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AI-Driven Data Literacy Development for Medical Students: A Teaching Reform Study at Guangdong Medical University

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Abstract

The rapid development of artificial intelligence (AI) is accelerating the digital and intelligent transformation of healthcare, placing new demands on the competencies required of future medical professionals. Data literacy, as a core component of medical students' professional competencies in the digital era, has become an important priority in the development of New Medical Education. However, data literacy education for medical students continues to face several challenges, including a misalignment between educational objectives and industry needs, underdeveloped curricula, insufficient digital competencies among faculty, and inadequate assessment mechanisms. In response, Guangdong Medical University has actively promoted the integration of AI into medical education and explored a new approach to data literacy development through curriculum restructuring, the development of intelligent teaching platforms, project-based learning, and innovative assessment mechanisms. Drawing on the university's teaching reform practices, this study examines the major challenges in developing medical students' data literacy, summarizes practical experiences in AI-enabled educational reform, and proposes strategies for future improvement. The findings aim to provide practical insights for local medical universities seeking to advance New Medical Education and accelerate the digital transformation of higher education.

Keywords

Artificial intelligence; data literacy; medical education; New Medical Education; teaching reform.

1. Introduction

With the rapid development of next-generation information technologies, society is accelerating its transition toward an intelligent era. As a key factor of production, data is facilitating the deep integration of artificial intelligence (AI) with medical knowledge and reshaping healthcare delivery models. Emerging technologies, including AI-assisted diagnosis, intelligent medical image analysis, and health big data platforms, are creating new demands for the education and training of future medical professionals [1–3].

On the national level, China has paid much attention to the evolution of healthcare and AI. The healthy China 2030 Planning Outline and the New Generation Artificial Intelligence Development Plan emphasize the need to encourage the use of big data in healthcare and develop innovative talent. With the increase in the pace of the digital transformation of higher education, the Guiding Opinions on Accelerating the Innovative Development of Medical Education, published by the General Office of the State Council, only accentuate the progress of

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the New Medical Education [4–6]. It is on this background that the use of AI to enhance the quality of medical education has taken a significant priority.

One of the essential skills of the digital age is data literacy. According to Koltay, data literacy is a thorough skill to utilize data to aid in making informed decisions [1]. Prado et al. are of the view that it involves several dimensions such as data acquisition, management, analysis and application [2]. Wolff et al. note that critical thinking and data ethics are critical [3]. To medical students, data literacy has a direct impact on their ability to perform clinical research and to utilize data to aid in disease prevention, diagnosis, and treatment in their future practice.

The past few years have witnessed the increased scholarly interest in AI-based education. Past research indicates that AI can change the educational ecosystem [4], reshape the teaching and learning patterns, enhance the educational effectiveness, and support individualized learning [6]. Another crucial area of research has also been the development of digitally enhanced teaching ecosystems and intelligent learning platforms [7-10]. In the framework of New Medical Education, Wang Weimin has highlighted how there is a need to develop interdisciplinary medical professionals who have integrated competencies [11]. Among the unresolved issues that have been cited by Liu Luying et al. are fragmentation of the curriculums and poor evaluation systems [12]. Despite the fact that some researchers have discussed the role of integrating the big data and intelligent diagnostic technologies in medical education [13], the systematic study on data literacy development among medical students is scarcely discussed.

In general, current literature has a number of flaws, such as the lack of systematic research adapted to medical students, the limitation of investigating the mechanisms of developing data literacy, and the absence of practical experience and proven methods in the local medical universities [14]. Guangdong Medical University, a higher education institution that has been prioritized to develop into a high-level university in Guangdong Province, has been proactive in recent years in encouraging the use of AI in medical education. Using this university as a case study, the paper explores the practical issues related to the development of the data literacy of medical students, summarizes the experiences of its educational reform efforts, and suggests a data literacy development pathway. The paper will offer hands-on information to local medical universities that want to promote New Medical Education and expedite the digitalization of higher education.

2. Medical student Practical Problems in AI-Assisted Data Literacy Development

As the use of artificial intelligence (AI) and big data technologies in healthcare spreads, creating a novel form of data literacy among medical students has become a major focus of the modern medical education system. Nonetheless, local medical universities are still experiencing significant issues with curriculum development, teaching materials, faculty training and evaluation. Based on the experience of Guangdong Medical University, this section discusses five key challenges.

