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Emergency Management of Online Teaching Platforms and Library Response Strategies: A Case Study of Xiamen University's SPOC Platform (Postprint)

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Abstract

[Purpose/Significance] This study summarizes the practice of Xiamen University Library's participation in managing online education platforms during the COVID-19 pandemic and explores development strategies for university libraries to promote teaching innovation in higher education institutions after the pandemic. [Method/Process] The research employs statistical analysis of annual course offerings, teacher and student numbers on the online education platform, user questionnaire surveys, analysis of the platform's strengths and weaknesses in course selection management, teaching platform functionality, teaching resources, teaching effectiveness, teaching models, and user satisfaction, as well as monitoring and analysis of server logs to achieve continuous performance improvement. [Results/Conclusion] The participation of university libraries in the management and service of online education platforms during the pandemic has facilitated the establishment of effective communication channels between librarians, teachers, and students, thereby expanding the library's service domains. While the pandemic represents a crisis, it also presents opportunities. University libraries should collaborate comprehensively with relevant university units to enhance capabilities in teaching informatization application, management, and service provision, thereby providing new momentum for advancing teaching innovation in higher education institutions.

Full Text

Emergency Management of Online Teaching Platforms and Library Response Strategies: A Case Study of Xiamen University's SPOC Platform

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Abstract:

[**Purpose/Significance**] This paper summarizes Xiamen University Library's experience in managing an online education platform during the COVID-19 pandemic and explores development strategies for university libraries to advance teaching innovation in the post-pandemic era. [**Method/Process**] The study conducted statistical analysis of annual course offerings, faculty, and student enrollments on the online education platform, administered user surveys to evaluate platform performance in course management, teaching functionality, resources, effectiveness, instructional modes, and satisfaction, and monitored server logs to enable continuous performance improvements. [**Result/Conclusion**] University library participation in online education platform management and services during the pandemic helped establish effective communication channels among librarians, faculty, and students while expanding the library's service scope. The crisis presented opportunities alongside challenges; university libraries should collaborate with relevant university units to enhance capabilities in educational information application, management, and service provision, thereby creating new momentum for advancing university teaching innovation.

Keywords: COVID-19; Moodle; SPOC; online teaching; service innovation

1. Introduction

The emergence and rise of MOOCs (Massive Open Online Courses) in 2012—dubbed “The Year of the MOOC” by *The New York Times*—sparked a global online education revolution. Chinese scholars, experts, and educators have conducted extensive and in-depth research on MOOCs and related technologies and applications, generating significant attention within library science and practice communities. A CNKI advanced search for CSSCI journal articles containing “library” and “online education” (or “online teaching” or “online courses”) yielded 2,914 publications, with 1,087 (37.3%) mentioning MOOCs. Notable studies include Qin Hong's exploration of five primary roles for libraries in the MOOC wave: copyright consultant, information literacy trainer, multimedia production instructor, learning space provider, and course content creator. Qin also iden-

tified challenges such as low completion rates, lack of interactive guidance, insufficient assessment methods, integrity assurance issues, curriculum standards and evaluation mechanisms, and sustainable business models. Gu Xiaoqing analyzed approaches to localizing MOOCs for the Chinese context, emphasizing the importance of technology platforms in this process. Kang Yeqin introduced SPOC (Small Private Online Course) practices at top institutions like Harvard and UC Berkeley, noting that SPOC's advantages lie in redefining the teacher's role, innovating teaching models, providing students with complete and in-depth learning experiences, and improving course completion rates.

SPOC was first proposed by Armando Fox in 2013 and can be translated as "Small Private Online Course." Zhu Zhiting rendered it as "私播课" (private broadcasting course). In contrast to MOOC's "massive" and "open" characteristics, SPOC emphasizes "small" scale and "private" restricted access, with typical enrollments ranging from several dozen to several hundred students who must meet specific requirements to participate. Domestic SPOC research has primarily focused on SPOC theory and models, online learning platforms, SPOC courses, and teaching practices, though few case studies have integrated SPOC concepts with technology platforms. Yang Li et al. introduced the Blackboard learning management system into information literacy instruction using the SPOC model and evaluated its effectiveness, finding improved student engagement and teacher-student interaction, though their study was limited in scale (60 students) and duration (one year). Li Hongxia and Zeng Yingrong argued that academic librarians could assume roles such as "teaching librarians" or "assistant librarians" in SPOC instruction. Luo Guofeng and Liu Na proposed a university library service model oriented toward SPOC teaching and conducted practical research based on Jiangsu University of Science and Technology's Fanya SPOC platform. Fu Xijin et al. surveyed 38 world-class universities and recommended that Chinese university libraries take curriculum services as a precursor to subject services while strengthening the substantive construction of course services. Yu Defeng analyzed the implementation content and methods of course services in American university libraries. Yao Yuan et al. introduced the content, methods, and operational models of embedded course services at Chongqing University Library. Overall, domestic research on university library course services has been limited to surveys of Western practices, with few case studies based on online teaching practice.

