

Exploring the Enhancement of Preservice Primary Teachers' Interdisciplinary Teaching Competence: Based on the Analysis of Interdisciplinary Teaching Cases

Baicheng Ye, Chuwen Ye, Yeshe Lin*

School of Education Science, Zhaoqing University, Yunfu, Guangdong, China

**Corresponding Author*

Abstract: In the context of new educational quality reforms, updated curricular standards such as the “Mathematics Compulsory Education Curriculum Standards (2022 Edition)” advocate innovative interdisciplinary teaching approaches. Interdisciplinary teaching implies transcending subject boundaries and fostering connections among disciplines to expand students’ thinking, cultivate problem-solving abilities, and promote holistic student development. Within this context, teachers’ interdisciplinary teaching competence plays a crucial role in implementing interdisciplinary instruction effectively. Therefore, by analyzing three exemplary interdisciplinary teaching cases, this study explores the interdisciplinary elements embedded within these cases and offers suggestions for cultivating preservice primary teachers’ interdisciplinary teaching competence.

Keywords: New Curriculum Standards; Interdisciplinary Teaching; Interdisciplinary Teaching Competence; Case analysis; Preservice Primary Teachers

1. Introduction

As a novel pedagogical paradigm, interdisciplinary teaching has garnered widespread attention in education under the new curriculum standards. Compared with integrated or single-subject curricula, interdisciplinary teaching aims to transcend the limitations of both by establishing connections and cooperation across subjects, thereby deepening students’ conceptual understanding and promoting deeper knowledge acquisition [1]. However, the successful implementation of interdisciplinary teaching heavily relies on teachers’ interdisciplinary teaching

competence. As emerging agents of change responsible for enacting the new curriculum standards, preservice primary teachers must enhance their interdisciplinary teaching competence.

This study seeks to analyze exemplary interdisciplinary teaching cases, identify the interdisciplinary elements present in successful practices, and reveal strategies and insights for enhancing preservice primary teachers’ interdisciplinary teaching competence, thus contributing to its development among preservice primary educators.

2. Demand for Cultivating Preservice Primary School Teachers’ Interdisciplinary Teaching Competence

The term “interdisciplinary” first appeared in the United States in the 1920s. During the 1960s, Professor Robert S. Woodworth, a prominent American psychologist, formally introduced the concept of “interdisciplinarity”, thereby initiating reforms in interdisciplinary curricula. Scholars such as Spelt et al. proposed that the goal of interdisciplinary higher education is to cultivate boundary-crossing skills, emphasizing that it effectively fosters students’ interdisciplinary thinking and enhances their comprehensive or integrative capabilities under such a framework [2]. In the 21st century, countries including the United Kingdom, the United States, and Germany gradually implemented educational reform policies, placing increasing emphasis on interdisciplinary teaching and urging educators to

develop the competence to design and implement interdisciplinary instructional activities. International research indicates that core knowledge themes in interdisciplinary studies can be categorized into four major areas: the knowledge framework and societal

impact of interdisciplinary research, multidisciplinary approaches in cancer treatment and patient care, multidisciplinary care and rehabilitation related to COVID-19, and optimization of multidisciplinary artificial intelligence and industrial applications. Additionally, it has been noted that both the quality and quantity of interdisciplinary research associated with artificial intelligence are continuously improving [3], highlighting the robust development of interdisciplinarity across various domains internationally and underscoring its growing necessity in the current era.

In China, against the backdrop of the new curriculum standards, interdisciplinary teaching has become one of the key drivers for advancing curriculum reform and achieving high-quality education. To promote practical implementation, numerous studies have been conducted domestically. For instance, thematic instruction has been advocated as a central approach, breaking down disciplinary boundaries through subject-based teaching while promoting interdisciplinary learning via problem-oriented strategies, thus supporting interdisciplinary thematic instruction aimed at Comprehensive Student Development [4]. Further research has revealed that interdisciplinary thematic teaching aligns with the internal logic of knowledge updating and creation from a knowledge development perspective. It begins with the phenomena, contexts, and problems of knowledge and progresses through interaction and integration, actively aiding students in understanding and applying knowledge [5]. Moreover, to enhance the interdisciplinary teaching literacy of primary and secondary school teachers and support their professional growth, certain studies have identified two core dimensions of teachers' interdisciplinary competence: one rooted in integrating disciplinary and interdisciplinary knowledge, and the other driven by developing practical abilities through project-based thematic instructional design, ultimately facilitating teachers' mastery of interdisciplinary teaching [6]. However, investigations based on the China National Knowledge Infrastructure (CNKI) indicate that although publications related to "interdisciplinary teaching" show an overall upward trend, domestic academic research remains largely focused on two areas: the

study of the interdisciplinary teaching process itself and the study of courses. This suggests a relative lack of attention to research specifically targeting teachers' interdisciplinary teaching competence [7]. Moreover, teachers encounter numerous challenges and obstacles in implementing interdisciplinary instruction. During the process of interdisciplinary teaching, issues such as insufficient understanding of interdisciplinary teaching and its related concepts, limited ability to organize interdisciplinary teaching resources, weak instructional capabilities, low overall competence, inadequate role identification, and incomplete mastery of interdisciplinary teaching techniques are commonly observed among teachers [8].

