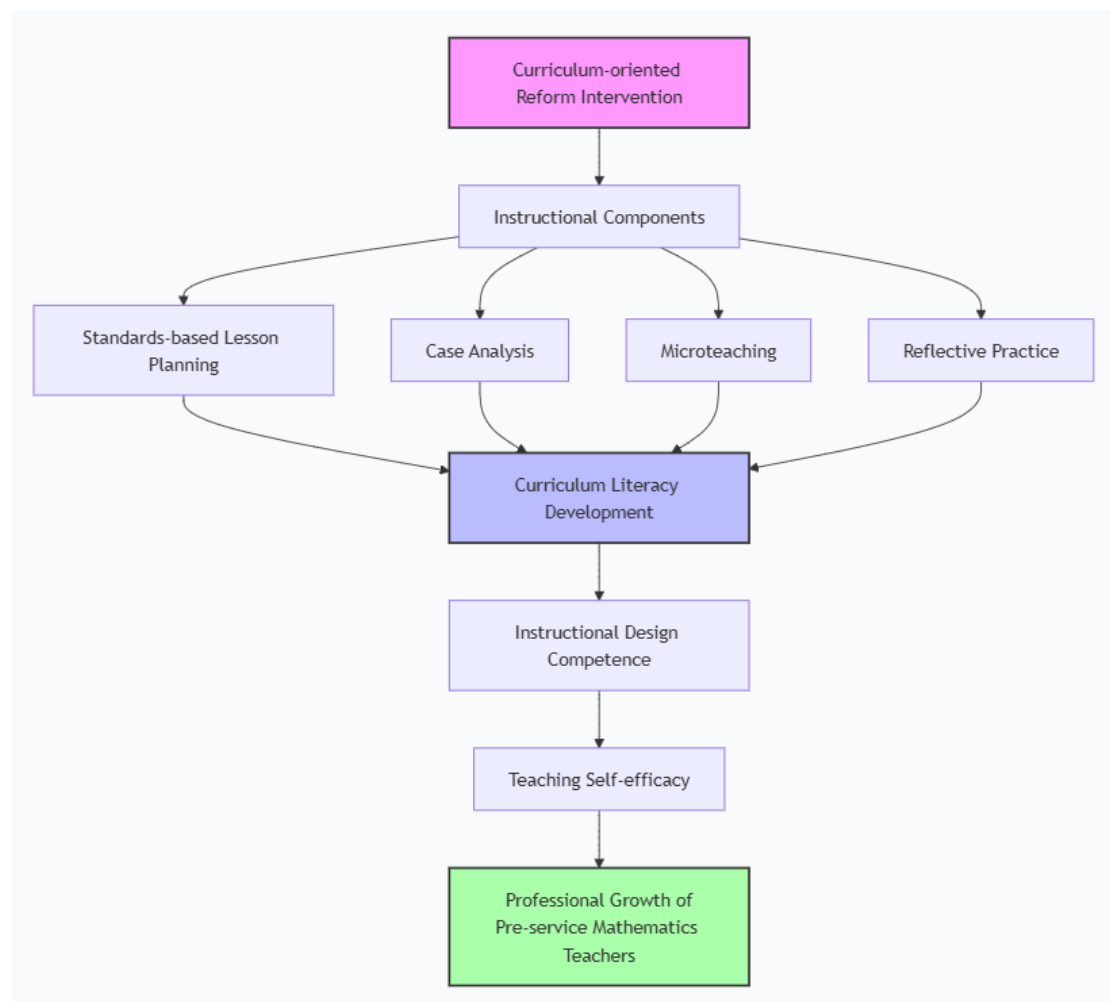


Figure 1: Conceptual Framework of the Study.

3.2 Research Context

The study was carried out at a local normal university in Guangdong Province, China, where the Teacher Qualification Theory and Practice course is offered as a professional elective for undergraduate students majoring in Mathematics and Applied Mathematics. The course is designed to prepare

prospective secondary mathematics teachers by combining theoretical instruction with practice-oriented learning activities. It also serves as an important bridge between university-based teacher education and the professional requirements of both the national teacher qualification examination and institutional teacher competency assessments.