By March 2020, China's online education user base had reached 423 million, representing 46.8% of all internet users and marking a 110.2% increase since the end of 2018. In early 2020, the COVID-19 pandemic forced the postponement of the spring semester nationwide, shifting instruction for 265 million students from offline to online. Chinese universities responded to the Ministry of Education's call for "suspended classes but continued teaching and learning" by organizing the largest-scale online teaching activity in history. This unprecedented shift will usher in a new phase of explosive growth in both theoretical research and practical applications of online education.

Facing the pandemic in early 2020, university libraries leveraged their existing platforms—such as Tsinghua University’s teaching reference service platform, Shanghai Jiao Tong University Library’s “Smart Ubiquitous Classroom,” Peking University Library’s electronic teaching reference platform, and University of Electronic Science and Technology Library’s online course resources platform—to quickly provide electronic teaching references and other services, ensuring the smooth implementation of online teaching and enhancing the library’s influence and recognition within their institutions. Xiamen University Library, leveraging its technical expertise, collaborated with the Graduate School and Information & Network Center to upgrade and optimize the university’s network teaching platform, which had been maintained for years using the open-source software Moodle. This upgraded platform served as the university’s SPOC platform for graduate students, providing comprehensive course services and technical support that effectively underpinned the smooth implementation of online teaching and received positive feedback from faculty and students. This paper reviews the library’s experience in building and maintaining the online teaching platform, combines it with lessons learned from pandemic-era management and services, and proposes strategies for libraries in the post-pandemic era when online teaching has become normalized, offering insights for peer institutions.

2. Building and Maintaining a Moodle-Based Online Teaching Platform

2.1 Introduction to the Open-Source Learning Management System

Moodle Foreign university libraries began paying attention to Learning Management Systems (LMS) in the mid-1990s. Institutions such as the University of Pennsylvania and Duke University utilized Blackboard to provide convenient online access to course materials, while four University of California campuses used Blackboard and WebCT for information literacy education. Chicago’s Columbia College Library developed a small plugin to facilitate embedding library resources and services into the Moodle platform.

In recent years, Chinese university libraries have actively embedded services into LMS platforms. Shanghai Normal University Library used Moodle to build a reader training platform; South China Normal University Library offered information literacy education and information retrieval courses; Hong Kong Baptist University Library developed a toolkit embedded in the school’s Moodle platform to provide one-stop access to resources, information literacy education, and subject librarians; and Xi’an Jiaotong-Liverpool University Library seamlessly integrated database resources into the platform through plugins. However, overall, Chinese university network teaching platform construction lags behind foreign counterparts, with relatively low adoption rates.

Moodle is an LMS and e-Learning platform developed based on constructivist learning theory, aiming to provide educators, administrators, and learners with

a powerful, secure, and integrated system for creating personalized learning environments. Moodle has several distinctive features. First, its open-source code, simple installation and maintenance, active user community, and rich extension plugins allow users to modify it to meet teaching needs. Second, its modular design enables teachers to organize teaching activities like building blocks, flexibly selecting from more than a dozen built-in classroom activity types and learning resource modules according to course requirements. Third, Moodle is based on advanced educational concepts that emphasize teacher-student interaction—its design reflects constructivist pedagogy throughout, focusing on the learner and promoting communication between teachers and students and among students themselves through forums, RSS, Wiki, Blog, and other modules. Fourth, Moodle supports a diversified evaluation system through assignments, feedback, interactive evaluation, voting, and other methods that enable comprehensive assessment of the learning process, including self-evaluation, peer evaluation, and instructor evaluation.

Like other globally popular platforms such as Blackboard and Canvas, Moodle has been widely adopted worldwide. As of March 2020, 98,000 active registered sites in 231 countries used this system platform, with a total of 183 million users. Moodle has become the primary learning management system outside the United States.

