An Empirical Study on the Teaching Pathway for Metaliteracy in Blended Teaching Models: Post-print

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Abstract

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Full Text

Preamble

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Title and Authors

An Empirical Study on the Teaching Path of Metaliteracy in the Blended Teaching Model

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Abstract

[**Purpose/Significance**] Based on an analysis of the distinctions and connections between metaliteracy and traditional information literacy education, this study conducts a teaching practice of metaliteracy within a blended teaching model, summarizing its effectiveness and challenges to provide reference for exploring effective metaliteracy teaching pathways. [**Method/Process**] Using a case study approach, this paper takes a graduate-level medical information retrieval course as the empirical research object. Centered on metaliteracy, threshold concepts, academic contexts, deep learning theory, and information ecological environment, it elaborates on the specific implementation steps and key points of teaching practice, and constructs a metaliteracy teaching path under the blended teaching model. [**Result/Conclusion**] The blended teaching model effectively aligns with metaliteracy teaching philosophy, and the adopted progressive, multi-stage, and multi-level teaching path proves to be an effective approach to achieving metaliteracy teaching objectives, thoroughly implementing the cultivation of metacognition, critical thinking, and inquiry-based learning throughout the entire process.

Keywords: blended teaching, metaliteracy, deep learning, teaching path
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Introduction

With the rapid development of information technology, the information ecological environment and user information behaviors have undergone tremendous changes. The *Information Literacy Competency Standards for Higher Education*, which had served as the fundamental guideline for information literacy education since 2000, can no longer adapt to the evolving information ecological environment and the demands of information literacy education. Consequently, in 2015, ACRL released the *Framework for Information Literacy for Higher Education* (hereinafter referred to as "the Framework"), which uses metaliteracy—with its rich connotations and integrated framework—to inherit and extend information literacy education. Metaliteracy integrates the core of multiple literacy theories, emphasizes critical thinking and interactive collaboration capabilities, and simultaneously attends to learners' emotional and metacognitive changes, aiming to cultivate learners who can independently adapt to new information environments. Metaliteracy has become the developmental direction of information literacy after its transformation and is expected to become the next-generation standard for information literacy.

Researchers both domestically and internationally have begun actively exploring the application of metaliteracy to guide teaching practice. For example, the University at Albany, SUNY, has carried out rich teaching activities under the guidance of metaliteracy theory. Domestic researchers such as Zhang Di have adopted a "cooperative integrated teaching" approach (continuous embedded lectures) to explore metaliteracy teaching practice paths for disciplinary service targets based on the *Framework for Information Literacy for Higher Education*. Zhang Li, building upon the core concepts and content of the *Framework*, has examined teaching design from the perspectives of metaliteracy education learning objectives, content, forms, and assessment methods.

The choice of teaching model is the starting point for implementing metaliteracy teaching. In recent years, the rise of MOOCs (Massive Open Online Courses) has enabled the segmentation of knowledge into fine-grained units that support flexible, free learning across multiple terminals, while also incorporating new media features such as online discussion forums and social media. From the perspective of students' perceived differences between traditional teaching and MOOC teaching, students generally approve of MOOCs, believing this teaching method offers high learning efficiency and strong autonomy. However, compared with traditional teaching, the prominent disadvantages of MOOCs include the lack of effective control measures, insufficient sustained learning motivation, and the absence of interactive experiences and relevant constraints between teachers and students, as well as among peers. The blended teaching model, which integrates MOOCs with traditional teaching, is more suitable for metaliteracy teaching. Students can utilize MOOC platforms to independently complete the understanding and memorization of teaching content while also developing information collaboration abilities in network environments. Subsequently, through traditional classroom sessions that address difficult questions, expand and extend teaching content, and facilitate face-to-face interaction, students' knowledge internalization and absorption are promoted.

