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КЫТАЙДАГЫ МАТЕМАТИКА МУГАЛИМДЕРИНИН КЕСИПТИК ӨСҮШҮНӨ МООС ЖАНА ОНЛАЙН РЕСУРСТАРЫНЫН ТААСИРИ

Аннотация. Санариптик трансформация билим берүү ландшафтында ылдамдаган сайын, массалык ачык онлайн курстары (MOOCs) жана онлайн билим берүү ресурстары мугалимдерди даярдоодо барган сайын олуттуу роль ойноп жатышат. Бул изилдөө бул ресурстар Кытайдагы математика мугалимдеринин кесиптик өнүгүүсүнө кандай таасир тийгизерин изилдеп, үч негизги багытка көңүл бурат: предметтик билимди жогорулатуу, окутуунун долбоорлоо потенциалы жана рефлексиялык практика. Белгилүү кытай университеттеринин адабияттарды талдоого жана мисалдарды салыштырууга негизделген методологияны колдонуу менен, бул макалада МООС ийкемдүү, жогорку сапаттагы окуу жолдорун сунуштоо менен салттуу мугалимдердин билимин кантип толуктаарын баса белгилейт. Бирок, изилдөө ошондой эле интерактивдүүлүктүн жоктугу жана ишке ашырууда чектелген жетекчилик сыяктуу көйгөйлөрдү белгилейт. Теориялык түшүнүктөрдү жана институционалдык тажрыйбаларды синтездөө аркылуу изилдөө мугалимдердин билим берүүсүнө онлайн ресурстарды натыйжалуу киргизүү үчүн окуу планын иштеп чыгуу жана саясатты колдоо боюнча интеграцияланган стратегияларды сунуштайт.

Негизги сөздөр: МООС, онлайн ресурстар, математика мугалими билими, кесиптик өнүгүү, аралаш окутуу, даярдоого чейинки мугалимдер, Кытай.

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ВЛИЯНИЕ МАССОВЫХ ОТКРЫТЫХ ОНЛАЙН-КУРСОВ И ОНЛАЙН-РЕСУРСОВ НА ПРОФЕССИОНАЛЬНЫЙ РОСТ БУДУЩИХ УЧИТЕЛЕЙ МАТЕМАТИКИ В КИТАЕ

Аннотация. По мере ускорения цифровой трансформации в образовательной сфере массовые открытые онлайн-курсы (МООК) и онлайн-образовательные ресурсы играют все более значимую роль в подготовке учителей. В этом исследовании изучается, как эти ресурсы влияют на профессиональное развитие будущих учителей математики в Китае, уделяя особое внимание трем основным областям: углубление знаний по предмету, способность к проектированию обучения и рефлексивная практика. Используя методологию, основанную на анализе литературы и сравнении практических примеров из ведущих китайских университетов, в статье подчеркивается, как МООК дополняют традиционное педагогическое образование, предлагая гибкие, высококачественные пути обучения. Однако в исследовании также отмечаются такие проблемы, как отсутствие интерактивности и ограниченное руководство по внедрению. Благодаря синтезу теоретических идей и институциональной практики, исследование предлагает комплексные стратегии для разработки учебных программ и поддержки политики в целях более эффективного внедрения онлайн-ресурсов в педагогическое образование.

Ключевые слова: Массовые открытые онлайн-курсы (МООК), онлайн-ресурсы, подготовка учителей математики, профессиональное развитие, смешанное обучение, будущие учителя, Китай.

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THE INFLUENCE OF MOOC AND ONLINE RESOURCES ON THE PROFESSIONAL GROWTH OF PRE-SERVICE MATHEMATICS TEACHERS IN CHINA

Abstract. As digital transformation accelerates across the educational landscape, Massive Open Online Courses (MOOCs) and online educational resources are playing an increasingly significant role in teacher training. This study investigates how these resources influence the professional development of pre-service mathematics teachers in China, focusing on three core areas: subject knowledge enhancement, teaching design capacity, and reflective practice. Employing a methodology based on literature analysis and case study comparisons from prominent Chinese universities, the paper highlights how MOOCs complement traditional teacher education by offering flexible, high-quality learning paths. However, the study also notes challenges such as lack of interactivity and limited guidance in implementation. Through synthesizing theoretical insights and

institutional case practices, the research proposes integrated strategies for curriculum design and policy support to more effectively embed online resources in teacher education.

Key words: MOOC, online resources, mathematics teacher education, professional development, blended learning, pre-service teachers, China.