2.2 Construction and Maintenance of Xiamen University’s Moodle Platform In 2006, Professor Fan Yihong of Xiamen University’s Institute of Education encountered Moodle while teaching a course on “Globalization and International Education” and requested library assistance with installation. After testing, library technical staff installed Moodle version 1.9 on a server using the domain name learn.xmulib.org, naming the site “Xiamen University Moodle Network Teaching Platform.” Subsequently, Professor Fan and several other young faculty members from the Institute of Education began offering courses on the platform, joined by two instructors from the School of Journalism and Communication. In the following years, additional teachers learned about the platform and began using it, though numbers remained small. In 2013, the platform merged with the platform used by the university’s Information & Network Center for instructors to store course materials, integrating into a single platform with a simplified domain name l.xmu.edu.cn using Moodle version 2.5.2, jointly maintained by the library and the Information & Network Center.

As shown in Table 1, usage of Xiamen University’s main campus Moodle platform increased dramatically: compared with 2013, the number of courses in 2020 grew nearly ninefold, faculty numbers increased twelvefold, and student enrollments grew sixfold.

Xiamen University Malaysia Campus officially began operations in February 2016, and the library simultaneously built a Moodle platform with the domain name l.xmu.edu.my. Due to the campus’s smaller initial scale and requirements

from the branch campus's academic affairs office, the system deployment, training, and promotion did not carry the same historical burden as the main campus. Consequently, the Moodle platform achieved broader coverage and greater dependency across all courses at the Malaysia campus compared to the main campus. As shown in Table 2, usage at the Malaysia campus also grew substantially: compared with 2016, the number of courses in 2020 increased more than threefold, while faculty and student numbers grew nearly fourfold.

Beyond platform construction, Xiamen University Library actively participated in platform maintenance and promotion, conducting regular technical upgrades, researching and promoting various platform functions to faculty, providing training across schools, responding promptly to phone and email inquiries, assigning course librarians to provide teaching reference resources, and delivering information literacy education through the platform.

3. Emergency Response and Services During the Pandemic

Since the outbreak of COVID-19, Xiamen University established the overarching goal of “No delay in learning, guaranteed quality” and the requirement that “Every course is implemented, no student is left behind.” The Graduate School mandated that all graduate courses commence online instruction on February 17, 2020. On February 7, 2020, Xiamen University Library and the Information & Network Center received the task to upgrade the university's Moodle network teaching platform both in software and hardware. Graduate advisors were required to post teaching materials—including syllabi, courseware, assignments, reference books and literature, and remote learning assessment requirements—on the platform. By February 16, 2020, all schools had completed comprehensive inspections of each course's platform construction, teaching methods, teaching material uploads, and online teaching preparedness. By February 19, 2020, the platform had 35,809 users, with 912 instructors having created 1,011 courses and a total of 29,726 course enrollments.

3.1 Platform Renaming and Upgrading Previously, the Moodle network teaching platform's name merely highlighted its technical background without precise positioning its usage. With the Graduate School's requirements and university leadership's attention, the platform's nature changed from an unofficial platform serving select schools to one serving all graduate faculty and students across the university. The SPOC concept aligned perfectly with the positioning and requirements of graduate education, prompting a rebranding to “Xiamen University SPOC Platform.”

Serving over 1,000 specialized courses for all graduate faculty and students meant that increased concurrent processes would substantially consume server memory and other resources, making the original single-server platform unable to withstand the load. The primary challenge was therefore a complete plat-

form upgrade. The final upgrade solution involved distributed server deployment comprising one load balancer server, ten web servers, one database server, three cache servers, and one NFS server. Software-wise, the system used Ubuntu 18.04 LTS as the operating system, MySQL for the database, Apache for web servers, and Nginx for the load balancer, plus ten Mediasite transcoding servers. The Moodle version was upgraded to 3.7.4. Network bandwidth was increased, and CDN servers were deployed (see system architecture in Figure 1 [Figure 1: see original paper]).