Metaliteracy teaching not only focuses on teaching models but also emphasizes the connection with academic research. The Framework elaborates and integrates related concepts such as research, scholarship, and retrieval, clarifying the boundaries between academic research guidance and traditional information literacy teaching, and emphasizing the close relationship between metaliteracy and academic research. The Framework also proposes that "searching is a contextualized and complex experience that affects the searcher's cognition, emotion, and behavior, and is in turn influenced by these factors." The searcher's information literacy, combined with external environmental factors such as time, location, organizational environment, and work tasks, constitutes the context. Different disciplinary backgrounds, grade levels, and academic research tasks create different academic contexts that affect the searcher's cognition, emotion, behavior, metacognition, and retrieval effectiveness. Therefore, metaliteracy teaching should conduct more appropriately matched teaching practices based on students' information literacy levels and academic contexts.

Since F. Marton and R. Saljo proposed the concept of deep learning in 1976, related theories have been continuously enriched. The interpretation of deep learning's connotation cannot be separated from inquiry-based learning, metacognition, critical thinking, and learning communities. Deep learning is a learning approach that can lead to lasting changes in learners' cognition, attitudes, emotions, and values, and promotes metacognitive development. Thus, metaliteracy education essentially encourages students to adopt deep learning approaches. If different teaching strategies can be applied to different stages of the deep learning process in metaliteracy teaching, not only can better teaching effects be achieved, but students' research, practical, and innovative abilities can also be cultivated.

This study takes a graduate-level medical information retrieval course as the empirical research object, drawing on existing research findings to construct a metaliteracy teaching path under the blended teaching model. Centered on metaliteracy, threshold concepts, academic contexts, deep learning theory, and information ecological environment, it sorts out teaching objectives, content, and methods, formulates specific implementation steps and key points, and summarizes and analyzes the effectiveness and existing problems of the teaching path implementation, aiming to provide reference and inspiration for exploring effective metaliteracy teaching pathways.

2. Brief Analysis of the Framework

The *Framework for Information Literacy for Higher Education* uses metaliteracy to extend and reconstruct information literacy. Metaliteracy is defined as "the literacy that generates other literacies." Grounded in metacognitive theory, it emphasizes not only the original connotation of information literacy—the ability to acquire, locate, evaluate, and understand information—but also focuses on learners' abilities to participate, share, cooperate, create, integrate, and utilize information in environments such as social media, online communities, mobile technology, and open educational resources. It further emphasizes critical thinking about information and interactive collaboration capabilities, forming a conceptual model with the characteristics of "metacognition-multiple literacies-interactive technology-critical interaction."

Metaliteracy organizes teaching objectives into four domains: behavioral (skills and abilities necessary to complete learning activities), cognitive (abilities to understand, organize, apply, and evaluate necessary to complete learning activities), affective (changes in learners' emotions and attitudes through participation in learning activities), and metacognitive (learners' critical reflection on their own learning activities). Based on these four domains, it further specifies concrete goals for metaliteracy behavior, cognition, emotion, and metacognition from four dimensions: critically evaluating information content and personal biases, following information ethics and moral norms, producing and sharing information and interactive collaboration in participatory environments, and developing lifelong learning abilities for personal and professional goals, with sev-

eral indicators for each dimension, providing specific guidance for implementing metaliteracy teaching practice.

The Framework proposes six threshold concepts: "Authority Is Constructed and Contextual," "Information Creation as a Process," "Information Has Value," "Research as Inquiry," "Scholarship as Conversation," and "Searching as Strategic Exploration." Among these, Research as Inquiry, Scholarship as Conversation, and Searching as Strategic Exploration provide detailed interpretations of the three core concepts of research, scholarship, and retrieval, emphasizing the relevance of metaliteracy teaching to students' academic research and highlighting the cultivation of students' academic skills and critical thinking during the teaching process.

