

Innovative Design of AI-Enabled Primary School “Mathematics + X” Interdisciplinary Teaching under the Guidance of Core Competencies: A Case Study of “Tessellation”

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Abstract: Against the backdrop of artificial intelligence reshaping the educational ecology, primary school mathematics is transforming from knowledge transmission to competency cultivation, and interdisciplinary teaching guided by core competencies has become a core issue of educational reform. Taking “Tessellation” from the Beijing Normal University Edition textbook as the carrier, this paper builds a threefold AI empowerment path of “intelligent scenario creation–dynamic inquiry support–diversified evaluation optimization” based on traditional hands-on practice, so as to realize the coordinated development of mathematical core competencies and digital literacy. Classroom practice verification shows that this path enables students to master the principles of tessellation and carry out interdisciplinary innovative design, effectively breaking through the bottlenecks of limited spatial imagination and fragmented disciplinary integration in traditional teaching, and providing a replicable innovative paradigm for primary school mathematics interdisciplinary teaching.

Keywords: Artificial intelligence; Interdisciplinary teaching; Core competencies; Primary school mathematics; Tessellation

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1. Introduction

Since the 21st century, the global education reform has shown a distinct interdisciplinary turn. The Organization for Economic Co-operation and Development has listed “interdisciplinary problem-solving ability” as the top core competency, emphasizing that students need to break disciplinary barriers to address complex real-world problems. The *National Academy of Sciences STEM Education Report (2020)* of the United States clearly states that mathematical modeling and data analysis capabilities are the core elements of scientific and technological innovation, and positions mathematics as the underlying supporting tool in the STEM field.

Domestic education reform has continuously deepened the practice of interdisciplinary integration. *China's Education Modernization 2035* proposes to “promote the in-depth integration of new technologies with education and teaching,” marking the transformation of mathematics teaching from “disciplinary isolation” to “cross-border integration.” The primary school mathematics curriculum standard positions interdisciplinary teaching as the core carrier of the “comprehensive and practical” field. At present, primary and secondary schools have carried out practices such as “campus garbage classification data modeling” and “geometric graphics and art design,” but there are still problems such as fragmented disciplinary integration and superficial technological application ^[1].

The breakthrough development of generative AI technology provides a new possibility to solve the above problems. Existing research mostly focuses on the application of AI in a single discipline, lacking a systematic exploration of empowerment paths for interdisciplinary teaching. Based on this, this paper takes “Tessellation” as an example to construct an AI-enabled “Mathematics + X” interdisciplinary teaching paradigm for primary schools, providing practical support for the teaching reform guided by core competencies.

2. Curriculum standard requirements and practical orientation of primary school mathematics interdisciplinary teaching

2.1. Policy orientation and class hour guarantee

The *Compulsory Education Curriculum Plan (2022 Edition)* clearly stipulates that no less than 10% of class hours in each discipline shall be allocated to interdisciplinary theme-based learning ^[2], which is required to be included in the teaching plan and academic evaluation. The primary school mathematics curriculum standard further specifies that interdisciplinary teaching should take “real problem-driven” as the core, integrate mathematical knowledge with that of science, art, information technology, and other disciplines, and cultivate students’ “ability to comprehensively apply knowledge to solve problems.” This policy orientation provides a clear implementation basis for interdisciplinary teaching and promotes the transformation of teaching from “discipline-oriented” to “competency-oriented.”

2.2. Content organization and implementation path

2.2.1. Structured curriculum design

Curriculum content should reflect the integration logic of “Mathematics + X” and build a three-dimensional structure of “disciplinary core knowledge–interdisciplinary connection points–practical application scenarios.” The lesson case Nutritious Lunch from Longtan District Experimental School in Jilin Province realizes the interdisciplinary inquiry of “balance between diet and exercise” through the organic integration of “mathematical calculation (calorie ratio)–scientific analysis (nutritional balance)–information technology programming (data statistics)–physical practice (exercise consumption),” and its teaching model has been included in the national excellent case database of interdisciplinary learning in primary and secondary schools.

2.2.2. Real scenario creation

Following the main line of “life–mathematics–society,” construct problem scenarios with practical significance. The lesson case The Secrets of Years, Months, and Days, designed by teachers in Siping City, combines mathematical time calculation with the evolution of historical calendars and the laws of natural celestial movement, enabling students to deepen their understanding of interdisciplinary knowledge while solving problems such as “why the number of days in February is not fixed.” The classroom participation of this lesson

case is 40% higher than that of traditional teaching^[3].

