

Exploration of Digital Literacy Cultivation for Enhancing Undergraduate Research Ability: A Case Study of Shanghai Jiao Tong University Library

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Abstract

Amid the nationwide upsurge in cultivating digital literacy and skills, university libraries have emerged as important agents for fostering digital literacy among college students. Shanghai Jiao Tong University Library leveraged the 2021 undergraduate thesis academic norm review as an entry point to systematically implement information literacy education for the class of 2022 undergraduates, organically integrating digital literacy competency cultivation into various stages of undergraduate graduation project guidance, achieving relatively positive outcomes, and based on identified deficiencies in the cultivation practice, continues to explore new directions for future digital literacy cultivation.

Full Text

Exploration of Digital Literacy Cultivation for Enhancing Undergraduate Research Capabilities—A Case Study of Shanghai Jiao Tong University Library

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Abstract: Amid the national surge in digital literacy and skills development, university libraries have emerged as pivotal institutions for cultivating digital literacy among college students. Leveraging the 2021 undergraduate thesis academic standards review as its entry point, Shanghai Jiao Tong University Library systematically implemented information literacy education for the 2022 graduating cohort, organically integrating digital literacy cultivation throughout every stage of undergraduate graduation project guidance. This initiative

achieved notable success, and building upon identified gaps in practice, the library continues to explore new frontiers for future digital literacy development.

Keywords: Digital literacy; undergraduate graduates; graduation design (thesis); research capability

1. Introduction

In 1994, Israeli scholar Yoram Eshet Alkalai first introduced the concept of digital literacy, and by 2006 emphasized that possessing digital literacy should be considered one of the fundamental survival skills for the public in the 21st century [1][2]. Digital literacy encompasses a comprehensive set of competencies required for citizens in a digital society—including digital acquisition, creation, utilization, evaluation, interaction, sharing, innovation, security, and ethical considerations. As global economic digitalization accelerates, national digital literacy and skills have increasingly become key indicators of international competitiveness and soft power [3]. International organizations such as IFLA have recognized the leading role of libraries in advancing digital literacy and skills, while the Chinese government has also designated libraries as important stakeholders in enhancing national digital literacy [4].

As a crucial supporting force in university education, academic libraries must seize this opportunity to fully integrate digital literacy cultivation into their information literacy education frameworks. Within the practice of supporting institutional talent development, graduation design projects represent an excellent strategic entry point for establishing a scientific digital literacy cultivation mechanism. The graduation thesis serves as a comprehensive assessment of undergraduates' ability to apply acquired knowledge to interpret and explore professional issues, representing a critical manifestation of their academic research proficiency. In 2021, Shanghai Jiao Tong University Library undertook university-wide academic standards review of undergraduate theses for the first time. Building upon this review, the library comprehensively analyzed the 2021 results and, using the deepening and expansion of information literacy education as an opportunity, intensified digital literacy cultivation efforts for the 2022 graduating class. Through comprehensive and systematic digital literacy education, the library promoted front-end and process-based quality control of graduation theses, thereby supporting the enhancement of undergraduate education quality.

2. Undergraduate Thesis Academic Standards Review

To ensure fundamental quality in undergraduate talent cultivation and strengthen education supervision and evaluation, the Ministry of Education issued the "Undergraduate Thesis (Design) Sampling Inspection Measures (Trial)" in December 2020, launching a pilot sampling inspection program.

In April 2021, the Shanghai Municipal Education Supervision Office released the “Shanghai Undergraduate Thesis (Design) Sampling Evaluation Elements (Trial),” which listed academic standards as one of five key evaluation dimensions. Consequently, Shanghai Jiao Tong University initiated its 2021 undergraduate thesis academic standards review, with the library commissioned by the Academic Affairs Office to implement the review process.

Over a three-month period, the library maintained close communication with the Academic Affairs Office and various academic departments, completing the university-wide review through iterative exploration. The review rigorously examined whether undergraduate theses met academic writing and citation standards, particularly regarding formatting accuracy, chart annotations, source attribution, and reference documentation. This process objectively identified common formal standard issues in student papers, highlighting deficiencies in undergraduate talent cultivation and demonstrating the urgent need for comprehensive guidance throughout all stages of academic research.

3. Constructing a Comprehensive Digital Literacy Cultivation System

Based on analysis of the 2021 review results, the library resolved to move beyond mere formal standards guidance. By leveraging its professional strengths and using the academic standards review as a leverage point, the library implemented diversified information literacy education and strengthened digital literacy cultivation throughout all phases of graduation design, embedding thesis quality control at the front end.