3. Design of Metaliteracy Teaching Path for Graduate Students

3.1 Hierarchical Relationship of the Metaliteracy Teaching Path Framework

Metaliteracy education is difficult to perfect within a single course and must extend beyond it. As the information retrieval course at our university is a foundational graduate course scheduled in the first semester of graduate study and difficult to embed into other courses, to ensure the after-effect and continuity of the retrieval course for metaliteracy education, the metaliteracy teaching path is designed to be divided into two stages: within the information retrieval course and outside the course. Combined with the deep learning process, it is further divided into three levels: mastery/understanding, transfer/reflection, and inquiry/application, respectively using three teaching forms: MOOC online teaching, physical classroom discussion, and academic research (specific academic research practice), to achieve teaching objectives at different levels of metaliteracy. The hierarchical relationship of the metaliteracy teaching path framework for graduate students is shown in Figure 1 [Figure 1: see original paper].

In Figure 1, the first level of the metaliteracy teaching path framework is to enable students to master and understand relevant metaliteracy knowledge and skills through MOOC online teaching, and to complete academic-contextualized practical operation questions, providing knowledge reserves for later learning. The second level addresses difficult questions from online teaching and practical operation questions through physical classroom discussions, while simultaneously expanding academic contexts through task-based discussions in class, promoting students to transfer and apply acquired knowledge and skills to relevant academic contexts, and reflecting on strategies and learning processes for solving academic context problems. These two levels are processes of gradually establishing metaliteracy concepts and frameworks and enlightening and catalyzing student thinking (metacognition), laying the foundation for metaliteracy education.

In previous teaching, it was found that some students could master knowledge and skills and solve specific task contexts, but could not apply them to their own academic research. Therefore, the third level extends metaliteracy and continuously integrates it into academic research closely related to graduate students, such as thesis proposals, experimental design, and research project initiation, which can both exercise metaliteracy again and simultaneously test and evaluate the after-effect and continuity of metaliteracy education. All three progressive levels integrate academic contexts but with differences: the first level integrates academic contexts into practical operation questions, called test academic contexts; the second level's academic contexts are designed by teachers based on students' professional backgrounds, different from the academic contexts students face according to their own needs, thus called task academic contexts; the third level is related to their own academic research and has personalized academic contexts, called practical academic contexts.

3.2 Implementation Steps and Key Points of the Teaching Path

3.2.1 First Level: Knowledge Reserve From the perspective of metaliteracy's composition, its core remains the connotation of traditional information literacy, focusing on the understanding and mastery of knowledge and skills such as information location, acquisition, evaluation, academic ethics, and information ethics. Therefore, MOOC online teaching divides traditional information retrieval teaching content into short videos and requires students to complete corresponding academic-contextualized practical operation questions after watching the videos.

Online teaching utilizes the autonomous, open, and interactive characteristics of MOOCs, integrating metaliteracy education content of the information ecological environment to cultivate students' information exchange and sharing abilities in network environments. Students can arrange their learning progress more autonomously and flexibly through various terminals (computers, mobile apps), and can repeatedly watch videos when encountering bottlenecks, making it easier to master and understand knowledge. Using MOOC platform discussion forums and group chat platforms (mobile apps) to carry out learning discussions enhances peer and teacher-student online interaction, improves students' information literacy, and cultivates critical thinking, autonomous learning ability, and metacognitive ability, thereby enhancing information skills (behavior and cognition). The specific framework is shown in Figure 2 [Figure 2: see original paper].

The teaching objectives at this stage are to cultivate autonomous learning abilities from the behavioral and cognitive domains of metaliteracy, promote the mastery of knowledge and skills for information location, acquisition, and evaluation; cultivate information exchange and sharing abilities in the information ecological environment; understand the transformation of information roles in the process of information creation, communication, and sharing; initially establish metaliteracy concepts, and lay the foundation for metaliteracy education.