Faced with so many servers, conventional manual deployment would be error-prone. Technical staff adopted automated deployment to ensure rapid and reliable implementation while facilitating future upgrades and code sharing and auditing. Moodle's versioning of static resources was well-implemented, so an Nginx server was deployed at the front end to intercept and cache static resources, significantly reducing pressure on backend web servers. Moodle's caching mechanism was also robust, including application-level, session-level, and request-level caching; three Redis servers were used for application-level and session-level caching and session synchronization, while request-level caching directly utilized web server memory. Moodle's detailed logs captured all user actions on the platform, including logins, accessed addresses, and downloaded content, providing valuable data for big data analysis in conjunction with final grades.

After ten days of round-the-clock work, all implementation plans were completed on schedule before the official start of online teaching on February 17, 2020. On the first day of the new semester's online instruction, 5,596 faculty and students logged into the SPOC platform, with a peak of 413 concurrent users, 1.868 million total web requests, 146 concurrent video viewers on the Mediasite streaming platform, and 1,084 GB of total CDN traffic distribution. Overall service ran smoothly, providing a positive user experience.

3.2 Platform Training For most graduate advisors, online teaching presented a completely new challenge. Faculty generally struggled with unfamiliarity with online instruction, unskilled operation of the course platform, and inability to produce audio-visual courseware. To address these challenges, the library formed an SPOC platform service promotion team composed primarily of librarians from the Information Technology Department with strong information technology application skills and learning abilities. After brief training, team members quickly mastered basic platform functions through self-directed learning and hands-on practice. Working collaboratively, they compiled user manuals for various platform function modules, creating documentation with text, screenshots, and animated GIFs. The first version of the operation manual was released promptly, along with recorded video tutorials to help faculty learn while using the platform.

The service promotion team also proactively joined QQ and WeChat support groups for graduate advisors to answer platform usage questions, guide instructors through course creation for the new semester, and assist with publishing

teaching materials. During this process, team members continuously compiled frequently asked questions from faculty into an online FAQ, enabling self-service problem resolution and improving team efficiency. As faculty became familiar with the platform, they requested new functionalities, prompting the team to update and improve the operation manual, releasing a third version by February 24, 2020.

To help faculty more efficiently master basic platform functions and operations, the library also experimented with live online training through screen sharing, allowing instructors to practice simultaneously and resolve questions through real-time interaction. Over 130 faculty members participated in these online training sessions, which proved highly effective.

3.3 Platform Usage Statistics and User Feedback To better serve as a bridge between faculty and students, Xiamen University Student Union and Graduate Student Union launched a series of “Xiamen University Online Teaching Survey” questionnaires on the first day of online instruction. The survey covered course management, teaching platforms, teaching resources, teaching effectiveness, instructional modes, and satisfaction levels, collecting 7,374 valid responses (5,514 from undergraduates and 1,860 from graduate students). Based on data analysis, the *Xiamen University Online Course Survey Report* was published. According to the report, 2,957 students rated the SPOC platform, giving it an average score of 3.82 out of 5, with 66.67% expressing satisfaction or high satisfaction and 8.01% expressing dissatisfaction or high dissatisfaction. Overall, the SPOC platform received positive recognition from students.

The main issues reported included instability, crashes, and flashbacks when viewing audio-visual courseware, with viewing history not being saved after reloading. Additionally, real-time interaction effects were relatively poor when using the SPOC platform. Some students, using the SPOC platform for the first time without carefully reading the user manual, found the platform’s functions and operations unfamiliar, affecting their learning effectiveness. The library continuously improved these issues to enhance the teaching and learning experience.

4. Library Strategies for Responding to Online Education Development

Xiamen University Library has long been attentive to university teaching reform and development, beginning exploratory practice in network teaching platform construction early on, which laid a solid foundation for responding to this sudden crisis. Through collaborative efforts with the Graduate School and Information & Network Center, the library ensured the smooth and orderly launch of graduate online teaching for the new semester. By participating in the construction and service support of Xiamen University’s SPOC platform, librarians

established effective communication channels with faculty and students, providing teaching platform technical support and literature resource guarantees that expanded the library's service scope.