INTRODUCTION. The rapid expansion of digital education platforms, particularly MOOCs and other online learning resources, has redefined the way teacher education is conducted around the world. In China, where educational reform is closely tied to technological advancement, integrating such tools into pre-service teacher training—especially in the domain of mathematics—is both timely and necessary. Mathematics, with its strong emphasis on conceptual understanding, structured thinking, and precise communication, requires teacher candidates to possess not only strong subject knowledge but also the capacity to design clear, effective, and engaging lessons. Traditional training approaches, while still valuable, often fall short in offering scalable, flexible, and up-to-date content.

1. Theoretical and Contextual Background

1.1 The Development and Evolution of MOOC and Online Learning in Teacher Education

MOOC (Massive Open Online Course) originated from the practice of connectivism learning theory in 2008. Its core features are open access (no admission threshold), large-scale participation (the number of registrations for a single course can reach tens of thousands), and structured learning paths (video - quiz - discussion forum closed loop). In the field of teacher education, online resources have expanded into a four-dimensional ecosystem: platform-based courses (such as the Coursera Mathematics Pedagogy Special Project), fragmented teaching videos (China's "One Teacher, One Excellent Lesson" library), digital resource libraries (K12 Mathematics animation Library), and open textbooks (such as the Linear Algebra module of the MIT Open Course). During the process of localization in China, MOOCs have undergone a transformation from "transtransplantation of imported products" (in 2013, Tsinghua University's "Xuetangx" introduced edX courses) to "independent innovation" : In 2017, the Ministry of Education recognized the first batch of 490 national excellent online open courses, among which mathematics education accounted for 12.3%. In 2022, the "Smart Higher Education" platform integrated 58,000 courses and specially set up a "Teacher Education" section, covering core courses such as "Teaching Design of Middle School Mathematics" [1, p. 1-15]. Local practices have formed a "dual-track drive" feature - systematic MOOCS led by universities (such as the "Introduction to Mathematical Thinking" course at East China Normal University, which has accumulated 230,000 course admissions) and UGC resources generated by grassroots teachers (Onion Math micro-videos have an average annual play count of over 1.6 billion times) coexist, in line with the "Three All, Two Highs, and One Large" development goals of the "Education Informatization 2.0 Action Plan" Provide pre-service teachers with a scaffold

for professional development that transcends time and space [1, p. 1-15].

Table 1.Comparison of Mainstream MOOC Platforms at Home and Abroad

Platform Name	Country of Origin	Course Coverage	Localization Support	Application in Teacher Education
Coursera	United States	Multi-disciplinary	Supports Chinese subtitles	Adopted by some teacher education institutions
EdX	United States	Strong in STEM	Primarily in English	Used for flipped classrooms
XuetangX	China	University major courses	Fully in Chinese	Rich in teacher education course systems

1.2 The Connotation and Challenges of Professional Growth for Pre-service Mathematics Teachers

The professional growth of pre-service mathematics teachers requires coordinated development in three dimensions: knowledge construction (subject content knowledge CK and teaching content knowledge PCK), design ability (serialization and organization of learning tasks), and reflective literacy (evidence-based teaching decision-making). Referring to Berliner's five-stage model, normal school students are in the transition period from "novice teachers" to "advanced novices", and their development bottlenecks often occur in three aspects: Firstly, there is a gap in the transformation of mathematical knowledge into teaching. For instance, the correct rate of normal school students solving algebraic problems is 92%, but the pass rate of introducing activities that design function concepts that are easy for students to understand is only 68% (Wang et al., 2023). Secondly, there is a cognitive conflict in technology integration [3, p. 223-246]. Although dynamic geometry software enhances intuitiveness, it weakens the training of deductive reasoning. Thirdly, the depth of reflection is insufficient. In microteaching, 75% of the feedback is focused on classroom management, with little analysis of the root causes of mathematical cognitive errors. The particularity of the mathematics discipline further magnifies the challenges: abstract concepts (such as limit definitions) need to be concretely represented, logical systems (such as geometric proofs) require rigorous thinking training, and the curriculum reform oriented towards core literacy places more emphasis on the creation of real scenarios - this demands that teachers possess both mathematical rigor (ensuring the accuracy of concepts) and teaching flexibility (designing inquiry activities). In this regard, China's "Professional Standards for Middle School Teachers" clearly stipulates that "mathematical thinking methods should

be integrated into teaching design", and MOOCs can precisely provide scaffolds such as expert teaching video disassembly and cross-school collaborative lesson preparation, accelerating the bridge between theory and practice for normal school students [2, p. 843-858].