3.2.2 Second Level: Face-to-Face Classroom Discussion Integrated with Academic Context This stage serves as a bridge, both consolidating knowledge and skills learned from MOOC online teaching and promoting knowledge transfer and reflective experience, while integrating the four domains of metaliteracy—cognitive, behavioral, affective, and metacognitive—into the teaching process. Good classroom design is crucial. In this teaching practice, classroom discussions are centered on academic contexts, with content settings including "basic retrieval strategies" and "extension and expansion" (posing more open academic questions) at two different levels for discussion and analysis. "Basic retrieval strategies" involve reviewing and consolidating learned knowledge and skills, while "extension and expansion" achieves knowledge transfer and application.

In the physical classroom, students are progressively guided and inspired to think and ask questions while conducting synchronous practical operations, allowing them to attempt to use their knowledge reserves to construct problem-solving paths. Students strengthen reflective experiences and promote metacognitive and affective transformations through discussion, communication, and interaction, cultivating critical thinking. The implementation details and key points for some classroom discussion content are listed in Table 1 .

The teaching objectives at this stage are to enhance knowledge and skills (behavior and cognition) through classroom discussions integrated with academic contexts, achieving knowledge transfer and application; to cultivate metacognitive abilities through critical thinking, summarizing experiences, and reflecting on learning processes within academic contexts; to emphasize information collaboration and sharing in the information ecological environment, and to establish concepts of inquiry-based research, scholarship as conversation, and searching as strategic exploration.

3.2.3 Third Level: Connection with Secondary Metaliteracy Education The teaching of the retrieval course is the first classroom for metaliteracy education, implanting concepts and building foundations for metaliteracy cultivation. Metaliteracy must be more effectively trained in the practice and learning of academic research and professional courses, and therefore metaliteracy education must extend into academic research and professional courses—these can also be considered the second classroom for metaliteracy teaching. To ensure the after-effect and continuity of the retrieval course for metaliteracy education, this stage lays the groundwork for secondary metaliteracy education through simulating project initiation (topic selection) and thesis proposals: Simulated project initiation requires students to "select topics of interest from recently approved National Natural Science Foundation projects in relevant majors, conduct literature retrieval for literature review, design technical routes, and attempt to form project proposals." Thesis proposals require each student to discuss and determine topics with their supervisors and complete literature reviews. The former is completed in the form of group collaborative research and presentations,

while the latter is independently completed by each student as a comprehensive internship report. Both require students to analyze academic contexts from the perspectives of project background, current status and trend analysis, project innovation points, and possible technical routes, simulating the entire process of literature research from topic selection to proposal writing. This deepens the understanding of threshold concepts such as inquiry-based research, scholarship as conversation, and searching as strategic exploration, enabling proficient application in academic research and professional course learning, thereby achieving further enhancement of metaliteracy.

Since the students are first-year graduate students with relatively weak research awareness and insufficient abilities, the research reports completed at this stage are not perfect. However, the perception and experience of the academic research process serve as a process for testing and training metaliteracy, representing an effective pathway for its enhancement.

The teaching objectives at this stage are to combine information collaboration and personalized academic research needs, allowing students to personally engage in the practice of inquiry-based research, scholarship as conversation, and searching as strategic exploration, simulating the process of solving information needs at different stages of academic research, stimulating students' learning motivation, and connecting ubiquitous secondary metaliteracy education to strengthen metaliteracy cultivation.

4. Teaching Effectiveness and Evaluation

4.1 Classroom Observation (MOOC and Face-to-Face) and Individual Interviews

The three progressive levels of blended teaching promote each other: MOOC online videos and practical operation questions are completed at a high rate before classroom discussions; students can use learned knowledge to analyze problems and think independently in classroom discussions, with deeper and more comprehensive thinking and significantly improved participation and activity levels. Good academic dialogue between teachers and students has transformed the teacher-dominated classroom model; after classroom discussions, students can reflect on and analyze their own learning processes and strategies, recognizing the differences in approaches and methods for solving different types of problems, actively modifying answers to MOOC online practical operation questions, and producing many corrections and supplements to reference answers. Teaching integrated with academic contexts has greatly improved students' ability to solve practical problems. In some practical questions combined with professional examples, such as "Please illustrate with examples the possible problems in subject concept extraction during the retrieval process" and "Explain with professional retrieval examples the impact of improper use of search terms on literature retrieval results," students no longer copy answers from the internet, textbooks, or MOOCs but can create their own examples based on academic

contexts, construct solutions from needs, obtain information, apply knowledge, and solve problems creatively.