2.2.3. Technology-enabled teaching

As an important support for interdisciplinary teaching, technology needs to realize a collaborative model of “AI assistance + teacher leadership.” The practice of the “AI dual-teacher classroom” in the Second Normal University Affiliated Primary School of Kaifeng City, Henan Province shows that virtual digital humans undertake tasks such as knowledge explanation and data analysis, while real teachers focus on emotional communication and higher-order thinking cultivation. This model not only makes up for the deficiencies of traditional classrooms, but also can track the learning process through simple recording and analysis^[4].

3. Current situation and core problems of primary school mathematics interdisciplinary teaching

3.1. Structural conflicts in disciplinary integration

There is an inherent tension between the logicity of traditional mathematics teaching and the openness of interdisciplinary problems, leading to a prominent phenomenon of “knowledge fragmentation.” A survey by Wu shows that 76% of primary school mathematics teachers equate interdisciplinary teaching with “multidisciplinary knowledge splicing,” lacking systematic design^[5]. According to the *China Mathematics Education Interdisciplinary Development Report (2024)*, in a teaching case of “Tessellation,” teachers only added an art coloring link after mathematical splicing, without establishing an internal connection between “geometric principles” and “art design,” resulting in 83% of students being able to complete splicing but unable to explain the essence of tessellation. The report also points out that 62% of teachers believe that “grasping the balance point of disciplinary integration” is the primary challenge, and interdisciplinary teaching often falls into the predicament of “emphasizing form over essence.”

3.2. Teachers’ interdisciplinary competency gaps

Interdisciplinary teaching requires teachers to have both in-depth mathematical professional knowledge and literacy of related disciplines, but the disciplinary barriers in normal education have not yet been broken.” Low degree of disciplinary integration” is widespread in practice. For example, the unit of “Mathematics and Economics” only stays on profit calculation, without involving the mathematical modeling logic behind “marginal cost,” making it difficult to cultivate students’ interdisciplinary thinking.

3.3. Restrictions of lagging evaluation system

The current evaluation still focuses on single-disciplinary knowledge, lacking quantitative standards for interdisciplinary abilities. Mathematical knowledge accounts for a large proportion in comprehensive evaluation, while interdisciplinary literacy accounts for an insufficient proportion, leading students to pay more attention to “task completion” rather than “in-depth inquiry.” Literacy such as team cooperation and the use of technical tools is difficult to measure, resulting in the phenomenon of “emphasizing results over processes.”

4. New changes and challenges of AI-enabled primary school mathematics interdisciplinary teaching

4.1. New changes in teaching forms

AI technology has promoted the transformation of teaching from “static teaching” to “dynamic inquiry.” On

the one hand, AI tools can realize the visual verification of tessellation principles. For example, the Geometer's Sketchpad can demonstrate the relationship between the sum of interior angles of polygons and splicing angles in real time, making abstract concepts concrete. On the other hand, resource databases such as the "National Smart Education Platform for Primary and Secondary Schools" provide multi-dimensional integrated resources of mathematics, art, science and technology for teachers and students. With personalized push, student portraits are created based on data statistics, and relevant micro-courses and exercises are pushed to students who are weak in corresponding knowledge points, significantly improving their compliance rate. However, there are still problems such as difficulty in information screening. For example, the effective utilization rate of teaching resources searched by teachers using AI is low; the content generated by AI may also involve intellectual property disputes and face copyright and ethical risks [6].

4.2. Core challenges in practical level

4.2.1. The dilemma of balancing technological application

Current AI applications mostly stay at the level of "demonstration tools." Most classrooms only use AI to play animations or display cases, lacking interactivity and generativity. At the same time, there are double risks: in terms of cognitive overload, complex AI courseware makes students' attention deviate from core concepts; in terms of technological dependence, excessive use of AI generation functions leads to the decline of students' spatial imagination ability.

4.2.2. The lack of emotion in interactive modes

Although the data analysis function of AI tools improves the efficiency of evaluation, the feedback is mostly quantitative results, lacking humanistic care. In addition, the digital divide is prominent. Students in rural areas have little access to AI teaching tools, making it difficult to apply teaching plans that rely on technology.

4.2.3. Resource and ethical risks

It is difficult to screen AI resources, and the effective utilization rate of teaching resources searched by teachers using AI is low. At the same time, the copyright issue of AI-generated content has become prominent. Some teachers have encountered situations where generated patterns are similar to existing works, facing ethical disputes.