2. Case-Based Analysis of MOOC Use in Mathematics Teacher Training

2.1 Typical Cases of MOOC Application in the Training of Mathematics Teachers in Chinese Universities

Chinese universities are exploring the integration model of MOOC and the training of pre-service mathematics teachers through differentiated paths. East China Normal University has integrated its independently developed MOOC "High School Mathematics Teaching Design" into the "Subject Teaching Theory" course. It requires normal school students to watch expert analysis videos (such as 10 strategies for introducing the concept of functions), then redesign their original teaching plans and submit comparative reflection reports. Two-year tracking shows that the average score of students' teaching plan objectives has risen from 2.8/5 to 4.1/5. Southwest University adopts a dual-track system of "MOOC+ Workshop ". Normal school students first take the MOOC "Mathematics Teaching Skills Training" on the "icourse" platform (with a cumulative learning duration of 25 class hours), and the offline workshops focus on controversial topic debates (such as "Will technology weaken mathematical reasoning ability"). Classroom observations show that students participating in the blended training increased the frequency of using teaching strategies in the simulated teaching by 47%. Northeast Normal University, relying on the national excellent course "Professional Development of Middle School Mathematics Teachers", has built a "three-stage hybrid practice platform" - completing knowledge graph tests online before class to identify weak points, solving real teaching difficulties in groups offline during class (such as using Geometer's Sketchpad to break through students' spatial thinking barriers), and conducting cross-provincial class evaluations through virtual teaching and research communities after class. The practices of the three universities have formed a spectral experience: East China Normal University focuses on the orientation of ability output, Southwest University strengthens the cultivation of critical thinking, and Northeast Normal University builds a full-process support ecosystem. Together, they confirm the leverage value of MOOCs in bridging the theoretical and practical gap [5, p. 939-953].

Table 2. Comparative Analysis of MOOC Integration Practices at Three Universities

University Name	MOOC Type	Application Method	Teaching Objective	Effect Observation
East China Normal University	Teaching Design Course	Supporting classroom design	Enhancing teaching design ability	Improvement in student case quality

University Name	MOOC Type	Application Method	Teaching Objective	Effect Observation
		assignments		
Southwest University	Mathematics Pedagogy	Viewing + Discussion	Strengthening awareness of teaching strategies	Enhanced classroom participation
Northeast Normal University	Teacher Professional Courses	Online tasks + Offline seminars		

2.2 Core Performance and Structural Bottlenecks of MOOC Integration

Moocs inject three transformative forces into the professional growth of pre-service mathematics teachers: The flexibility of time and space breaks through the barriers of traditional training, and normal school students in remote areas can access equally high-quality resources (for example, the proportion of western elective courses in the MOOC "Frontiers of Mathematics Education" of Beijing Normal University reaches 34%). The democratization of resources reconstructs knowledge distribution. The 76,000 mathematics teaching cases on the national Smart Education platform enable ordinary colleges and universities to share the experience of senior teachers. Learning personalized adaptation to diverse needs, AI-driven learning analysis systems (such as "Rain Classroom") can push customized remedial plans for each normal school student (for example, automatically associate relevant micro-lessons with those who are weak in function teaching). However, deep integration still faces multi-dimensional constraints: the problem of superficial interaction is prominent. A survey in a certain province shows that 81.3% of normal school students think that the responses in the discussion area "lack professional depth" (typical comment: "Please refer to Chapter 5 of the textbook") [6, p. 65-81]. The challenge of self-management leads to learning impairment. The average completion rate of MOOCs is only 38.7%, and the dropout rate of high cognitive load content (such as probability and statistics teaching design) exceeds 60%. The gap in institutional support has intensified the implementation resistance. Only 29% of universities offer MOOC credit recognition standards, which has weakened the learning motivation. The deeper contradiction lies in the paradox of technological empowerment - although 92% of normal universities require the use of online resources, only 16% of teacher educators have received MOOC instructional design training. A professor interviewed admitted, "We are forced to become 'amphibious marginal people' who understand neither mathematics education nor digital media." These bottlenecks call for systematic solutions rather than merely the accumulation of technologies.

Table 3. Support Pathways of MOOCs for the Professional Growth of Teacher Education Students

Growth Dimension	Specific Manifestation	MOOC Support Method
Professional Knowledge Enhancement	More systematic understanding of concepts	Courses taught by experts
Teaching Skill Development	Enhanced lesson plan design ability	Case analysis, teaching tasks
Reflective Teaching Awareness	Comparative learning promotes reflection	Demonstrations of

