Advances in Educational Technology and Psychology (2025)
Clausius Scientific Press, Canada

DOI: 10.23977/aetp.2025.090217
ISSN 2371-9400 Vol. 9 Num. 2

Exploration of Teaching Reform in Theoretical Bridging Courses Aimed at Enhancing Professional Competencies of College Students Majoring in Teacher Education: A Case Study of "Elementary Mathematics Research"

Li Hao[1,2], Chengqiang Wang[2,a,*], Fang Wang[1], Hongyao Jiang[1]

[1]*School of Mathematics and Statistics, Qinghai Normal University, Xining, Qinghai, 810008, China*
[2]*School of Mathematics and Physics, Suqian University, Suqian, Jiangsu, 223800, China*
[a]*chengqiangwang2022@foxmail.com*
[*]*Corresponding author*

Keywords: Teaching Reform, Professional Competencies, Theoretical Bridging Courses, Elementary Mathematics Research, Teacher Education

Abstract: The professional competencies of teacher education majors are essential for their success in real-world classrooms. As education systems evolve, there is an increasing need to bridge the gap between theoretical knowledge and practical teaching skills. One effective way to achieve this is through the reform of theoretical bridging courses, which provide future educators with the opportunity to connect classroom theory with actual teaching practice. This study explores various strategies designed to enhance these courses and improve teacher preparation. These strategies include integrating classroom-based action research, utilizing collaborative learning and peer teaching, connecting theory with practice through case analysis, embedding technology in teaching and learning, and encouraging reflective journaling and portfolio development. Each of these strategies plays a crucial role in equipping teacher candidates with the skills needed to navigate diverse classroom environments and adapt to evolving educational technologies. Action research, for example, encourages reflective practice and continuous improvement, while collaborative learning fosters communication and teamwork. Technology integration enhances engagement and prepares educators for modern classroom settings. Reflective journaling and portfolio development provide opportunities for self-assessment and professional growth. This study evaluates the relative importance of these strategies based on their impact on teacher education programs. By identifying the most effective approaches, the research aims to provide valuable insights into improving teacher preparation and ensuring that future educators are well-equipped to meet the challenges of contemporary classrooms.

1. Introduction

Improving the professional competencies of college students majoring in teacher education, particularly in mathematics, has become a central focus of current educational reform efforts. Research has shown that the effectiveness of teacher preparation programs is closely linked to

student learning outcomes and the development of subject-specific teaching skills. Geiger et al. [1] emphasize the importance of aligning teaching practices with theoretical frameworks, such as Valsiner's zone theory, to foster deeper engagement and understanding in mathematics classrooms. Similarly, Qian and Youngs [2], through a cross-national study using TEDS-M data, highlight how well-structured teacher education programs significantly enhance prospective teachers' mathematical content knowledge and pedagogical skills.

The student teaching experience plays a critical role in shaping future teachers' instructional approaches, as demonstrated by Peterson and Williams [3], who explored how practical classroom exposure significantly impacts mathematics teaching capabilities. Furthermore, long-term professional development initiatives have been found to produce measurable and sustained improvements in both teacher effectiveness and student performance. Kutaka et al. [4] reported on a comprehensive four-year elementary mathematics specialist program that successfully bridged theoretical learning with instructional practice.

Teaching in diverse educational contexts also demands highly responsive and adaptive pedagogies. Berry et al. [5] provide insights into how elementary teachers in high-poverty urban schools align their practices with national mathematics standards, while Walsh [6] examines the challenges faced by support tutors lacking formal mathematics education training. These studies collectively point to the urgent need for bridging courses that not only convey theoretical knowledge but also emphasize practical application and innovation in teaching.

In response to these insights, Wang et al. [7] advocates for curriculum optimization aimed at enhancing students' innovative thinking and teaching abilities through integrated, practice-oriented instruction. Building on this foundation, the present study focuses on the exploration of teaching reform in theoretical bridging courses, designed to connect subject theory with pedagogical practice, specifically, a case study of the course *Elementary Mathematics Research*, which aims to enhance the comprehensive professional competencies of teacher education majors by improving research literacy, instructional design, and reflective teaching practices.

The rest of the paper is organized as follows. In Section 2, we explain in detail the limitations of theoretical bridging courses in teacher professional competency development. In Section 3, we propose several strategies for improving theoretical bridging courses aimed at enhancing professional competencies of college students majoring in Teacher Education. In Section 4, with the aid of entropy method, we perform an empirical study based on our teaching team's experience and several experts' suggestions. In Section 5, we present several concluding remarks.