In response to the implementation of the Mathematics Curriculum Standards for Compulsory Education (2022 Edition), the course was redesigned to place greater emphasis on curriculum-oriented teacher preparation. Rather than focusing primarily on examination content, the revised course encouraged participants to interpret curriculum standards, design standards-based lessons, develop an understanding of core mathematical competencies, and apply these ideas in authentic teaching contexts.

The curriculum reform was implemented over a 16-week semester. Throughout the course, curriculum standards were incorporated into classroom instruction, teaching practice, assessment tasks, and reflective learning activities, providing participants with repeated opportunities to connect curriculum theory with instructional practice.

3.3 Participants

The study involved 58 pre-service mathematics teachers enrolled in the Teacher Qualification Theory and Practice course at a local normal university in Guangdong Province, China. All participants were third-year undergraduate students majoring in Mathematics and Applied Mathematics and were preparing for secondary school mathematics teaching.

Of the participants, 43 were female and 15 were male. Although they had completed several mathematics education courses before entering the study, most had little experience in interpreting curriculum standards or designing standards-based mathematics lessons.

3.4 Course Reform Design

The course reform was designed to encourage pre-service mathematics teachers to move beyond examination-oriented learning and develop a curriculum-oriented understanding of mathematics teaching. Rather than treating curriculum standards as content to be memorized for teacher qualification examinations, the redesigned course emphasized their practical use in lesson planning, classroom instruction, and professional reflection.

The reform was organized around four interconnected learning activities.

(1) Standards-based Lesson Planning. Participants began each instructional unit by examining the Mathematics Curriculum Standards for Compulsory Education (2022 Edition). They identified curriculum objectives, core mathematical competencies, instructional expectations, and intended learning outcomes before preparing lesson plans. This process encouraged participants to translate curriculum requirements into concrete instructional decisions.

(2) Curriculum Interpretation through Case Analysis. Classroom cases drawn from mathematics teaching were used to support collaborative discussion and curriculum interpretation. Rather than evaluating teaching techniques alone, participants analyzed how curriculum standards were reflected in lesson objectives, mathematical tasks, classroom interaction, and opportunities for developing students' mathematical thinking.

(3) Microteaching and Peer Feedback. Throughout the semester, each participant conducted at least one microteaching session based on a standards-based lesson plan. Following each presentation, peers and the course instructor provided structured feedback on curriculum alignment, instructional organization, classroom communication, and lesson implementation. Participants then revised their lesson plans in response to the feedback received.

(4) Reflective Practice. Reflection was incorporated into the course through learning journals and group discussions. Participants were encouraged to examine how their understanding of curriculum standards evolved over time, identify difficulties encountered during teaching practice, and consider possible improvements for subsequent lessons.

3.5 Instruments and Data Collection

To obtain a comprehensive understanding of the effects of the curriculum-oriented reform, both quantitative and qualitative data were collected. The instruments and data sources included the following

components.

(1) Curriculum Literacy Questionnaire (CLQ). Curriculum literacy was assessed using a questionnaire specifically developed for this study. The instrument drew on previous research on curriculum literacy and teacher professional competence^[17] and incorporated the competency requirements specified in the Mathematics Curriculum Standards for Compulsory Education (2022 Edition)^[1]. It comprised 24 items rated on a five-point Likert scale (1=strongly disagree; 5=strongly agree), covering four aspects of curriculum literacy: understanding of curriculum standards, curriculum interpretation, standards-based instructional design competence, and reflective curriculum awareness.

(2) Teaching Self-efficacy Scale (TSS). Participants' teaching self-efficacy was measured using an adapted version of the Teachers' Sense of Efficacy Scale (TSES) developed by Tschannen-Moran and Hoy^[18]. The original instrument was adapted to the context of a teacher qualification course for pre-service mathematics teachers and aligned with the competency requirements of the Mathematics Curriculum Standards for Compulsory Education (2022 Edition)^[1]. The revised scale contained 18 items rated on a five-point Likert scale, assessing participants' confidence in lesson planning, classroom management, instructional communication, and teaching implementation.

The two instruments demonstrated satisfactory reliability in the present study. The Curriculum Literacy Questionnaire (CLQ) produced an overall Cronbach's α of .91, while the Teaching Self-efficacy Scale (TSS) yielded an overall Cronbach's α of .88. Reliability coefficients for each subscale are reported in Table 1.

Table 1 Reliability Analysis of the Research Instruments.