2.1. Lack of Fit between Educational Goals and the Requirements of Smart Healthcare

There has been a historic focus on clinical skills in medical education, and relatively little focus on data-driven thinking and the use of AI. Growth mind The creation of smarter healthcare demands four fundamental competencies to be gained by medical students: data awareness, data processing, data analysis and modeling, and data ethics and security. Educational practice observations show that students do not tend to think systematically and interdisciplinarily working with real-world clinical cases or research data. This disparity helps to emphasize the

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incompatibility of current educational goals and the dynamism of the healthcare sector needs, which makes it crucial to alter the focus towards competency-based medical education.

2.2. Lagging Curriculum Development

Current data literacy education is mainly based on conventional classes, including Medical Statistics, and has a number of limitations, including course content that is outdated, lacks interdisciplinary integration, inadequate training in practical skills and lacks curricular coherence. In Guangdong Medical University, courses like Fundamentals of Artificial Intelligence have been established, but intercourse among courses is not yet well-developed, and cross-disciplinary elective opportunities are not yet standardized as a part of the curriculum. As a result, students face loopholes in their acquisition of the integrated abilities to use data analytics and AI in medical practices.

2.3. Lack of Resources to train in practice

Access to real-world data and project-based learning is crucial in the development of data literacy. Nevertheless, there are three significant obstacles to practical training. First, privacy and data security conditions restrict access of students to real clinical cases and big health data. Second, not all local universities have a properly developed lab and AI modeling platforms. Third, there is little research-based training and involvement in discipline-specific competitions. One way that Guangdong Medical University has attempted to address some of these limitations is by creating a public health big data platform. However, some more advancements should be implemented in promoting interdisciplinary, integrated applied training.

2.4. Require to Improve Strengths of Faculty Digital Competencies.

Most medical teachers have been educated in the conventional education setting and struggle to learn how to apply AI and other digital technologies, combine interdisciplinary knowledge into instruction, and create data-driven practical tasks and formative assessments. Even though Guangdong Medical University has delved into digital skills training and the creation of two-qualified teaching teams comprising of academic and practical knowledge, the systematic and sustainable capacity-building of digital skills among faculty members still needs institutional investment and long-term capacity-building processes.

2.5. Lagging Assessment Mechanisms

Current assessment practices remain largely centered on final examinations and graduation theses, resulting in limited assessment dimensions, insufficient monitoring of learning processes, and incomplete evaluation frameworks. Guangdong Medical University has introduced a three-dimensional assessment framework encompassing knowledge, competence, and literacy, while also exploring formative assessment approaches. However, the associated assessment methods, operational criteria, and implementation standards require further refinement and broader application.

Overall, these issues limit the process of developing the data literacy of medical learners and hinder the digital revolution of medical education. To this, Guangdong Medical University has conducted a series of curriculum restructuring, educational platform building, project-based instruction and assessment innovations. Such initiatives can give a viable basis to further educational change and can serve as a valuable example in other local medical universities aimed at enhancing their data literacy education in the era of AI-based healthcare.

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3. AI-Enabled Reform Practices for Data Literacy Development among Medical Students at Guangdong Medical University