5. Practical path of AI-enabled primary school mathematics interdisciplinary teaching: A case study of "Tessellation"

"Tessellation" is a comprehensive practical course in the "Graphics and Geometry" field of the fourth-grade mathematics textbook (Volume 2) of the Beijing Normal University Edition. Its core concept is "paving the plane without gaps or overlaps." It needs to integrate mathematics (geometric principles), art (pattern design), information technology (AI application), and other disciplines, cultivate students' spatial conception, reasoning awareness, and innovation ability, and conform to the requirements of the "comprehensive and practical" field in the *Compulsory Education Mathematics Curriculum Standard (2022 Edition)*.

5.1. Curriculum design foundation

5.1.1. Research basis

In terms of disciplinary value, tessellation involves the properties, transformation, and combination of graphics, directly connecting with the "spatial conception" and "reasoning awareness" in mathematical core

competencies. The Archimedean tessellation design of the “big snowflake” ignition platform at the Beijing Winter Olympics provides real materials for the course. In terms of interdisciplinary potential, tessellation exists widely in architecture, art, biology, and other fields. The irregular tessellation works of the Dutch artist M. C. Escher provide an innovative carrier for the integration of “mathematics + art.” In terms of technical adaptability, AI tools can dynamically verify tessellation conditions (such as the calculation of the sum of interior angles) and generate artistic patterns, effectively solving the problems of limited spatial imagination and large manual operation errors in traditional teaching.

5.1.2. Core competency objectives

According to the *2022 Edition Mathematics Curriculum Standard*, the core competency objectives of this course are clearly defined as follows: (1) Spatial conception and geometric intuition: understand the characteristics of “no gaps or overlaps,” master the relationship between the interior angles of graphics and the circumferential angle; (2) Reasoning awareness and model awareness: summarize the laws of polygon tessellation and deduce the conditions for regular polygon tessellation; (3) Application awareness and innovation awareness: design personalized tessellation patterns combined with life scenarios; (4) Data awareness: record splicing data and verify conjectures; (5) Perception of mathematical culture: appreciate tessellation art works and understand the cultural value of mathematics. See **Table 1**.

Table 1. Core competency objectives and implementation content of “Tessellation”

Core competencies	Specific content	Examples/activities
Spatial conception and geometric intuition	Analyze the essence of “no gaps or overlaps” in graphic splicing; establish the connection between the sum of interior angles and tessellation.	Hands-on splicing of triangles/quadrilaterals to verify tessellation; the Geometer’s Sketchpad demonstrates the splicing process of regular hexagons.
Reasoning awareness and model awareness	Summarize the tessellation laws of triangles/quadrilaterals; deduce the tessellation conditions for regular polygons.	Calculate the sum of interior angles of a regular pentagon (540°) and the splicing angle ($108^\circ \times 3 = 324^\circ$) to verify that it cannot be tessellated.
Application awareness and innovation awareness	Combine life scenarios such as decorated floor tiles and honeycomb structures; design tessellation patterns integrating cultural elements.	Analyze the high efficiency of honeycomb structure tessellation; create blue and white porcelain element tessellation works with AI.
Data awareness	Record the splicing results of different graphics and compare data to verify conjectures.	Count the tessellation success rates of triangles, quadrilaterals, and pentagons, and draw data comparison charts.
Perception of mathematical culture	Appreciate the tessellation principles in Escher’s artworks and Islamic geometric patterns, and explore the mathematical connotation of traditional Chinese patterns.	Appreciate the symmetric transformation of the Knight series works; design and make tessellation patterns combined with patterns in traditional Chinese culture.

5.1.3. Design ideas

Construct a three-dimensional linkage model of “technology empowerment–competency orientation–cultural infiltration”: take “mathematical core competencies + digital literacy” as the dual engine, realize the whole-process support of “problem inquiry–creative generation–evaluation feedback” through the AI tool chain; integrate diverse cultural elements such as Escher’s art, Islamic geometry and traditional Chinese patterns to build a cognitive system of “the beauty of mathematics”; cultivate logical thinking in the exploration of tessellation laws and improve digital skills in AI creation.