Instrument	Dimension	No. of Items	Cronbach's α
Curriculum Literacy Questionnaire	Understanding of Curriculum Standards	6	.82
	Curriculum Interpretation Ability	6	.84
	Standards-based Instructional Design Competence	6	.89
	Reflective Curriculum Awareness	6	.85
Teaching Self-efficacy Scale	Lesson Planning	5	.81
	Classroom Management	4	.83
	Instructional Communication	4	.85
	Teaching Implementation	5	.87

(3) Reflective Journals. Reflective journals were completed after major teaching activities throughout the semester, generating a total of 174 journal entries. These reflections provided valuable evidence of participants' learning experiences, evolving understanding of curriculum-oriented teaching, and professional development.

(4) Teaching Design Assignments. Participants completed standards-based mathematics lesson plans and instructional design tasks. These assignments were analyzed to examine the development of standards-based instructional design competence and participants' ability to apply curriculum standards in lesson planning.

(5) Semi-structured Interviews. Ten participants were purposively selected for semi-structured interviews based on their engagement in the course and overall learning performance. Each interview lasted approximately 30–40 minutes and was audio-recorded. The interviews explored participants' perceptions of curriculum standards, experiences with the curriculum-oriented reform, instructional challenges, and professional development.

4. Findings

4.1 Quantitative Findings

4.1.1 Changes in Curriculum Literacy

To examine the effects of the curriculum-oriented reform on participants' curriculum literacy, descriptive statistics and paired-samples t-tests were conducted. As shown in Table 2, participants achieved higher post-test scores across all four dimensions of curriculum literacy and the overall scale, indicating substantial improvement following the intervention.

Table 2: Paired-sample t-test Results for Curriculum Literacy (N = 58).

Dimension	Pre-test Mean (SD)	Post-test Mean (SD)	t(57)	p	Cohen's d
Understanding of Curriculum Standards	3.18 (0.52)	4.22 (0.45)	-8.92	< .001	1.16
Curriculum Interpretation Ability	3.07 (0.50)	4.12 (0.48)	-8.45	< .001	1.08
Standards-based Instructional Design Competence	3.01 (0.55)	4.08 (0.49)	-9.21	< .001	1.22
Reflective Curriculum Awareness	3.22 (0.51)	4.18 (0.47)	-7.98	< .001	1.00
Overall Curriculum Literacy	3.12 (0.48)	4.15 (0.44)	-9.56	< .001	1.26

Paired-samples t-tests indicated statistically significant improvements across all four dimensions of curriculum literacy and the overall scale ($p < .001$). The largest improvement was observed in standards-based instructional design competence ($d=1.22$), followed by understanding of curriculum standards ($d=1.16$). These large effect sizes suggest that the curriculum-oriented reform was particularly effective in enhancing participants' ability to interpret curriculum standards and translate them into standards-based lesson planning and instructional practice.

4.1.2 Changes in Teaching Self-efficacy

Similar improvements were observed in participants' teaching self-efficacy. As presented in Table 3, post-test scores were significantly higher than pre-test scores across all four dimensions and the overall scale, indicating enhanced confidence in mathematics teaching following the intervention.

Table 3: Paired-sample t-test Results for Teaching Self-efficacy (N = 58).

Dimension	Pre-test Mean (SD)	Post-test Mean (SD)	t(57)	p	Cohen's d
Lesson Planning	3.05 (0.60)	4.18 (0.50)	-8.31	< .001	1.08
Classroom Management	3.20 (0.55)	4.10 (0.48)	-7.22	< .001	0.94
Instructional Communication	2.98 (0.62)	4.02 (0.52)	-8.05	< .001	1.04
Teaching Implementation	3.10 (0.58)	4.10 (0.51)	-7.89	< .001	1.02
Overall teaching self-efficacy	3.08 (0.52)	4.10 (0.46)	-8.69	< .001	1.14

Paired-samples t-tests indicated statistically significant improvements across all four dimensions of teaching self-efficacy and the overall scale ($p < .001$). The largest improvement was observed in lesson planning ($d=1.08$), followed by instructional communication ($d=1.04$). Overall, the findings indicate that the curriculum-oriented reform substantially enhanced participants' confidence in planning, managing, communicating, and implementing mathematics instruction.