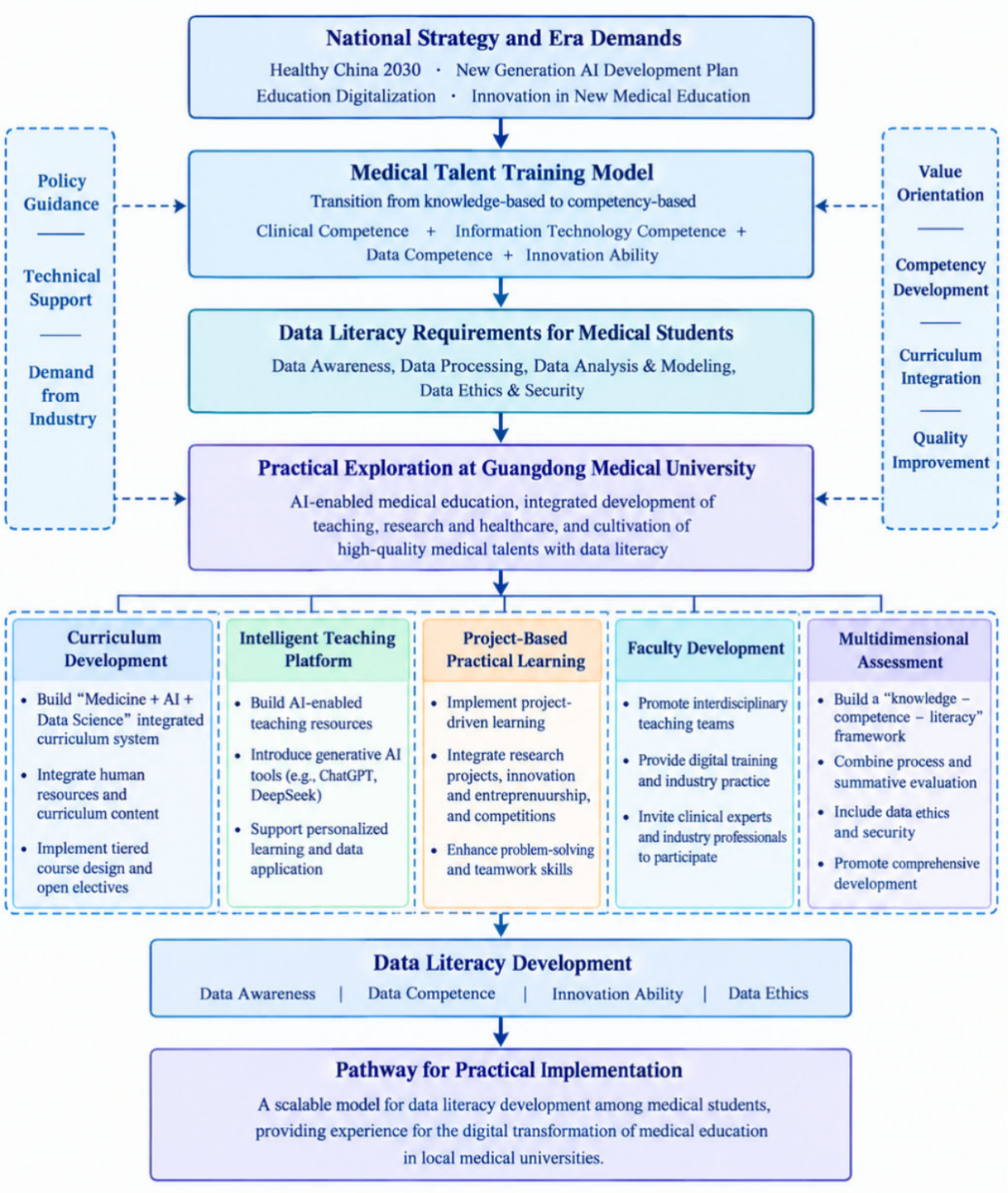


Figure 1. Research framework for AI-enabled data literacy development among medical students.

Limited data literacy education for medical students mainly stems from the underdeveloped curriculum, lack of practical training, faculty capacity limitation and over-reliance on traditional assessment methods. Guangdong Medical University takes these challenges as opportunities to innovate medical education with AI. Reform practices mainly include

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development and innovation of data literacy-related courses, teaching platforms, assessment methods, and project-based learning (PBL) reform. These practices help establish a data literacy development model suited to the local context of medical universities. The overall framework of the reform is illustrated in Fig. 1.

According to Fig. 1, the development of data literacy for medical students is essentially aligned with the strategic priorities of the country and the transformation of competency requirements of medical staff. Within the framework of the reform, efforts are made to improve medical students' data awareness, data skills and innovation capability through the integration of curriculum, intelligent teaching platform, project-based learning and assessment.

3.1. Integrated Curriculum in Medicine, Artificial Intelligence and Data Science

Medical education incorporates a foundation for teaching data literacy. Based on the three stages of curriculum development, namely foundational understanding, competency development and innovative practice, Guangdong Medical University has designed courses that address data awareness and data science skills. At the foundational stage, courses in the areas of Artificial Intelligence and Intelligent Medical Programming are provided. At the competency-development stage, the course Medical Big Data and Decision Making is offered to equip students with skills in AI integration with medical knowledge. At the innovative practice stage, students are trained to apply data analytics skills and AI to solve medical problems by participating in research, innovation and entrepreneurship and in domain-related competitions. The integration of these stages facilitates the development of students' data literacy.

3.2. Designing Intelligent Teaching Platforms

To build students' hands-on competencies in data science, the university has focused on the development of digital teaching environments. The university's teaching and research centers integrate medical data and other educational resources to create a virtual environment that supports students in analyzing medical data. Additionally, the university has integrated Generative AI in teaching to enable students perform literature searches and case analysis.

3.3. Implementing Project-Based Practical Learning

Projects, competitions, and other activates related to innovation and entrepreneurship offer opportunities to foster data literacy. Guangdong Medical University uses these types of projects in its teaching. Because of this, the university has established a learning model that integrates courses with projects and practices, resulting in the development of students' analytical abilities, innovative thinking, and teamwork. Data literacy plays an important role in finding solutions for real world problems (e.g. in disease prediction and public health survey activities).