3. Classic Case Analysis of Interdisciplinary Teaching in Primary Education

To enhance the interdisciplinary teaching competence of preservice teachers in primary education, an analysis of classic interdisciplinary teaching cases is essential. Examining such cases not only helps reveal how disciplinary knowledge is integrated and applied within interdisciplinary instruction, but also highlights the connections between subjects, thereby strengthening interdisciplinary knowledge integration. Furthermore, these cases offer insights into how interdisciplinary teaching activities can effectively foster students' core competencies under the new curriculum standards and promote their overall development.

Therefore, this study employs qualitative research methods, specifically case studies supplemented by literature review. Three representative cases were selected based on four criteria: representativeness (recognized as exemplary interdisciplinary teaching practices), diversity (involving various subject combinations), authenticity (prioritizing real classroom recordings), and timeliness (developed after the implementation of the new curriculum standards). These cases aim to provide strategies and insights for enhancing the interdisciplinary teaching abilities of preservice teachers in primary education.

3.1 Case 1: Interdisciplinary Teaching Case Combining Primary Mathematics and Primary Chinese Language at Shanghai

University Affiliated Jiading Liuyun Middle School

This case is based on Unit 3 of the sixth-grade compulsory Chinese textbook titled “The Imperial Palace Museum.” It adopts a project-based interdisciplinary teaching model centered around a “virtual tour of the Forbidden City.” Teachers create a realistic scenario—“A Day Tour of the Forbidden City by the Xiao Gu Family”—to initiate the virtual visit. Under the teacher’s guidance, students proceed through four sequential tasks: describing features of the Forbidden City, designing a visiting route, selecting key attractions, and calculating travel expenses. Throughout this interdisciplinary instructional process, teachers support students in deeply understanding the text, identifying the architectural characteristics of the Forbidden City, and summarizing its main features in one sentence, thus cultivating their language comprehension and expression skills. Subsequently, students were tasked with designing tour routes based on textbook content, closely aligning the activity with real-life needs to enhance hands-on and practical skills. Next, they were guided to select preferred scenic spots within a limited timeframe and explain their choices, further engaging them in real-life contexts while sparking interest. Students described these sites using the Chinese language knowledge they had acquired, thereby deepening their understanding of the subject matter. During the “Virtual Tour of the Forbidden City”, students also used WeChat mini programs to check ticket information and applied mathematical concepts to calculate travel expenses, achieving effective interdisciplinary integration between mathematics and Chinese language learning. This approach enabled students to grasp abstract mathematical concepts through real-world scenarios and appreciate the appeal of mathematics. Finally, by using panoramic display software, teachers arranged for students to virtually tour the Forbidden City along predetermined routes, allowing an immersive experience of its charm, reinforcing classroom learning impressions, and strengthening the interdisciplinary teaching experience between Chinese and mathematics.

The project-based interdisciplinary teaching model implemented in this case highlights the

positive significance of integrating academic knowledge. On one hand, the essence of interdisciplinary teaching lies in connecting disciplinary knowledge with practical learning experiences. To successfully implement interdisciplinary teaching, the integration of subject knowledge is essential; without such integration, interdisciplinary teaching becomes meaningless. On the other hand, both the integration of disciplinary knowledge and interdisciplinary teaching aim at better cultivating students’ core competencies [9]. Case One created a real-life scenario—“A Virtual Tour of the Forbidden City”—guiding students to appreciate the grandeur of the Forbidden City through Chinese language textbooks. At the same time, by adopting a travel-themed format, it skillfully embedded mathematical problems into realistic travel scenarios, achieving a seamless connection and transition between Chinese and mathematical knowledge. This effectively integrated subject knowledge, directing efforts toward the goal of cultivating students’ core competencies, focusing on developing thinking and language application abilities, strengthening cultural confidence, and incorporating mathematical knowledge to foster spatial awareness and data literacy.