4.2 Qualitative Findings

4.2.1 Thematic Coding Results

Qualitative data from 174 reflective journals, 58 lesson plans, and 10 semi-structured interviews were analyzed using thematic analysis. Initial open coding generated 47 preliminary codes, which were subsequently grouped into five major themes (see Table 4).

Table 4: Major Themes and Representative Codes.

Theme	Representative Codes
Development of Curriculum Awareness	(1) Understanding curriculum objectives; (2) Recognizing competency-oriented teaching; (3) Awareness of core mathematical competencies.
Transition from Examination-oriented to Curriculum-oriented Teaching	(1) Reduced memorization; (2) Deeper curriculum interpretation; (3) Connecting standards with practice.
Growth in Instructional Competence	(1) Lesson planning improvement; (2) Classroom interaction; (3) Teaching adaptability.
Reflective Professional Development	(1) Self-evaluation; (2) Teaching reflection; (3) Peer feedback.
Challenges in Curriculum-oriented Teaching	(1) Abstract curriculum concepts; (2) Difficulty translating standards into activities; (3) Teaching anxiety.

4.2.2 Theme 1: Development of Curriculum Awareness

Analysis of the reflective journals and interview data suggested noticeable changes in participants' understanding of the Mathematics Curriculum Standards. At the beginning of the course, many participants described the standards primarily as examination content that needed to be memorized. As the course progressed, however, they began to view the standards as practical resources for planning lessons and making instructional decisions. This change was evident in both the interview transcripts and the reflective journals. One participant explained:

"Previously, I focused mainly on memorizing curriculum terminology for the teacher qualification exam. Now I understand that curriculum standards actually tell me what students should learn and how I should design my lessons. They are not just policy documents—they are teaching tools." (Interview, Participant 5)

4.2.3 Theme 2: Transition from Examination-oriented Learning to Curriculum-oriented Teaching

Interview data and reflective journals indicated a gradual change in how participants viewed teacher preparation. Rather than seeing the course primarily as preparation for the teacher qualification examination, many participants began to describe teaching as a process of interpreting curriculum goals and supporting students' mathematical learning. One participant commented:

"The course changed my understanding of teacher preparation. Teaching is not only about passing exams—it's about understanding students, aligning with curriculum goals, and making mathematics meaningful." (Interview, Participant 8)

4.2.4 Theme 3: Growth in Instructional Competence

Comparison of participants' lesson plans before and after the course revealed clear changes in standards-based instructional design. Initial lesson plans were often centered on textbook content with limited reference to curriculum standards. By contrast, the final lesson plans demonstrated clearer curriculum objectives, more inquiry-oriented mathematical activities, and closer alignment with core mathematical competencies. These improvements were also reflected in the interview data. One participant remarked:

"My first lesson plan was basically a list of textbook pages. My final lesson plan has clear objectives derived from the standards, group work with mathematical reasoning tasks, and a closing reflection. I never thought I could design such a lesson." (Interview, Participant 3)

4.2.5 Theme 4: Reflective Professional Development

Participants' reflective journals showed that many gradually developed the habit of examining their own teaching after classroom activities. Early journal entries often described teaching experiences in a descriptive manner, whereas later reflections included more critical evaluation of lesson design, curriculum alignment, and instructional decision-making. This progression is illustrated by the following journal excerpt:

"At first, I didn't know what to write. But after reading the instructor's feedback, I started asking myself: Did my lesson align with the standard? What would I change next time? This kind of thinking is new to me." (Reflective Journal, Week 8)

4.2.6 Theme 5: Challenges in Curriculum-oriented Teaching

Interview data indicated that some participants continued to experience difficulties when interpreting the competency-oriented concepts introduced in the curriculum standards. Concepts such as *mathematical abstraction* and *logical reasoning* were frequently described as difficult to translate into concrete classroom activities, despite participants' overall improvement in curriculum literacy. One participant explained:

"I still find the concept of mathematical core competencies confusing. What does 'mathematical abstraction' look like in a 40-minute lesson on functions? I need more concrete examples." (Interview, Participant 2)

4.3 Integrated Mixed-methods Interpretation

Taken together, the quantitative and qualitative findings present a consistent picture of the impact of the curriculum-oriented reform. The questionnaire results showed marked improvements in standards-based instructional design competence ($d = 1.22$) and lesson planning confidence ($d = 1.08$). These

improvements were reflected in the interview data, reflective journals, and lesson plans, where participants described becoming more capable of interpreting curriculum standards and incorporating them into lesson design.