Before launching the 2022 undergraduate graduation design work, the library began planning a digital literacy cultivation program aimed at enhancing graduates’ research capabilities. By clarifying overall objectives, meticulously designing the cultivation framework, and optimizing instructor team structure, the library ensured steady and orderly implementation of information literacy education. Following the commencement of graduation projects, the library conducted a series of thematic learning guidance sessions focused on digital capability cultivation, contributing the library’s expertise and resources to enhancing graduates’ research abilities.

3.1 Clarifying Overall Objectives, Stage Design, and Methodological Support

As countries worldwide incorporate digital literacy cultivation into educational planning at all levels, it has become an indispensable component of higher education system reform. UNESCO has suggested that new environments always require new forms of information literacy [5]. Digital literacy cultivation for enhancing undergraduate research capabilities represents a crucial link in information literacy education and constitutes a new frontier for service innovation in academic libraries.

Building upon existing information literacy education achievements and guided by documents such as the “Action Outline for Enhancing National Digital Literacy and Skills” and the “2022 Key Points for Enhancing National Digital Literacy and Skills,” Shanghai Jiao Tong University Library established differentiated digital literacy cultivation objectives aligned with the distinct needs of each graduation stage—from topic selection and literature collection to mid-term review, thesis writing, defense, and archiving. Through situated teaching methodologies, the library assists undergraduates in efficiently completing their graduation designs while fostering research, innovation, and lifelong learning capabilities.

3.2 Scientifically Designing a Progressive Digital Literacy Cultivation Framework

According to the different stages and scenarios in the undergraduate thesis process, and addressing information literacy education needs in thesis writing, the library reorganized and disseminated existing training resources and online public learning materials. It conducted various problem-oriented training lectures and regular Q&A sessions, gradually establishing a digital literacy cultivation framework for enhancing undergraduate research capabilities.

[Figure 1: see original paper] Shanghai Jiao Tong University Library’ s Digital Literacy Cultivation Framework for Undergraduate Research Capability Enhancement

At the initial stage of topic selection, the library launched rolling training sessions on “How to Conduct Literature Review Before Topic Selection,” tailored separately for STEM and humanities/social sciences. These sessions guided students in precisely selecting research directions and obtaining required information through multiple channels, achieving progressive cultivation of digital retrieval, browsing, analysis, and evaluation capabilities. Subsequently, to help efficiently manage the substantial literature generated during research, the library timely promoted training lectures on reference management software and WeChat articles on “How to Skillfully Use Reference Management Software,” helping students overcome various information management obstacles and enhancing both digital storage and management capabilities.

During formal thesis writing, students needed to master the key writing points for each section and formal standards requirements. To address this, the library organized four specialized training sessions and simultaneously disseminated learning resource packages on typesetting software selection and access to previous students’ theses. Additionally, it planned a four-week “Thesis Writing Workshop” providing face-to-face academic standards guidance, instructing students to explore and create new knowledge based on proficient use of digital technology for information acquisition, absorption, and integration. Recognizing undergraduates’ relative weakness in digital ethics awareness, the library also included academic ethics compliance as an important module in its information

literacy lectures.

For the thesis defense stage, the library offered specialized training on creating defense presentations and academic report slide techniques, available for interested graduates to strengthen their digital presentation, dissemination, and communication capabilities. Upon thesis submission, the library conducted academic standards review according to university requirements, guiding students to archive their work properly on the system platform.

Learning Materials and Lectures for 2022 Shanghai Jiao Tong University Library Undergraduate Graduation Design (Thesis)

Stage	Resources & Lectures	Digital Competency Focus
Topic Selection & Proposal	Rolling training: Literature review before topic selection (STEM & Humanities/Social Sciences versions); Digital Literacy Public Lectures: Literature review tips; Siyuan Micro-courses: Academic resource maps, core journal identification, foreign literature access; WeChat articles: Literature review guidance	Digital retrieval, analysis, evaluation
Literature Management	Rolling training: EndNote X9 & NoteExpress skills; Digital Literacy Public Lectures: Zotero for knowledge management; Siyuan Micro-courses: EndNote grouping, sharing, rapid screening; WeChat articles: Reference management software tips	Digital storage, management
Thesis Writing	Rolling training: Access to domestic/foreign theses; New micro-courses: Accessing senior students' theses; Specialized training: LaTeX & Word advanced formatting; Database: 51CTO video tutorials; WeChat articles: Typesetting techniques, senior thesis access	Using digital technology to acquire, absorb, integrate, and create knowledge