2. Limitations of theoretical bridging courses in teacher professional competency development

In this section, our main aim is to explain the limitations of theoretical bridging courses in teacher professional competency development of college students majoring in Teacher Education. We shall highlight key shortcomings in theoretical bridging courses within teacher education programs. These challenges include limited practical application, insufficient focus on soft skills, and outdated or irrelevant content, each of which hinders the development of essential professional competencies. While theoretical knowledge is crucial, it must be complemented by hands-on experience, interpersonal skills, and up-to-date content to ensure future teachers are fully prepared for the dynamic realities of modern classrooms. These gaps can affect teacher readiness, leaving graduates struggling to apply what they have learned and respond effectively to diverse student needs and classroom environments. Addressing these shortcomings is essential for enhancing teacher education programs and improving overall educational outcomes.

2.1. Limited practical application

Theoretical bridging courses often focus heavily on educational theories and concepts, which may not directly relate to everyday classroom teaching. While understanding theory is important, these courses sometimes lack clear examples or activities that show how to use the ideas in real-life situations. As a result, students may find it difficult to apply what they've learned when they start teaching. Without enough hands-on practice or real-world connections, the knowledge gained can feel distant or abstract, limiting its usefulness in building practical teaching skills, professional confidence, and overall classroom readiness.

2.2. Insufficient focus on soft skills

Theoretical bridging courses in teacher education often place strong emphasis on academic content and teaching theories, but they tend to overlook the development of essential soft skills. These include communication, empathy, emotional intelligence, conflict resolution, adaptability, and collaboration in which, skills that are critical for success in real classroom environments. Teaching is not just about delivering content; it's about building relationships with students, managing classroom dynamics, and creating a positive learning atmosphere. Without proper training in these interpersonal areas, future teachers may struggle to connect with students, handle behavioral challenges, or work effectively with colleagues and parents. Moreover, soft skills help teachers respond to diverse student needs, manage stress, and maintain a healthy professional approach. When these skills are not addressed in teacher preparation, graduates may feel unprepared for the emotional and social demands of the profession. As a result, the lack of focus on soft skills in theoretical bridging courses creates a gap in teacher readiness, which can negatively affect both teaching performance and student outcomes.

2.3. Outdated or irrelevant content

One major shortcoming of theoretical bridging courses in teacher education is the use of outdated or irrelevant content. Many of these courses rely on traditional teaching models, old research findings, or education policies that no longer reflect the realities of modern classrooms. As education systems continue to evolve, especially with the rise of digital tools, inclusive education practices, and changing student needs, it is essential that course materials stay current and practical. However, when courses fail to update their content, students may be learning theories and methods that are no longer effective or widely used in schools. This disconnect can leave future teachers underprepared for the challenges they will face, such as integrating technology into lessons, supporting students with diverse learning needs, or adapting to new curriculum standards. Furthermore, irrelevant content can lead to a lack of engagement and motivation among teacher education students, who may struggle to see the value in what they are learning. For teacher training to be effective, it must be closely aligned with current classroom practices and expectations. Without regular updates and real-world relevance, theoretical bridging courses risk weakening the professional competencies they are meant to strengthen.

3. Strategies for improving theoretical bridging courses aimed at enhancing professional competencies of college students majoring in Teacher Education

In this section, we discuss strategies for improving theoretical bridging courses aimed at enhancing the professional competencies of college students majoring in Teacher Education. These carefully developed strategies are specifically designed to equip teacher candidates with the

practical skills, critical dispositions, and reflective practices necessary for success in today's diverse and dynamic classrooms. They include integrating classroom-based action research, using collaborative learning and peer teaching, connecting theory with practice through case analysis, embedding technology in teaching and learning, and incorporating reflective journaling and portfolio development. Each of these evidence-based strategies serves to bridge the gap between educational theory and classroom practice. By encouraging active engagement, critical thinking, and real-world application, these approaches promote professional growth, strengthen teaching competencies, and better prepare future educators to navigate complex classroom environments and adapt to evolving educational technologies and pedagogical trends.