The blended teaching model has promoted students' information exchange, sharing, and collaboration, enhancing their learning willingness, sense of achievement, and enjoyment, making them more willing to participate in MOOC discussion forums and APP group chats. They boldly attempt, apply, and evaluate content beyond textbooks and MOOCs. For example, when completing the assignment "Familiarize yourself with RSS and create a relevant RSS display based on your research topic or topics of interest," students combined search engines to verify and demonstrate various RSS tool applications. During interviews, most students believed that the blended teaching model improved learning efficiency, with one student summarizing, "Literature retrieval has brought me more cultivation of independent research ability, allowing me to rely on my own learning to answer questions and master rigorous scientific research thinking and experimental operation methods." Overall teaching effects are superior to traditional teaching methods, with students' information abilities and metacognitive abilities showing significant improvement.

4.2 Questionnaire Survey

To promote teaching reform and improve teaching effectiveness, we distributed a questionnaire on "Blended Teaching (MOOC + Face-to-Face Classroom)" through SurveyStar, collecting 90 valid responses. The questionnaire investigated the recognition of blended teaching, the relationship between MOOC and face-to-face classroom, and the course's promotion effects on information literacy, critical thinking, reflective experience, and information exchange and collaboration. The results show: (1) 73% of students believe that the blended teaching model (MOOC + face-to-face classroom) is more suitable for the "Medical Information Retrieval" course and offers higher learning efficiency. (2) Over 60% of students believe that MOOC and face-to-face classroom can promote each other: knowledge reserves obtained through MOOC learning enable active participation in classroom discussions, while face-to-face teaching deepens understanding of MOOC content and expands learning. (3) 86% of students believe that the course has enhanced their information awareness, information ability, and information ethics; regarding information ability, students believe the course most significantly helps improve information acquisition (recognition rate of 98%), followed by information screening (evaluation), information analysis, information tracking, information management, and information utilization (recognition rates all above 60%). (4) The blended teaching model effectively promotes reflective experience (recognition rate of 83%) and critical thinking development (recognition rate of 63%). (5) 64% of students believe that information exchange, sharing, and mutual assistance in online communities are helpful for problem-solving and are willing to actively participate; 67% of students believe they will continue to use the teaching content on the MOOC platform to assist in problem-solving after the course ends. These survey results indi-

cate high recognition of blended teaching and good teaching effectiveness, with learners' comprehensive information literacy, critical thinking, and metacognition being effectively cultivated.

The ratio of MOOC online teaching to face-to-face classroom hours is an important factor affecting the effectiveness of blended teaching. In this teaching practice, students reported that face-to-face classroom hours were relatively insufficient, resulting in insufficient in-depth exploration of some academic context issues. In future teaching processes, we will optimize the ratio of MOOC to face-to-face classroom based on students' learning load, supplemented by short-term live streaming to increase opportunities for answering students' questions.

5. Summary and Reflection

This empirical study, based on analyzing the distinctions and connections between metaliteracy and traditional information literacy and combining the professional characteristics of the graduate medical information retrieval course at our university, designs and constructs a teaching path under the blended teaching model guided by metaliteracy education philosophy. The advantages and disadvantages of this teaching path in practical application are summarized, and subsequent improvement strategies are considered:

(1) The blended teaching model effectively aligns with metaliteracy teaching philosophy and achieves good teaching results, representing one of the effective methods for current metaliteracy teaching. The combination of MOOC and face-to-face classroom constructs an information ecological environment more suitable for learners to experience information role transformation; it enables learners to exercise abilities in information creation, communication, sharing, and collaboration in interactive environments. MOOC and face-to-face classroom complement each other (MOOC online teaching is the foundation for face-to-face classroom discussions, which in turn consolidate knowledge and skills obtained from MOOC online teaching), promoting knowledge internalization and absorption. The entire learning process advances learners' metacognitive and affective transformations.