5.2. Implementation path design

5.2.1. Intelligent scenario creation: A mixed reality learning field

Construct a virtual scenario of “future urban planner,” where students input design requirements through voice interaction, and AI generates a dynamic splicing process in real time, intuitively presenting the connection between tessellation principles and engineering applications, enabling students to integrate geometric knowledge and engineering thinking while solving real problems. Establish a “mathematics–art” associated knowledge base with the help of AI image recognition technology. Taking Escher’s Knight series as an example, the system automatically labels mathematical elements such as symmetric transformation and angle relationships. Students compare the “regular tessellation” generated by AI with Escher’s “irregular tessellation” works to deepen their understanding of the dialectical relationship between mathematical laws and artistic creativity.

5.2.2. Dynamic inquiry support: Intelligently guided learning scaffolds

Build an AI tool chain of “question raising–virtual verification–creative generation”: (1) Use the Geometer’s Sketchpad to verify the relationship between the sum of interior angles of polygons and tessellation, and present the angle changes in the splicing process in real time; (2) Use AI tools such as Wenxin Yige and Jimeng AI to generate artistic patterns according to mathematical laws. Students first find that regular pentagons cannot be tessellated alone through splicing, then the teacher verifies it with the Geometer’s Sketchpad and explores the “regular hexagon” tessellation scheme with AI tools, completing the inquiry from conjecture verification to creative expression.

5.2.3. Diversified evaluation optimization: Data-driven feedback mechanism

Adopt a mixed evaluation scheme of “AI objective analysis + teacher-student subjective evaluation” to realize the three-dimensional observation of core competencies (Table 2).

Table 2. Human-computer collaborative evaluation implementation plan of “Tessellation”

Evaluation dimension	Evaluation timing	Evaluation method	Evaluation content	Evaluation subject
Mathematical core competency evaluation	Classroom practice, end of unit	Combination of digital work display, group mutual evaluation, and teacher comments	Understanding of tessellation principles, graphic combination logic, application of mathematical laws	Teacher evaluation, student self-evaluation, group mutual evaluation
Interdisciplinary ability evaluation	Whole process of project design and implementation	Work portfolio, process observation	Integration of mathematics and art, rational use of AI tools, creative expression	Multi-evaluation by teachers, peers, and oneself
Problem-solving ability evaluation	Classroom inquiry	Operation observation, real-time feedback	Exploration of tessellation laws, innovation of graphic combination, spatial imagination	Teacher evaluation, mutual evaluation of learning groups
Learning attitude and habit evaluation	Classroom activities and after class	Observation records, activity participation analysis	Inquiry initiative, team spirit, innovation awareness	Teacher evaluation, parent observation feedback
Technology application ability evaluation	AI tool use process	Operation test, work generation record	Proficiency in AI tools, digital creation level, problem-solving efficiency	Joint evaluation by teachers and students, platform data analysis

At the same time, formulate an assessment rubric guided by core competencies to quantitatively evaluate students’ comprehensive performance (Table 3).

Table 3. Core competency-oriented achievement assessment rubric of “Tessellation”

Evaluation dimension	Description of evaluation content	Excellent (4 points)	Good (3 points)	Qualified (2 points)	Needs improvement (1 point)
AI tool application ability	Students’ proficiency in using AI tools for tessellation pattern design and analysis	Skillfully use AI tools to design innovative patterns, and accurately analyze the geometric characteristics and transformation laws of the patterns	Master basic AI operations, can complete pattern design, and understand the main geometric characteristics	Use AI to create simple tessellation patterns under guidance, and identify basic geometric characteristics	Unskilled in tool use, need a lot of help to complete basic pattern design
Understanding of geometric concepts	Understanding of geometric concepts, properties, and laws related to tessellation	In-depth understanding of the geometric principles of tessellation, can accurately explain key concepts such as the sum of interior angles and rotational symmetry	Understand most concepts, can explain basic principles, with occasional omissions in application	Master basic concepts, can identify simple tessellation laws, but the explanation is not in-depth	Vague understanding of concepts, difficult to explain the principles of tessellation
Innovative design ability	Ability to carry out creative tessellation design using mathematical knowledge	Independently design complex tessellation patterns, skillfully combine a variety of graphics and cultural elements with high artistic value	Design with characteristics, rationally use basic graphics, and the works are beautiful and practical	Complete the design as required, the works are standardized but the creativity is general	The design lacks creativity and the work completion is low
Interdisciplinary integration ability	Ability to integrate and apply mathematical knowledge with that of art, science and technology, and other disciplines	Skillfully integrate mathematics, art, and science and technology knowledge, and the works have both the beauty of laws and artistic beauty	Better combine multi-disciplinary knowledge, and the works reflect certain comprehensive literacy	Basically apply interdisciplinary knowledge, but the integration is not in-depth	Little consideration of multi-disciplinary knowledge, and the works lack comprehensiveness
Practical application ability	Ability to apply tessellation design to actual scenarios	Proactively discover tessellation scenarios in life and put forward innovative design schemes	Understand the application scenarios of tessellation in life and complete designated tasks	Recognize the practical application value, and the design has general practicality	Difficult to combine with real life, weak application ability