3.1. Integrating classroom-based action research

Integrating classroom-based action research is a powerful strategy for improving theoretical bridging courses in teacher education programs. This approach involves teacher candidates actively engaging in small-scale research projects within real or simulated classroom settings. Instead of passively learning educational theories, students investigate specific teaching problems, test instructional strategies, collect data, and reflect on their outcomes. For example, in a course like Elementary Mathematics Research, teacher candidates might explore how different questioning techniques impact students' problem-solving skills. This strategy bridges the gap between theory and practice by encouraging students to apply what they've learned in meaningful, context-rich environments. It promotes critical thinking, problem-solving, and a deeper understanding of pedagogical concepts. Moreover, it nurtures reflective practice, as students analyze their teaching methods and consider how to improve them based on evidence. By participating in action research, future teachers develop a habit of inquiry that supports lifelong professional growth. They also become more confident and competent in making instructional decisions, adapting to diverse classroom needs, and engaging in continuous improvement. Overall, integrating classroom-based action research into theoretical bridging courses transforms them from abstract, lecture-driven experiences into dynamic, practice-oriented learning journeys that better prepare teacher education majors for the realities of today's classrooms.

3.2. Using collaborative learning and peer teaching

Using collaborative learning and peer teaching is an effective strategy to enhance professional competencies in teacher education majors. By working in groups, students can share their knowledge, tackle complex teaching challenges together, and learn from diverse perspectives. This collaborative environment fosters critical thinking, teamwork, and communication skills—essential qualities for future educators. In teacher education, these skills are especially valuable as teachers often need to collaborate with colleagues, parents, and students in real-world settings. Incorporating peer teaching further strengthens these competencies. When students teach their peers, they must clearly explain concepts, engage others, and adapt their communication to suit different learning styles. This reinforces their own understanding of the material while simultaneously helping others learn. For example, in a course like Elementary Mathematics Research, students can design and teach mini-lessons on specific math topics, honing both their teaching and presentation skills.

Overall, collaborative learning and peer teaching promote active learning, enhance professional preparation, and build a supportive learning community.

3.3. Connecting theory with practice through case analysis

Connecting theory with practice through case analysis is a crucial strategy for improving

theoretical bridging courses in teacher education programs. This strategy allows students to actively engage with real-world scenarios, helping them apply abstract educational theories to practical teaching situations. By analyzing case studies, future teachers can bridge the gap between what they learn in textbooks and how those concepts manifest in actual classrooms. Case analysis typically involves presenting students with detailed classroom situations—often based on real or simulated teaching environments—where they must identify challenges, analyze teaching strategies, and propose solutions. For example, in a course like Elementary Mathematics Research, students might examine a case where a teacher struggles to engage a group of students in a math lesson. The students would then apply relevant theories about student motivation, differentiated instruction, or formative assessment to suggest improvements. This strategy deepens students' understanding by encouraging them to think critically about how theoretical concepts can be practically applied. It also fosters problem-solving skills, as students must assess multiple perspectives and potential outcomes before proposing solutions. Moreover, case analysis strengthens students' decision-making abilities, helping them recognize the complexities of teaching and the need for flexible, context-specific approaches. In addition, case analysis enhances reflective practice. By discussing and analyzing cases in groups, teacher candidates can refine their own beliefs about effective teaching. They learn not only from their own experiences but also from the insights of their peers, encouraging collaborative learning.

Overall, connecting theory with practice through case analysis makes theoretical bridging courses more relevant, engaging, and effective, preparing teacher education majors for the dynamic challenges they will face in the classroom.

3.4. Embedding technology in teaching and learning

Embedding technology in teaching and learning is a critical strategy for improving theoretical bridging courses aimed at enhancing professional competencies in teacher education majors. As technology continues to shape modern classrooms, it is essential for future teachers to be well-versed in using digital tools to enhance their teaching and engage students. Incorporating technology into theoretical bridging courses allows students to not only understand educational theories but also explore how these theories can be effectively applied through digital platforms. For instance, in a course like Elementary Mathematics Research, students can be trained to use interactive tools such as GeoGebra or Desmos to create dynamic lessons that engage students in exploring mathematical concepts. These tools help students visualize abstract ideas and make learning more interactive and accessible. Additionally, technology can support differentiated instruction, allowing teachers to tailor lessons to the varied needs of students through adaptive learning platforms. Moreover, integrating technology into teacher education courses enhances future teachers' digital literacy, enabling them to navigate online resources, educational software, and communication tools. It also prepares them to incorporate blended learning, flipped classrooms, or online assessments into their teaching practices, fostering flexibility in the classroom.

Overall, embedding technology into teacher education helps bridge the gap between theoretical knowledge and modern teaching practices, ensuring that graduates are equipped with the skills necessary to thrive in today’s digital learning environments.