3.2 Case 2: An Interdisciplinary Teaching Practice in Mathematics and Science at Fangqian Experimental Primary School, Xinwu District, Wuxi City

In Case 2, a task-driven and project-based learning approach was adopted by the teacher, who structured the activity around the theme of “Understanding Healthy Weight and Scientific Weight Management” into three stages. The first stage involved data collection and calculation, during which students gathered their height and weight data from Grades 1 to 5 and calculated the corresponding BMI values for each grade level. The second stage focused on drawing and analyzing statistical charts, where students created graphs based on both individual and class-wide BMI data and analyzed the factors contributing to changes in body mass index. The third stage centered on proposing solutions and reflective summary, wherein students discussed ways to improve physical fitness and reflected upon and summarized the entire learning process. After the instructional activity, based on students’

positive feedback regarding the interdisciplinary practical tasks, the teacher concluded that this activity promoted students' learning and integration of interdisciplinary knowledge and fostered the development of core competencies.

This case design engaged students in an interdisciplinary practical activity involving collecting and analyzing height and weight data, calculating BMI values, and drawing statistical charts. It emphasized the practical nature of interdisciplinary teaching with the aim of strengthening students' awareness of knowledge application through hands-on practice during instruction. This approach focused on cultivating key competencies in mathematics, such as data awareness, application awareness, and number sense, while simultaneously enhancing students' understanding of health-related scientific knowledge. In this case, the effectiveness of the interdisciplinary teaching practice was promptly collected and evaluated, which facilitated reflection on shortcomings in the current interdisciplinary instruction and further improved the teacher's interdisciplinary teaching capacity.

3.3 Case 3. An Interdisciplinary Teaching Practice in Mathematics and Physical Education at Beijing Xiluoyuan No.5 Primary School

In Case 3, students were first guided by the physical education teacher to pay attention to the positioning of starting lines through 50-meter straight running and 100-meter curved track running during PE class. Then, the mathematics teacher led the students back to the classroom, where they applied their knowledge of circumference to calculate the "actual running distance" of each lane. Charts and other visual representations were used to help students understand the structural features of the track that remained constant or changed. Upon completing the mathematics lesson, the teacher took the students back to the sports field to measure and draw fair starting lines, followed by a re-race, thus concluding the interdisciplinary teaching activity. Students expressed approval of this interdisciplinary approach. Throughout the process, teachers learned how to design and implement interdisciplinary lessons, reflected on the shortcomings of the instruction, and

consequently improved their ability to integrate knowledge across disciplines.

This interdisciplinary teaching practice was student-centered and designed around real-life situations familiar to students. The question—Why are the starting lines different for different lanes—was used to stimulate student thinking, arouse interest, and encourage them to explore knowledge progressively through practical actions, ultimately achieving clarity and fulfilling the core competency development goals in both mathematics and physical education under interdisciplinary instruction. Similar to Case 2, in Case 3, teachers also conducted evaluations and reflections on their interdisciplinary teaching practices to further enhance their interdisciplinary teaching competence.

4. Strategies for Enhancing the Interdisciplinary Teaching Competence of Preservice Teachers in Primary Education

Analysis of the three exemplary interdisciplinary teaching cases and related literature reveals that the student development objectives in all three cases are closely aligned with the core competency standards outlined in the new curriculum guidelines, with clearly defined teaching goals oriented toward disciplinary core competencies. Moreover, these interdisciplinary teaching practices not only center on students and incorporate experiential activities grounded in real-life contexts but also skillfully connect knowledge throughout the teaching process. By appropriately sequencing and transforming content, these practices effectively integrate disciplinary knowledge, thereby enhancing students' learning efficiency. After the interdisciplinary instruction, the teachers involved evaluate the implemented interdisciplinary teaching practices. Using practice as an opportunity, they reflect on and improve deficiencies in design and implementation, focusing on "interdisciplinary integration" to better base their efforts on cultivating students' core competencies. In this way, they complete the evaluation and reflection of interdisciplinary instructional practices, thereby enhancing their interdisciplinary teaching competence.

The interdisciplinary teaching requirements under the "New Curriculum Standards" demand appropriate interdisciplinary activities

to promote interdisciplinary instruction. Teachers' abilities in instructional design, implementation, and evaluation are prerequisites for the smooth execution of any teaching activity. This indicates that teachers' interdisciplinary teaching competence should also encompass interdisciplinary instructional design capability, interdisciplinary instructional implementation capability, and interdisciplinary instructional evaluation capability [10]. Based on the analysis of three interdisciplinary teaching cases in this study, it can be concluded that to enhance interdisciplinary teaching competence and successfully implement interdisciplinary instruction, preservice primary school teachers can achieve this by combining and applying the following four strategies:

(a) Deeply understand the New Curriculum Standards, solidify foundational subject knowledge, clearly grasp requirements such as subject-specific practices, integrated learning, and competency orientation in the new standards, and clarify instructional objectives under interdisciplinary teaching.