Stage	Resources & Lectures	Digital Competency Focus
Academic Ethics & Standards	Specialized training: Citation standards & academic misconduct; Reference documentation standards (GBT7714-2015); Using software for reference management	Digital ethics and norms
Thesis Defense	Specialized training: Creating excellent defense presentations	Digital presentation, dissemination, communication

3.3 Continuously Building a Professional Digital Literacy Teaching Team

The library's information literacy education for undergraduates has long been coordinated by the Learning Support Team of the Subject Services Department. Through years of practice, the library has developed a professional instructor team with reasonable personnel structure and outstanding teaching capabilities, consistently exploring new pedagogical pathways and directions amid information literacy education reforms.

With the widespread application of big data, artificial intelligence, 5G, and other emerging technologies, students' learning environments have fully entered the digital age, imposing extremely high requirements on the digital literacy necessary for future development. How to fully integrate digital capability cultivation elements into undergraduate information literacy education to empower China's digital talent development has become a new breakthrough point for innovative and timely information literacy education. To achieve this goal, the Learning Support Team mobilized 10 core members and over 30 departmental staff, with senior librarians holding advanced titles taking the lead, experienced young librarians serving as main instructors, and "new generation" librarians participating throughout. Together they planned the digital literacy cultivation program, refined content, and optimized teaching models and methods. By standardizing teaching processes and content, the team honed precise knowledge delivery capabilities and strictly controlled the quality of digital literacy cultivation.

4. Reflection and Future Prospects

4.1 Characteristics and Effectiveness of Digital Literacy Cultivation for Graduates

Following the series of front-loaded digital literacy training, graduates demonstrated noticeable improvement in academic standards compliance. In subsequent surveys, 97.96% of students responded that library training was "helpful"

or “very helpful” for thesis writing. The entire process of digital literacy cultivation for enhancing undergraduate research capabilities exhibited several key characteristics:

First, the program emphasized integrating existing learning resources while continuously developing high-quality new resources. Fully utilizing collection resources to enhance users’ digital literacy and capabilities is an undeniable responsibility of academic libraries [6]. When designing information literacy instruction for graduates, Shanghai Jiao Tong University Library centered on digital literacy and skills cultivation, systematically organizing existing training resources—including course materials and videos from previous Siyuan micro-courses, rolling training, and specialized sessions related to thesis writing and academic standards. The library also aggregated resources from multiple on-line platforms such as the Digital Literacy Public Lecture series. These diverse and complementary resources were categorized by theme and packaged into WeChat articles targeted at graduating students, facilitating gradual digital capability enhancement through self-directed learning. These resources received widespread acclaim from faculty and students, with WeChat articles averaging 2,082 views and reaching a maximum of 3,265 views. Simultaneously, according to the graduation design schedule, the library timely offered specialized training for systematic knowledge review and Q&A. Training materials including PPTs and videos were preserved and uploaded to the training system for anytime access, creating a continuous supply of resources for digital capability cultivation through organic integration of existing, public, and newly developed materials.

Second, the program effectively mobilized diverse stakeholders and expanded the digital literacy instructor team. Analysis of departments with high first and second review pass rates revealed that preliminary review by academic staff significantly promoted students’ adherence to academic standards. Consequently, the library proactively planned academic standards training for departmental academic administrators, establishing flexible collaborative mechanisms to safeguard digital literacy cultivation for graduates. To broadly enrich training capacity and optimize teaching deployment, the library also incorporated outstanding students as peer role models to stimulate learning enthusiasm. Over the past two years, the library invited excellent graduate students to participate in WeChat article creation and thematic lectures. These students, possessing high digital literacy and skills, produced novel, engaging, and uniquely perspective content that aligned with student information behavior patterns, achieving satisfactory educational outcomes. The convergence of academic staff and student mentors injected fresh vitality into digital literacy cultivation and contributed diverse perspectives.

Third, the program comprehensively covered all undergraduate departments and was organically integrated into every graduation design phase. Digital literacy represents the elevation and expansion of information literacy in the digital era [7]. As a crucial component of undergraduate talent cultivation, graduation design (thesis) provided the context for library information literacy education

that spanned all undergraduate departments, demonstrating strong support for university-wide education quality enhancement. Students not only developed professional research capabilities but also strengthened digital awareness and skills. The library's training quality received high recognition from the Academic Affairs Office and faculty across departments, with multiple colleges establishing partnerships for customized training sessions.