(2) The progressive, multi-stage, and multi-level teaching path designed by drawing on deep learning process research findings conforms to students' learning patterns and cognitive processes, representing an effective pathway to achieving metaliteracy teaching objectives. The progressive teaching path helps regulate the teaching objectives of the four metaliteracy domains and implements targeted teaching strategies at different stages and levels, ensuring the entire process of cultivating metacognition, critical thinking, and inquiry-based learning.

Effective cooperation between teachers and students is an important factor affecting the smooth implementation of the teaching path and the achievement of teaching objectives. Currently, this teaching path still has some problems in

practice: students' information ability levels vary significantly, and differences in learning enthusiasm and importance affect the completion rate of MOOC online tasks, ultimately leading to insufficient participation in face-to-face classroom discussions and poor quality of academic research stage reports. Additionally, teachers new to the blended teaching model and path still have deficiencies in role transformation and overall teaching control. Therefore, corresponding improvement measures must be taken in future teaching processes: For students, consider conducting a preliminary screening of information ability at the beginning of the course, then provide targeted attention during teaching, adopt effective supervision measures, set up participation reward and punishment mechanisms, and encourage collaborative learning; For teachers, first, improve their own quality through various channels, second, strengthen MOOC platform management (grading assignments, timely replying to student questions, participating in student discussions), such as recruiting teaching assistants to help with management, and finally, pay attention to timely grasping students' learning situations for targeted guidance.

(3) Critical thinking can only be effectively trained and accurately evaluated in authentic contexts of academic research and information literacy application. All three progressive levels of this teaching path integrate academic contexts: academic-contextualized practical test questions, expanded task academic contexts, and practical academic contexts related to academic research. Students cultivate critical thinking in the process of analyzing academic contexts and constructing problem-solving paths, practicing inquiry-based research, scholarship as conversation, and searching as strategic exploration, which helps enhance academic research abilities.

Teaching practice must be combined with actual teaching conditions, teaching objects, and professional characteristics, and teaching content that can integrate academic contexts must be designed to achieve good teaching results. To ensure that the set academic contexts are more closely integrated with students' majors and academic research, in future teaching, consider inviting professional course teachers as instructional consultants or co-designing with other courses such as *Research Thinking and Methods* to further improve the metaliteracy teaching path.

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Author Contributions

Lin Xiaohua: Empirical research and analysis, paper writing and revision
Lin Danhong: Provided ideas and guidance for research topic selection
Zhong Ling: Empirical research and guidance

English Title and Abstract

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Abstract: [Purpose/significance] Based on the analysis of the difference and connection between metaliteracy and traditional information literacy education, the teaching practice of metaliteracy in the blended teaching model is carried out, and the results and problems are summarized to provide reference for exploring effective metaliteracy teaching paths. [Method/process] This paper uses the case study method and takes the medical information retrieval course for graduate students as the empirical research object. It elaborates the specific implementation steps and main points of teaching practice around metaliteracy, threshold concepts, academic context, deep learning theory, and information ecological environment, and studies and constructs the teaching path of metaliteracy in the blended teaching model. [Result/conclusion] The blended teaching model can effectively improve the metaliteracy teaching philosophy. The gradual and progressive teaching path designed in stages and levels is an effective way to achieve metaliteracy teaching objectives, and it emphasizes the whole process of cultivating metacognition, critical thinking, and inquiry learning.

Keywords: blended teaching, metaliteracy, deep learning, teaching path

Note: Figure translations are in progress. See original paper for figures.