3.5. Inviting reflective journaling and portfolio development

Inviting reflective journaling and portfolio development is an effective strategy for improving theoretical bridging courses in teacher education programs. This approach encourages teacher candidates to actively engage with their learning by reflecting on their experiences, challenges, and growth throughout the course. By incorporating reflective journaling, students can explore their

thoughts, feelings, and personal insights related to the concepts they are studying, helping them make connections between theory and practice. This reflective process not only deepens understanding but also nurtures critical thinking and self-awareness, that is, key competencies for effective teaching. In a course like Elementary Mathematics Research, for example, students might keep a journal to document their experiences with lesson planning, teaching practices, and student feedback. They could reflect on what strategies worked well, what didn't, and how they can improve in the future. This continuous reflection promotes a growth approach and helps students develop the habit of self-evaluation, which is crucial for lifelong professional development.

Alongside journaling, portfolio development provides a structured way for students to compile evidence of their progress. Portfolios might include lesson plans, student feedback, teaching videos, and reflections, offering a comprehensive picture of their development. This process allows teacher candidates to track their own growth, identify strengths and areas for improvement, and demonstrate their competence to future employers. Ultimately, reflective journaling and portfolio development help bridge the gap between theoretical knowledge and practical teaching skills. They promote continuous professional growth, ensuring that teacher education majors are better prepared for the complex demands of the teaching profession.

4. An empirical study based on the entropy method

This section presents an empirical study grounded in the entropy method, a widely recognized approach for objectively determining indicator weights in multi-criteria evaluations. This method captures the degree of disorder or uncertainty in the dataset, allowing for more accurate assessment of variable importance. The following analysis applies this technique to real-world data, aiming to uncover meaningful patterns and insights. The results provide a robust foundation for interpreting the underlying structure and informing decision-making processes in the studied context.

Data collection. To construct the evaluation matrix $(\tilde{p}_{ij})_{m\times n}$, we consulted several domain experts through interviews and surveys, and systematically gathered insights from our teaching team's accumulated practical experience, instructional records, and course evaluations over recent years.

Data normalization. We obtained the matrix of normalized data by applying the min-max normalization method. This approach eliminates the influence of differing units and magnitudes among indicators, ensuring comparability across variables. This step is essential for maintaining consistency and improving the accuracy of the entropy-based weight determination. We define p_{ij} ,based on the primal evaluation matrix $(\tilde{p}_{ij})_{m\times n}$, by

$$p_{ij}=\frac{\tilde{p}_{ij}-\min\limits_{1\leqslant i\leqslant m}\tilde{p}_{ij}}{\max\limits_{1\leqslant i\leqslant m}\tilde{p}_{ij}-\min\limits_{1\leqslant i\leqslant m}\tilde{p}_{ij}},\ i=1,2,\cdots,m,\ \ j=1,2,\cdots,n.$$

Calculation of the entropy. We define E_j by

$$E_j=-\frac{1}{\ln(m)}\sum_{i=1}^{m}L(p_{ij}),\ \ j=1,2,\cdots,n,$$

with $L(t)=\begin{cases}t\ln(t), & t>0\\ 0, & t=0\end{cases}$.

Calculation of the weights based on the entropy. We get

$$w_j = \frac{1 - E_j}{\sum_{j=1}^{m} (1 - E_j)}, \quad j = 1, 2, \cdots, n .$$

Table 1: Proposed strategies and the initial judgements

Items / Strategies	Item 1	Item 2	Item 3	Item 4	Item 5	Item 6	Item 7	Item 8	Item 9
Integrating classroom-based action research	95.55	97.69	95.56	97.87	93.97	97	91.78	94.89	98.89
Using collaborative learning and peer teaching	93.56	93.89	93.78	97.87	93.97	95.89	94.69	98.82	95.55
Connecting theory with practice through case analysis	95.87	95.89	95.78	95.56	95.97	95.89	95.69	95.82	95.55
Embedding technology in teaching and learning	94.87	98.55	90.78	94.56	93.97	97.89	96.69	99	95.89
Inviting reflective journaling and portfolio development	96.89	95.87	96.56	92.55	91.78	94	99	92.89	92.97

Table 2: Comprehensive scores of the proposed strategies

Strategies	Contributions
Integrating classroom-based action research	0.1496
Using collaborative learning and peer teaching	0.2445
Connecting theory with practice through case analysis	0.3013
Embedding technology in teaching and learning	0.2154
Inviting reflective journaling and portfolio development	0.0891