(b) Centering on the selected interdisciplinary theme, comprehend the connections between disciplinary knowledge within the interdisciplinary teaching model, consider the integration pathways of linking methods and logical sequences among related disciplinary knowledge, including both self-directed and collaborative integration approaches of interdisciplinary content, thus improving interdisciplinary knowledge integration capability [10].

(c) Incorporating Tyler's four elements of instructional design—defining instructional objectives, selecting learning experiences, organizing learning experiences, and evaluating learning outcomes—design interdisciplinary instructional practices closely tied to students' real-life contexts to enhance interdisciplinary instructional design capability. Furthermore, implement responsive interdisciplinary instruction based on the designed interdisciplinary teaching practices; during implementation, strengthen interdisciplinary learning motivation, interdisciplinary learning guidance capability, and presentation skills regarding interdisciplinary learning outcomes, thus promoting the enhancement of interdisciplinary instructional implementation

capability [10].

(d) Based on implemented interdisciplinary teaching activities, conduct interdisciplinary multi-stakeholder organizational evaluations and multidimensional student evaluations of interdisciplinary learning. Through metacognition, recognize one's comprehensive application ability of teaching evaluation methods and self-awareness within interdisciplinary teaching, establish an interdisciplinary instructional evaluation and reflective system, and thereby enhance interdisciplinary instructional evaluation capability [10].

By integrating these four strategies, preservice teachers in primary education can attempt to design interdisciplinary teaching activities that combine different subject themes. They can evaluate and reflect upon these activities to accumulate experience and enhance their interdisciplinary teaching competence. For example, in implementing interdisciplinary instruction bridging primary mathematics and primary Chinese language arts, preservice teachers can begin by examining the curriculum objectives of both subjects, identifying connections between mathematical and linguistic knowledge, selecting appropriate instructional content or topics suitable for students' developmental levels, integrating knowledge from both disciplines, and designing practical interdisciplinary teaching practices centered around student learning while focusing on fostering core competencies. Within the interdisciplinary teaching research activities conducted at Zhaoqing No.4 Primary School involving collaboration between Foshan and Zhaoqing, the interdisciplinary teaching activity titled "Our Weather Calendar" focused on improving students' practical abilities and cultivating core mathematical and linguistic competencies within primary education. This activity used real-life weather conditions related to travel as a guiding theme to design interdisciplinary teaching experiences, skillfully linking mathematical and Chinese language arts knowledge with meteorological concepts. It enabled students to recognize the applicability and value of integrated knowledge while developing their core competencies through experiential learning.

5. Conclusion

This case clearly demonstrates multiple aspects aligning with the strategies explored in this study, thereby proving the feasibility of these strategies. By extension, interdisciplinary teaching activities across various subject themes can also utilize the general strategies proposed in this study for interdisciplinary instructional design. This approach supports preservice teachers in successfully implementing interdisciplinary teaching across diverse subject areas. Through continuous engagement and reflection during the process of designing interdisciplinary teaching activities, preservice teachers can further refine their skills and elevate their level of interdisciplinary teaching competence.

By analyzing interdisciplinary teaching cases and relevant literature, this study identifies strategies and insights for developing the interdisciplinary teaching competence of preservice primary school teachers. Preservice teachers should gain a deep understanding of the new curriculum standards, adopt student-centered approaches, clarify the objective of interdisciplinary teaching in cultivating students' core competencies, and design interdisciplinary teaching activities that reflect real-life contexts. This can enhance their abilities in integrating interdisciplinary knowledge, designing instructional plans, implementing teaching practices, and evaluating interdisciplinary learning outcomes. However, there are limitations in the proposed strategies for improving the interdisciplinary teaching competence of preservice primary school teachers. For instance, questions remain regarding whether "the selected cases are sufficiently representative" or whether "the cases reflect students' feedback on interdisciplinary teaching." During the implementation process, additional challenges arise, such as how to reasonably allocate class hours for interdisciplinary instruction, how to select subject themes that are both relevant to students' daily lives and engaging, how to assess students' learning outcomes effectively in interdisciplinary classrooms, what students' emotional attitudes are during interdisciplinary instruction, and what new challenges preservice teachers may face when applying the strategies proposed in this study. These issues highlight the limitations of the current study and call for further research and investigation.

Acknowledgments

This article is a partial outcome of the 2024 Undergraduate Innovation and Entrepreneurship Training Program at Zhaoqing University titled "Research on Preservice Teachers' Interdisciplinary Teaching Competence under the New Curriculum Standards" (Project No.: 202410580005).

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