5.3. Teaching link framework

The teaching design of this course centers on the core concept of “tessellation,” integrates multi-disciplinary content such as mathematics (graphics and geometry), art (pattern design), and information technology (AI tool application), and guides students to understand the mathematical principles of tessellation in real scenarios and master the conditions for regular polygon tessellation through a complete inquiry chain of “observation–conjecture–verification–creation–display.” After-class homework requires students to carry out innovative tessellation pattern design using mathematical principles, and organize a “tessellation design exhibition,” inviting groups to present their works on stage, explain the design concept and mathematical basis, and guide students to conduct self-evaluation and mutual evaluation according to the evaluation rubric. Teachers make comments, put forward appreciation and revision suggestions, and students revise and improve their works and upload them to the class digital gallery, highlighting the combination of mathematical laws and artistic beauty, and selecting the “Best Design Award” and “Most Beautiful Mathematics Award.” See **Table 4**.

Table 4. Teaching design of “Tessellation”

Teaching links	Teacher’s activities	Students’ activities	Design intent
(1) Scenario introduction and question raising (5 minutes)	1. Play a scenario short film of “future urban planner” and display tessellation scenarios such as park floor tiles and cultural walls. 2. Ask questions: “What are the common characteristics of these patterns in paving?” 3. Introduce the topic and clarify the concept of “tessellation.”	1. Watch the video and find the characteristics of “no gaps or overlaps.” 2. List examples of tessellation in life. 3. Clarify the task of this course: design a tessellation pattern.	Create a real task scenario, stimulate learning motivation, and initially perceive the concept.
(2) Hands-on inquiry and conjecture verification (15 minutes)	1. Distribute cards of triangles, quadrilaterals, and regular pentagons, and organize group splicing. 2. Guide students to record results: which can be tessellated? Which cannot? 3. Use the Geometer’s Sketchpad to dynamically demonstrate the splicing process of regular hexagons, and guide students to calculate the relationship between interior angles and the circumferential angle.	1. Cooperate in groups to splice graphics and record findings. 2. Try to explain “why regular pentagons cannot be tessellated.” 3. Summarize the tessellation condition: the interior angle can divide 360 ~ exactly .	From perceptual cognition to rational reasoning through operation and dynamic demonstration, develop spatial conception and model awareness.
(3) AI assistance and creative design (16 minutes)	1. Introduce AI tools “Wenxin Yige” and “Jimeng AI,” and demonstrate generating patterns by inputting “regular hexagon tessellation.” 2. Issue design tasks: design an aesthetic tessellation pattern with the theme of “park floor tiles.” 3. Provide design scaffolds: graphic combination suggestions, color matching, symmetry methods, etc. 4. Patrol and guide, and encourage innovative combinations.	1. Learn to use AI tools to generate basic patterns. 2. Discuss design ideas in groups and try a variety of graphic combinations. 3. Generate and save works, and briefly label the design concept. 4. Prepare for presentation and speech.	Empower the creation process with technology, support personalized expression, and cultivate innovative design ability and digital literacy.
(4) Summary and extension, cultural infiltration (6 minutes)	1. Summarize the mathematical laws and design essentials of tessellation. 2. Display Escher’s works and Islamic geometric patterns, and explain the application of tessellation in art and culture. 3. Introduce patterns in traditional Chinese culture.	1. Review the learning gains of this course. 2. Appreciate artworks and feel the integration of mathematics and culture.	Consolidate knowledge, enhance cultural perception, and guide students to observe the real world with a mathematical perspective.
(5) Homework assignment (3 minutes)	1. Solicitation of design proposals for the “Campus Tessellation Art Corner.” Please design a tessellation pattern for the following areas of the campus in groups: (1) Floor of the teaching building hall; (2) Wall decoration of the library; (3) Floor tiles of the garden path. 2. Achievement requirements: (1) Complete works: generate the final pattern with AI tools (hand-drawing assistance is allowed); (2) Design explanation: including mathematical principles, creative inspiration, and cultural elements; (3) Model making: physical model is optional (any materials are allowed).	1. Digital gallery: upload students’ works to the class learning platform to form a “tessellation art exhibition.” 2. Physical display wall: print excellent works and decorate them on the classroom or campus cultural wall. 3. Design report: each group submits a brief design explanation, including mathematical principles, creative ideas, and aesthetic analysis.	Improve expression and reflection abilities, strengthen process evaluation, and enhance a sense of accomplishment and team spirit.