Based on the scores, each strategy contributes differently to the effectiveness of theoretical bridging courses in enhancing professional competencies; see Tables 1 and 2. Connecting theory with practice through case analysis (0.3013) ranks highest, emphasizing its role in helping teacher candidates apply abstract concepts to real classroom situations. This method develops their analytical thinking, decision-making, and adaptability, skills essential for effective teaching. Using collaborative learning and peer teaching (0.2445) follows closely, highlighting its value in fostering communication, teamwork, and mutual learning. These skills are foundational in classroom instruction and professional collaboration, preparing future educators for dynamic teaching environments. Embedding technology in teaching and learning (0.2154) is also significant. In an increasingly digital world, familiarity with educational technologies enhances instructional delivery and student engagement, making tech integration a vital part of teacher training. Integrating classroom-based action research (0.1496) promotes reflective teaching and continuous improvement. It encourages future teachers to observe, evaluate, and refine their methods, fostering a habit of evidence-based practice. Lastly, inviting reflective journaling and portfolio development (0.0891),

though scoring lowest, supports long-term growth by helping students track their development and articulate their learning experiences.

5. Conclusions

In conclusion, this study explored effective strategies for enhancing the professional competencies of teacher education majors through the reform of theoretical bridging courses. By analyzing the relative importance of five targeted approaches, including case analysis, collaborative learning, technology integration, action research, and reflective journaling, we identified the most impactful methods for bridging theory and practice. Among them, connecting theory with practice through case analysis emerged as the most influential, followed by collaborative and technology-enhanced learning. These findings highlight the need for integrated, practice-oriented instruction that fosters critical thinking, adaptability, and innovation. The results offer valuable insights for curriculum designers and educators seeking to improve teacher preparation and ensure future educators are equipped for real-world classroom challenges.

Acknowledgements

Chengqiang Wang is supported by Philosophy and Social Sciences Research Program for Colleges and Universities in Jiangsu (2024SJYB1744), by Qinghai Normal University Young and Middle-aged Teachers Research Foundation (1001/17101040219), by Industry-University Cooperation Collaborative Education Program of Education Ministry of China (231001065275917), by Philosophy and Social Sciences Research Program in Suqian (24SYC-124), by Startup Foundation for Newly Recruited Employees and the Xichu Talents Foundation of Suqian University (2022XRC033), by Professional Certification Oriented Teaching Reform Research Special Program of Suqian University (2023ZYRZ04), by Qing Lan Project of Jiangsu, by The Program of Quality Assurance and Evaluation on Higher Education in Suqian University (2024ZBPJ13), by Higher Education Reform Research Project of Jiangsu (2023JSJG718), by Higher Education Scientific Research Planning Project of the Higher Education Association of China (23SX0203).

References

[1] Geiger V, Anderson J, Hurrell D. A case study of effective practice in mathematics teaching and learning informed by Valsiner's zone theory[J]. Mathematics Education Research Journal, 2017, 29(2): 143-161.

[2] Qian H, Youngs P. The effect of teacher education programs on future elementary mathematics teachers' knowledge: A five-country analysis using TEDS-M data[J]. Journal of Mathematics Teacher Education, 2016, 19(4): 371-396.

[3] Peterson B E, Williams S R. Learning mathematics for teaching in the student teaching experience: Two contrasting cases[J]. Journal of Mathematics Teacher Education, 2008, 11(6): 459-478.

[4] Kutaka T S, Smith W M, Albano A D, Edwards C P, Beattie H L, Stroup W M. Connecting teacher professional development and student mathematics achievement: A 4-year study of an elementary mathematics specialist program[J]. Journal of Teacher Education, 2017, 68(2): 140-154.

[5] Berry R Q, Bol L, McKinney S E. Addressing the principles for school mathematics: A case study of elementary teachers' pedagogy and practices in an urban high-poverty school[J]. International Electronic Journal of Mathematics Education, 2009, 4(1): 1-22.

[6] Walsh R. A case study of pedagogy of mathematics support tutors without a background in mathematics education[J]. International Journal of Mathematical Education in Science and Technology, 2017, 48(1): 67-82.

[7] Wang C Q, Wu Q X, Zhao X Q, Lv Z W. Enhancement of innovation competence of college students majoring in Mathematics Education through curriculum optimization[J]. Journal of Contemporary Educational Research, 2024, 8(10), 83-89.