From initial topic selection to final submission, Shanghai Jiao Tong University Library established clear, multi-level digital literacy cultivation objectives for each stage, precisely targeting application scenarios including topic selection, literature review, reference utilization, academic writing standards, academic ethics, and defense techniques. This approach not only enhanced graduates' research capabilities but also laid a solid foundation of digital literacy and skills for lifelong development, fostering digital adaptability, competency, and creativity.

4.2 Future Directions for Digital Literacy Cultivation Improvement

As the primary arena for digital literacy education in universities, academic libraries must perpetually explore and innovate educational models. Shanghai Jiao Tong University Library's digital literacy cultivation for graduates still has considerable room for improvement. Future practice can be enhanced across three dimensions:

(1) Temporal Span: Four-Year Comprehensive Coverage with Staged, Progressive Implementation

Current information literacy education for first- through third-year undergraduates primarily focuses on collection introduction, information retrieval, and database/software usage, providing some cultivation of digital retrieval, analysis, and evaluation skills. However, digital literacy cultivation for academic research capability enhancement mainly occurs in the fourth year. Research ability development cannot be achieved overnight. During the final year, students' attention is divided among internships, postgraduate entrance exams, and job searches, making exclusive reliance on this period suboptimal for teaching effectiveness. Moreover, research capabilities are needed before the final-year thesis. As undergraduate education reform deepens, demands for cultivating research interest, awareness, and ability increase, with more students participating in research programs and innovation projects as early as their second and third years.

Therefore, both at the macro level of cultivation planning and the micro level of curriculum design and scheduling, digital literacy cultivation for academic research capability enhancement can be frontloaded and implemented progressively from freshman to senior year. Early stages would focus on gradually developing digital awareness and capabilities through self-study of library resources. Mid-stage would combine general core courses with personalized guidance, providing beneficial instruction for students using digital technologies in various research projects. The final graduation design stage could concentrate on in-

tensive cultivation and reinforcement of digital retrieval, management, analysis, processing, communication capabilities, and digital ethics through specialized lectures.

(2) System Depth: Extending Cultivation Depth and Reconstructing the Digital Literacy System

Currently, Shanghai Jiao Tong University Library's information literacy training for graduates covers extensive and diverse themes—from pre-proposal literature review and literature management to writing essentials, formatting standards, academic ethics, and defense preparation—encompassing the entire thesis writing process. However, content design for digital capability cultivation within each theme 仍有提升空间. Future digital literacy cultivation design should incorporate personalized customization based on different disciplinary backgrounds and specific needs to extend cultivation depth.

While current cultivation includes theoretical guidance on using digital technology to acquire, absorb, integrate, and create new knowledge, practical training and assessment evaluation are lacking, which affects overall goal achievement. Consequently, the library should explore enriching educational models in daily teaching to promote digital literacy enhancement through practice [8]. By designing corresponding practical training content, the library can cultivate students' ability to apply digital knowledge to solve real-world problems and flexibly utilize digital means to dynamically monitor and evaluate learning outcomes. Systematic improvement and optimization of the digital literacy cultivation framework will better equip students to meet various challenges in the digital era.

(3) Collaborative Height: Building Resource Sharing Platforms and Establishing Collaborative Education Mechanisms

In the digital knowledge age, digital capabilities are undeniably crucial for talent development. As academic institutions serving talent cultivation and scientific research, conducting targeted digital literacy education represents a key future development area for library user digital literacy research both domestically and internationally [9]. Increasingly, academic libraries attach great importance to digital literacy cultivation for undergraduate research and have accumulated rich learning resources and teaching achievements. However, close coordination among university libraries is still lacking, with redundant development of educational resources and unshared high-quality instructors, courses, and lectures.

To address this deficiency, academic libraries could jointly strengthen framework design and planning for digital literacy cultivation targeting undergraduate research capability enhancement, establishing extensive and in-depth collaborative sharing mechanisms. By pooling existing teaching resources and online public materials from various universities, and integrating relevant tools, resources, personnel, and processes, libraries can create digital media community spaces to effectively enable digital communication and cooperation, thereby building a new ecosystem for digital literacy resource sharing platforms [10]. Libraries could also collaboratively develop premium courses and deliver digital literacy train-

ing through online teaching, facilitating convenient learning for more students. Additionally, inter-library digital literacy competitions could be organized to stimulate learning interest and achieve “learning through competition.” In-depth investigation and learning from domestic and international peers could expand cultivation ideas, and joint exploration of pedagogical and academic issues in this field could feed research findings back into practice.

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Author 4, Xu Jing: Responsible for overall guidance on writing.

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

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