While online teaching demonstrated advantages during the pandemic, such large-scale practice also exposed issues, including the need to improve faculty online teaching capabilities, strengthen student information literacy, address insufficient online teaching platform functionality, and disconnections with existing teaching reference systems. The *Xiamen University Online Course Survey Report* also identified problems such as lack of textbooks and difficulties locating library electronic resources. Additionally, we recognized that large-scale online teaching placed higher demands on librarians' service capabilities. Post-pandemic, online education will become an important mode of instruction in higher education institutions. Facing this new normal, libraries should focus on the following areas:

4.1 Enhancing Librarian Professional Competencies and Developing “Course Librarians” to Provide Quality Course Services Since 2015, Xiamen University Library has established a “course librarian” technical role in the Moodle platform, effectively assigning a library assistant to each instructor. Course librarians' primary responsibility is to acquire and upload teaching resources (books, journal articles, newspapers, videos, etc.) requested by faculty through various channels, including library collections, for use in courses. During this process, we paid special attention to intellectual property protection: for library-scanned documents, we uploaded them by chapter to the platform with copyright notices, reminding faculty and students to protect copyright during use.

The library's service transformation in the digital environment depends on enhancing librarians' professional competencies. Librarians must fulfill the new role of “course librarians” on online teaching platforms, becoming not just resource providers but course assistants who help faculty deliver information literacy education, respond to student subject inquiries in discussion forums, and interpret academic integrity standards. In online teaching, this new librarian role increases the library's integration with courses and enables more in-depth information services. Course librarians represent an extension and development of subject librarians; course service-based library services constitute natural “embedded” services and important support for teaching, providing direction for exploring innovative library services amid teaching model reforms.

4.2 Student-Centered Information Literacy Education to Improve Online Teaching Quality University libraries serve as information resource guarantee centers for university teaching, as well as important bases for students' self-directed learning and information literacy education. Facing the new situation of pandemic-era online education, Xiamen University Library offered a series of information literacy lectures and an elective course on “Information Lit-

eracy and Online Literature Retrieval” through the SPOC platform, established discussion forums to facilitate communication with students, and launched a live-streaming course project through its established information literacy education brand “i-Learning Academy.” Course design focused on students’ core needs: general courses covered searching electronic literature resources and literature acquisition for research topic selection and writing; customized courses addressed the practical needs of graduate thesis writing and literature management.

Traditional offline teaching is teacher-centered, with students’ learning constrained by physical conditions. To some extent, online teaching disrupts this pattern, enabling student-centered teaching by allowing learning anytime and anywhere. In practice, student-centered online teaching should focus on cultivating students’ self-directed learning awareness and enhancing their information literacy, which will effectively improve online teaching quality, expand new content and forms of knowledge services, and promote the transformation and upgrading of library information literacy education.

4.3 Participating in Teaching Platform Management to Provide Technical Support for Online Teaching Currently, Chinese university libraries primarily embed into network teaching platforms by building their own teaching reference systems. Some of these systems connect with university network teaching platforms for convenient resource access, while others remain disconnected, requiring faculty and students to log into the teaching reference system separately to obtain resources—creating a wall between the library and its users. As the university’s literature and information resource center, the library should not only guarantee literature resources (particularly electronic resources) for online teaching but also provide technical support by attempting to embed into network teaching platforms. Starting from faculty teaching needs and student learning needs, libraries should integrate resources (including library-purchased e-books, digitized print books, journal articles, audio-visual materials, and interlibrary loan resources) directly into courses.

Practice has proven that using open-source software to build network teaching platforms for universities is a forward-looking, proactive choice that facilitates convenient embedding of library resources and services. In such autonomous network teaching platforms, collaboration between the library and university teaching management departments becomes more seamless. In the long term, Chinese university libraries should accelerate migration from library automation systems to new-generation library service platforms to integrate print and electronic resources, particularly achieving full lifecycle management of electronic resources and fine-grained management of various knowledge elements to ensure the library’s knowledge services in future open science environments.

China Education Modernization 2035 proposes the strategic task of “building intelligent campuses and constructing integrated intelligent teaching, management, and service platforms.” Faced with the severe and complex situation

caused by the pandemic, universities have used information technology to innovate teaching methods and models, conducting large-scale online teaching practice that provides a foundation for deepening teaching reform in the future. As the literature resource guarantee center for university teaching and research, libraries should timely transform their thinking in this new environment, integrate into university teaching reform and development, leverage resource advantages, and demonstrate library value. Post-pandemic, university libraries should continue to deepen teaching service reform, cooperate fully with relevant university units, enhance capabilities in educational information application, management, and service provision, and create new momentum for promoting teaching innovation.

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Author Contributions

Ma Luwei: Conceived the article framework and provided main content;

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Zheng Haishan, Xiao Zheng, Xiao Dehong: Provided technical insights and revision suggestions;

Huang Guofan: Organized text and finalized the manuscript.

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

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