3.4. Strengthening Interdisciplinary Faculty Development

In order to meet the changing needs of medical education in the AI era, Guangdong Medical University has promoted the collaborative teaching of faculty members from medicine, computer science and data science. Faculty are offered digital teaching training and placement in industry and university-hospital collaborations. The university also promotes curriculum development and practical teaching through collaboration of faculty members from affiliated hospitals and professional workers from the related field.

3.5. Establishing a Multidimensional Assessment Mechanism

The university emphasizes the complementary roles of knowledge assessment and competency evaluation by developing a three-dimensional assessment framework encompassing knowledge, competence, and literacy. Students' data awareness, analytical skills, and innovation capabilities are evaluated through multiple forms of assessment, including classroom participation, project-based practice, coursework examinations, and research

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outputs. Data ethics and security are also incorporated into the assessment framework. This multidimensional approach aims to support continuous monitoring of student learning and provide a more comprehensive evaluation of their development.

4. Analysis of Reform Outcomes and Educational Effectiveness

With the determination and persistence of faculty members and the support of adequate means, Guangdong Medical University has developed a model of medical talent training combined with the integration of AI with data literacy in a relatively short time. Through the integration of intelligent teaching and projects, the university aims to develop students' data awareness and analytical skills as well as creativity and innovation. This exemplifies the value of the potential reform approach.

4.1. Improved Students' Data Awareness

Prior to the implementation of the reform, the university adopted traditional teaching to instruct students on the importance of clinical data for diagnosis and treatment, clinical research and public health management. Upon the implementation of the reform, the university incorporated data-driven teaching in all aspects of its medical curriculum, combining Case-based teaching, PBL and/or AI teaching, to further empower students to recognize the importance of clinical and public health data and research data in diagnosis, treatment, and the management of public health, and facilitating students' acquisition of Data awareness, analytical skills and innovative abilities, for the development of a new generation of medical talents.

Teachers utilize case studies with electronic health records and public health surveys to educate students on how to reflect on medical issues from a data perspective. This method helps students recognize the critical role that data plays in clinical decision making and research. With an increased awareness of the importance of data in clinical practice, students have begun to recognize emerging developments in healthcare such as AI-based diagnosis and treatment.

Furthermore, students are increasingly able to incorporate data to solve problems. In coursework, research, and innovation and entrepreneurship projects, the use of data analysis to address practical problems has seen an increase, with an increasing number of students utilizing AI tools and data analysis software to solve problems.

4.2. Continuous Improvement in Data Analysis and Application Competencies

Fostering the ability to apply data analysis to practical problems has been the mainstay of data literacy education. The integrated curriculum in medicine, AI, and data science helps students build the skills needed to analyze data to solve practical problems in medicine.

First, students have improved their data processing skills. For example, via Python and R programming courses, they have learned how to work with and visualize medical data. Second, students have improved their use of AI to solve practical problems. Some of the students have used machine learning to predict disease risk and other health-related behaviors.

It can be seen clearly in the training and graduation thesis of students, how the use of R and AI-assisted tools has improved the analysis of data, resulting in better and more efficient research work. The experiences, however, suggest that the impact of this reform is even beyond the enhancement of know-how, that is, it improved the skills of students in the practical application of data.

4.3. Improved Innovation and Practical Problem-Solving Capabilities

In addition to theory, practical learning supports the development of the students' data literacy. To foster advanced data literacy, Guangdong Medical University provides various training

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opportunities on data application in different areas. These activities help improve students' understanding on the use of data science in solving complex problems.

More students are participating in innovation and entrepreneurship workshops, medical data analysis competitions, and the Challenge Cup. Increased project output associated with these has also been noted.

4.4. Continuous Improvement in Faculty Digital Teaching Competencies

The development of students' competencies is associated with the parallel development of teachers. As part of the educational reform, the university has promoted faculty digital literacy through specialized trainings, teaching seminars, and industry-based practical training. The aim was to upgrade faculty's ability to integrate AI in teaching.

The use of generative AI for curriculum development and the integration of intelligent teaching platforms in the development of teaching resources, student assessment and feedback has been reported. Some faculty members have incorporated teaching methods based on modular learning and self-directed learning. The use of teaching resources to facilitate the shift from knowledge transmission to digitally supported teaching has been documented.

The increasing use of computing in teaching practices has enabled interdisciplinary teams to combine their expertise in both medical and computer science disciplines to promote data literacy.