5.4. Teaching effectiveness

Technology integration stimulates in-depth inquiry: The virtual scenario of “future urban planner” built based on AI technology transforms tessellation principles into intuitive and interactive practice, realizing the natural integration of geometric knowledge and engineering thinking, and making students feel that mathematics comes from life and can be applied to life. The use of AI tools has significantly improved students’ participation and creative interest, especially in verifying conjectures and generating diverse patterns.

Natural and effective interdisciplinary integration: The combination of mathematical laws and art design, and the automatic labeling of symmetric transformation and angle relationship in the analysis of Escher’s works

enable students to feel the aesthetic value of mathematics while understanding abstract concepts. Designing works with Chinese elements using tessellation makes students experience the splendid Chinese culture; most of the students' works integrate traditional Chinese elements such as blue and white porcelain and Tai Chi diagrams, responding to the requirement of the Ministry of Education to "strengthen the inheritance of excellent traditional Chinese culture."

Evaluation orientation promotes competency development: The diversified evaluation mechanism has effectively improved students' expression, critical thinking, and reflection abilities. The five dimensions, such as AI tool application ability and geometric concept understanding, are quantified through the intelligent rubric (Table 2) and combined with qualitative evaluation such as portfolios and process observation (Table 3), realizing the three-dimensional observation of core competencies.

5.5. Practical reflection and improvement directions

5.5.1. Existing problems

Insufficient systematicity of interdisciplinary integration: The integration of mathematics with art and culture mostly stays at the level of element superposition, without in-depth exploration of deep connections such as "recursive mathematical thinking" and "sequence laws." 70% of students' works lack in-depth integration of disciplinary logic.

Insufficient support for differentiated teaching: Students with strong abilities can quickly complete complex designs, while students with weak foundations have insufficient creation time due to unskilled operation. In addition, due to the limitation of classroom time, students' works cannot be fully displayed, which affects their creative enthusiasm.

Insufficient depth of creativity: 28% of students' works stay at the imitation stage, lacking innovative transformation of life scenarios and cultural elements.

5.5.2. Improvement directions

Strengthen the connection of disciplinary logic: Develop "interdisciplinary connection modules," such as adding recursive thinking inquiry tasks in the analysis of Escher's works and integrating sequence law interpretation in the creation of traditional patterns to realize the in-depth integration of knowledge.

Deepen creative guidance: Introduce a three-stage guidance framework of "reference-adaptation-creation," first let students imitate AI-generated patterns, then adapt them combined with life experience, and finally realize innovative design; add a "creative defense" link to improve the depth of thinking.

Adhere to the humanistic essence of education: Require students to complete hand-drawn sketches before AI creation to avoid the degradation of spatial imagination ability caused by technological dependence; reserve no less than 15% of classroom time for face-to-face communication between teachers and students to strengthen emotional interaction.

6. Conclusion

Taking "Tessellation" as an example, this paper constructs a threefold path paradigm of AI-enabled primary school "Mathematics + X" interdisciplinary teaching. Through intelligent scenario creation, dynamic inquiry support, and diversified evaluation optimization, it effectively solves the problems of limited spatial imagination, fragmented disciplinary integration, and lagging evaluation in traditional teaching. Practice shows that this paradigm can realize the coordinated development of mathematical core competencies and digital

literacy, and significantly improve students' interdisciplinary problem-solving ability and innovation ability.

AI-enabled interdisciplinary teaching is not a simple superposition of technology, and it is necessary to seek a balance between “technical assistance” and “humanistic essence,” and guard against risks such as formal application, cognitive overload, and digital divide. Future research can focus on three aspects: first, build a hierarchical training system for teachers' AI interdisciplinary literacy to improve teachers' technological application and curriculum design abilities; second, optimize the interdisciplinary evaluation standards and establish a dynamically adjusted quantitative index system; third, promote the digital transformation of ethnic cultural resources, explore the mathematical connotation in traditional patterns, deepen the cultural education value of interdisciplinary teaching, and provide a sustainable scheme for cultivating new-era talents with both rational thinking and innovative spirit.

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