At the same time, the qualitative findings added further insight by revealing difficulties that were not fully reflected in the questionnaire results. Although participants reported higher levels of curriculum literacy and teaching self-efficacy, many still found competency-oriented concepts, such as mathematical abstraction, difficult to apply in specific teaching situations. This complementary evidence suggests that confidence and instructional competence may develop more rapidly than a deeper understanding of curriculum concepts.

5. Conclusion and Discussion

The curriculum-oriented reform examined in this study was designed to strengthen the professional preparation of pre-service mathematics teachers by embedding curriculum standards into course learning and teaching practice. Drawing on evidence from both quantitative and qualitative data, the study shows that participants made substantial progress in curriculum literacy (particularly standards-based instructional design competence) and teaching self-efficacy over the semester. More importantly, many participants no longer viewed the curriculum standards merely as examination content but began to use them as a reference for lesson planning and classroom decision-making. These findings suggest that teacher qualification courses can contribute to professional learning when curriculum documents are treated as resources for teaching rather than as knowledge to be memorized.

One notable outcome concerns the development of curriculum literacy. The largest quantitative improvement was found in standards-based instructional design competence ($d = 1.22$), indicating that participants became increasingly capable of translating curriculum requirements into mathematics lessons. This result is consistent with previous research emphasizing that curriculum interpretation is a core aspect of teacher professionalism^[3]. It also supports the argument of Song and Lee^[19] that meaningful engagement with curriculum documents is essential for competency-oriented teaching. Instead of simply learning curriculum terminology, participants gradually learned how curriculum standards could guide instructional planning and classroom practice.

The findings also highlight the value of practice-oriented teacher education. Throughout the course, participants repeatedly engaged in lesson planning, case analysis, microteaching, peer discussion, and reflective activities. Together, these learning experiences appear to have strengthened their confidence in lesson planning, classroom communication, and teaching implementation, which is reflected in the significant increase in teaching self-efficacy (overall $d = 1.14$). This pattern aligns with Shulman's^[5] view that effective teaching depends on the integration of curriculum knowledge, pedagogical knowledge, and subject knowledge rather than on disciplinary knowledge alone.

The qualitative data provide additional insight into how participants experienced the reform. Analysis of reflective journals and interviews suggests that reflection gradually became part of participants' professional learning. Rather than simply describing classroom events, many participants began to question their instructional decisions, evaluate lesson quality, and consider possible improvements. Such changes support Beauchamp and Thomas's^[14] argument that professional identity develops through sustained reflection and teaching experience.

At the same time, the study identified issues that warrant further attention. Although participants reported greater confidence in curriculum implementation, many continued to find competency-oriented concepts difficult to interpret in concrete classroom situations. Concepts such as *mathematical abstraction* and *logical reasoning* were frequently described as challenging to transform into lesson activities. This contrast between quantitative improvements and qualitative reflections suggests that perceived competence may develop more quickly than deeper curriculum understanding. Future studies may therefore incorporate classroom observations, concept mapping, or performance-based assessments to capture curriculum literacy more comprehensively.

Several limitations should also be considered. The study was conducted in a single teacher education institution with a relatively small sample, limiting the transferability of the findings. In addition, the absence of a comparison group means that improvements cannot be attributed solely to the curriculum reform. Future research could adopt quasi-experimental or longitudinal designs across multiple institutions to examine whether the observed changes are sustained during the transition from pre-service preparation to classroom teaching.

The findings also have practical implications for teacher education. Rather than concentrating primarily on examination preparation, teacher qualification courses should provide systematic opportunities for curriculum interpretation, standards-based lesson planning, authentic teaching practice, collaborative feedback, and reflective learning. Embedding these experiences within teacher education may better prepare future mathematics teachers to implement competency-oriented curriculum reforms.

Overall, this study adds to the growing body of research on mathematics teacher education by showing how curriculum-oriented and practice-oriented teacher qualification courses can foster curriculum literacy, instructional competence, and professional confidence among pre-service mathematics teachers. It also provides empirical support for integrating curriculum standards into teacher preparation as a way of narrowing the gap between curriculum theory and classroom practice.

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