Reforming pedagogies has positive spiral effects on faculty development and teaching improvement which in turn strengthens student learning.

4.5. Establishing a Replicable Model for Data Literacy Development

A data literacy development model has been devised at Guangdong Medical University that comprises of four interconnected components such as curriculum development, intelligent platforms, project-based learning and assessment.

The model is centered on students' developmental needs and integrates AI into the broader process of talent development in order to enhance the integration and combination of students' knowledge, ability and value. The university's work focuses on the medical students' data literacy and other aspects of digital transformation of local medical universities.

From a training mechanism perspective, the model is broadly transferable to other educational organizations in different contexts. The model is expected to strengthen the integration of medical education and AI, contribute to the development of a new generation of healthcare professionals with the ability to address the demands of smart and integrated healthcare. More work is needed to determine the model's effectiveness and long-term impact in different universities and student cohorts.

5. Conclusions and Future Directions

While revolutionizing artificial intelligence (AI) in medicine offers many opportunities for digital transformation of medical education, it increases the need for data literacy of medical students. Based on reform practices of Guangdong Medical University, this study innovatively used AI to develop data literacy of students through curriculum reform, intelligent teaching platform, and project-based integrated learning. Different assessment methods are used to evaluate students' data literacy. Based on the results of practical work, this approach contributes to the awareness, analysis and innovation of medical students, and helps medical staff to meet the challenges of more interdisciplinary and complex smart healthcare.

More refined AI is expected to fundamentally change medical education, provide a wide range of interdisciplinary and cross-field integrated curricula and practical teaching platforms, enhance faculty's digital skills, and develop more sophisticated, evidence-based and integrated

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assessment methods. The above strategies help to improve the skills of future generations of medical staff, to meet the requirements of Quality of Medical Education and to promote the Healthy China initiative.

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References

[1] Koltay, T. (2015). Data literacy: In search of a name and identity. Journal of Documentation, 71(2), 401–415. https://doi.org/10.1108/jd-02-2014-0026.

[2] Calzada Prado, J., & Marzal, M. A. (2013). Incorporating data literacy into information literacy programs: Core competencies and contents. Libri, 63(2), 123–134. https://doi.org/10.1515/libri-2013-0010

[3] Wolff, A., Gooch, D., Cavero Montaner, J. J., Rashid, U., & Kortuem, G. (2016). Creating an understanding of data literacy for a data-driven society. Journal of Community Informatics, 12(3), 9–26. https://doi.org/10.15353/joci.v12i3.3275

[4] Sun, S. H., & Liu, B. Q. (2020). Theoretical framework and practical approaches for educational applications of artificial intelligence. E-Education Research, 41(10), 5–15. (in Chinese)

[5] Ou, F. F., & Ou, Y. K. (2020). Applications and impacts of artificial intelligence in higher education. Higher Education Forum, 12, 127–130. (in Chinese)

[6] Zhang, Y. (2025). AI-enabled classroom teaching: Value implications, practical challenges, and implementation pathways. Theory and Practice of Education, 45(18), 51–55. (in Chinese)

[7] Chen, Y. T., & Ai, X. (2024). The connotations, characteristics, and practical requirements of a digital-intelligent teaching ecosystem. Academic Exploration, 7, 148–156. (in Chinese)

[8] Li, Y. Z., Zeng, J. Z., & Tian, L. J. (2024). Challenges and strategies for improving the digital-intelligent literacy of accounting and finance faculty in higher education. Higher Education Forum, 8, 37–42. (in Chinese)

[9] Hu, Q. T., & Zheng, K. (2023). The logic, challenges, and pathways of educational digital transformation. Modern Distance Education Research, 1, 3–11. (in Chinese)

[10] Huang, R. H., & Zhang, M. H. (2021). Educational transformation and innovation in talent development in the era of artificial intelligence. China Educational Technology, 8, 1–8. (in Chinese)

ISSN: 2637-6067 DOI: 10.6918/IJOSSER.202611_9(11).0029

[11] Wang, W. M. (2022). Reform and innovative development of medical education in the context of New Medical Education. China Higher Medical Education, 10, 1–4. (in Chinese)

[12] Liu, L. Y., & Chen, M. (2023). Current status, challenges, and development trends of medical information literacy education. Researches in Medical Education, 31(4), 489–494. (in Chinese)

[13] Liu, X. H., Liu, Y. Y., & He, X. Y. (2025). Exploration and practice of curriculum teaching in information management and information systems under the "AI + X" paradigm. Theoretical Research and Practice of Innovation and Entrepreneurship, 8(9), 39–41. (in Chinese)