3. Strategies and Recommendations for Effective Use

3.1 The Integration Path of MOOC and Pre-service Teacher Education Curriculum Teaching

To achieve a deep coupling between MOOCs and teacher education professional courses, it is suggested that a three-level penetration framework be constructed in core courses such as "Mathematics Teaching Theory" and "Teaching Design" : At the knowledge foundation level, the video of the national excellent MOOC "Psychology of Mathematics Education" is cut into 15-minute micro-units and matched with the pre-class self-study task sheet (such as "Comparing the Differences between Behaviorism and Constructivism in Equation Teaching"). At the ability transformation level, a mixed cycle of online learning (watching lectures by senior teachers) + offline discussion (deconstructing the logic of teaching decisions) + practical tasks (combining imitation and creation to design teaching plans) is designed. For example, for the "Junior High School Geometry Proof Teaching" module, normal school students need to first analyze the advantages and disadvantages of the three introduction strategies in the MOOC, and then design a visual auxiliary tool plan in groups (Hoyos, 2016). Finally, it was implemented in the microteaching classroom and a reflection video was recorded. In the innovation assessment layer, dynamic digital portfolios are adopted to replace traditional test papers, including MOOC learning trajectory maps, peer review records, classroom teaching videos, and AI-generated analysis reports on teacher-student interactions. Typical cases include the pilot project of Capital Normal University: The MOOC "Art of Mathematics Classroom Management" of East China Normal University was disassembled into a three-step model: "Self-study (watching conflict resolution cases) → virtual teaching research (cross-school discussion on solutions) → situational practice (simulating parents' questioning of the amount of mathematics homework)" [4, p. 359-384]. Practice has shown that this model has increased the rate of meeting the classroom adaptability standards of normal school students by 52%. Moreover, 87% of the learners believe that "digital portfolios better reflect true abilities than exams." This reconstruction has broken down the barriers between theoretical courses and practical courses, transforming MOOCs from

marginal resources into the nerve center for teacher training.

Table 4. Integration Model Design of MOOC and Teacher Education Courses

Course Module	MOOC Content	Face-to-Face Extension	Outcome Format
Teaching Theory	Video learning and reading	Teacher explanation + Q&A	Course essay
Lesson Plan Practice	Watching excellent teaching design	Group discussion	Lesson plan submission
Teaching Demonstration	Imitating teaching videos	Classroom practice	Feedback

3.2 Institutional Guarantee and the Construction of a Coordinated Development System

To break through the integration predicament of MOOCs, it is necessary to build a triangular support system At the operational level of colleges and universities, the "1+X credit certification System" is implemented - one compulsory school-based MOOC development course (such as "Design and Production of Mathematics Micro-Lessons") and X platform courses are self-selected (for example, the certification of the China University MOOC "History of Mathematics" can be used to offset the elective credits of "Mathematics Culture"), and at the same time, it is required that the educational internship report must include a chapter on the application reflection of MOOC resources [9]. At the policy-driven level, the Ministry of Education should revise the "Teacher Education Curriculum Standards", clearly stipulating the rigid requirement that "online learning for normal school students should be no less than 20% of the total class hours", and establish a special fund for the development of teacher MOOCS (referring to the model of Shanghai's "Morning Light Plan"), giving bonus points for professional title evaluation to teams that develop high-quality courses such as "Breakthroughs in Key and Difficult Points of High School Mathematics". In the dimension of personal development, a "Digital Teacher Growth Archive" cloud platform is created to automatically integrate multiple evidence chains such as MOOC learning data of normal school students, the usage rate of digital teaching plan resources, and the value-added curves of students' academic performance in internship schools, supporting lifelong tracking from pre-service training to post-service development. The key breakthrough lies in establishing a resource pool for industry-education integration: Led by the provincial teacher development center, a crowdfunding platform for mathematics teaching resources has been jointly established with universities, primary and secondary schools, and enterprises (such as Xuetangx). It adopts a "contribution value exchange" mechanism (uploading one high-quality teaching design allows downloading five excellent materials) [10, p. 697-704]. The first batch of pilot

projects has already gathered 32,000 mathematics teaching resource packages certified by subject experts. Monitoring shows that the digital literacy compliance rate of graduates from the six universities implementing this system has reached 94.5%, and the frequency of innovative application of MOOC derivative resources in their teaching designs is 3.8 times that of the traditional training model, confirming the necessity of systematic reform.

CONCLUSION

This research has demonstrated that MOOCs and online educational resources play a vital role in fostering the professional development of pre-service mathematics teachers in China. These tools offer scalable access to high-quality content, flexible learning pathways, and exposure to diverse pedagogical practices, thereby supporting teachers' growth in subject mastery, lesson planning, and instructional reflection. The case studies from multiple universities affirm the potential of integrating MOOCs into teacher training programs, particularly through blended learning models. However, challenges remain, including insufficient scaffolding, limited digital literacy among educators, and varying resource quality. Addressing these requires systemic efforts from universities, policymakers, and platform developers. It is essential to embed MOOC use within a broader pedagogical framework that includes institutional support, structured feedback, and reflective practice.

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