University Library Learning Support Services Activity System and Its Model Construction Postprint

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Date: 2023-07-26T00:00:00+00:00

Abstract

[Purpose/Significance] Summarize the activity system of university library learning support services and construct a model to better understand the overall structure and operational mechanism of university library learning support services. [Method/Process] Based on practical investigation and main functions, summarize the basic forms and supporting conditions of university library learning support services. Taking activity as the basic unit, analyze the operational mechanism of learning support service activities, and subsequently attempt to construct a model for university library learning support service activities. [Result/Conclusion] Resource service form and quality cultivation form are the basic forms of university library learning support services, while space, technology, and personnel are the three supporting conditions that should be integrated with the basic forms. Various combinations of the two basic forms and the three supporting conditions constitute the activity system of university library learning support services, requiring deep integration based on activity design and organization. A double helix model for university library learning support service activities is constructed, which in terms of mechanism exhibits characteristics such as subjective activity-driven, nonlinear logical progression, collaborative support services, and symbiotic integrated development.

Full Text

Preamble

Volume 63, Issue 22 | November 2019

The System and Modeling of Learning Support Services in Academic Libraries

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Abstract

[**Purpose/Significance**] This paper summarizes the activity system of learning support services in academic libraries and constructs a model to better understand the overall structure and operational mechanism of these services. [**Method/Process**] Based on practical investigation and analysis of core functions, the basic forms and supporting conditions of learning support services in academic libraries were identified. Using activity as the fundamental unit, the operational mechanism of learning support service activities was analyzed, and a model for academic library learning support services was constructed. [**Result/Conclusion**] Resource service and quality cultivation constitute the two basic forms of learning support services, while space, technology, and personnel serve as the three supporting conditions that should be integrated with the basic forms. Various combinations of these two basic forms and three supporting conditions constitute the activity system of learning support services in academic libraries, requiring deep integration through activity design and organization. A double-helix model for academic library learning support service activities was constructed, which exhibits characteristics including subjectivity-driven activities, non-linear logical progression, synergistic support services, and symbiotic integrated development in its mechanism.

Keywords: academic libraries; learning support services; basic forms; supporting conditions; double-helix model

DOI: 10.13266/j.issn.0252-3116.2019.22.008

Introduction

Learning support services in academic libraries aim to promote student growth and development. Based on their own advantages and distinctive features, libraries integrate various material, social, and psychological elements—including resources, tools, scaffolding, cognition, emotion, and strategies—to provide supportive assistance for students' learning behaviors, activities, and processes [1]. Currently, research in library and information science abroad primarily focuses on specific practices, cases, and particular topics related to learning support services, such as the relationship between space and learning [2-4], evaluation of service effectiveness, and learning analytics based on artificial intelligence and big data [5-6]. Few studies treat "learning support services" as a holistic concept or theoretical framework. In contrast, domestic library and information science research in recent years has examined learning support services as an integrated concept, including investigations and introductions to specific conditions and successful experiences in American and other countries' academic libraries [7-9], theoretical discussions or case sharing of domestic learning support services [10-11], and studies on the impact and effectiveness evaluation of learning support services on student learning and success [12-13].

Overall, however, there remains a scarcity of research at the meso-level on the holistic structure of learning support services in academic libraries, particu-

larly regarding theoretical attention to their system composition and functional mechanisms. The specific forms of learning support services are rich and varied, with distinctive features depending on institutional contexts. The composition of activity systems and operational mechanisms constitute fundamental issues in learning support services. As the ancient Chinese proverb states, "When the main rope is held, the net opens; when the root is grasped, the branches follow"—thus necessitating greater attention and research. This paper explores the construction and operational mechanism of the activity system for learning support services in academic libraries and constructs a relevant model to achieve a more comprehensive, in-depth, and intuitive understanding.

1. Analysis of the Learning Support Service Activity System

1.1 Investigation-Based Analysis

To gain a more comprehensive understanding of the current state of learning support services in academic libraries both domestically and internationally, the author visited the websites of the top 10 universities in the QS 2018 comprehensive rankings and 10 university libraries affiliated with CALIS national and regional documentation centers. The learning support service projects offered by these libraries were systematically documented. It should be noted that: (1) only the main libraries were included, excluding departmental branch libraries; (2) only libraries with course guide sections were counted, excluding subject guides or cases with only individual course guides; and (3) due to the limitations of web-based investigation, some omissions or incomplete information were inevitable, which were supplemented with literature research during analysis.

For brevity, the findings are presented in simplified tables (see and). The web-based investigation revealed that, in addition to basic information resource retrieval and access services, four common types of services supporting student learning were provided by the 20 domestic and international university libraries: course reserve services, information literacy education, learning spaces, and cultural activities. Course guides were particularly common in foreign academic libraries, especially in American institutions.

1.2 Analysis of Basic Forms

Form refers to the structure or mode of expression of intrinsic elements, with content and form being closely linked and mutually constraining. The same content can adopt multiple forms, and the same form can reflect different content. From the perspectives of content and purpose, the relevant forms of learning support services can be further summarized as follows:

(1) **Course reserve services and course guides** are primarily resource-related services. Like conventional library information services, they are based on libraries' rich, organized information resources, aiming to pro-

vide users with needed information resources. The concept and scope of information resources in contemporary academic libraries have evolved and expanded, forming a diversified resource system with multiple carriers and formats. While facilitating user retrieval and utilization, libraries can further optimize information selection and conduct deep-level processing and combination to provide or recommend various secondary and tertiary documents, specialized course reserve services, course resource navigation, or disciplinary information portals. This service form, which uses rich, organized information resources as content to provide users with needed resources, can be summarized as a basic form of learning support services in academic libraries (referred to as the "resource service form").

(2) **Information literacy education** primarily focuses on designing relevant training or instruction around the cultivation of users' information awareness, information skills, information ethics, and critical thinking abilities. The main purpose is to enhance users' information literacy. The Association of College and Research Libraries (ACRL) issued the *Information Literacy Competency Standards for Higher Education* (hereinafter "old Standards") in January 2000 and the *Framework for Information Literacy for Higher Education* (hereinafter "new Framework") in March 2015. The new Framework proposes integrating information literacy with other academic and social learning objectives, extending the scope of student learning, and emphasizing dynamism, flexibility, individual growth, and group learning [14]. Current practices in information literacy education at the 20 domestic and international university libraries remain predominantly skills-oriented, as reflected in their curriculum design and training content, including standalone courses (online and offline), embedded disciplinary courses, and lectures/training (general or customized), with content focusing primarily on resource promotion and skills training. This service form, which uses information literacy training, course instruction, and practical operations as content to improve information literacy, can be summarized as another basic form of learning support services (referred to as the "quality cultivation form").

The *Regulations on Academic Libraries in Regular Institutions of Higher Education* states that "the main functions of libraries are educational and information service functions." These functions are determined by libraries' social nature and status, indicating what they should do, while their capabilities emphasize what roles they can play based on their elements and structure. Libraries can have many capabilities, but their functions result from social recognition and selection. As teaching support institutions and research support units in universities, libraries must serve the central task of talent cultivation and support the realization of this core mission. Yale University Librarian Bennett proposed that "to make learning happen in libraries, we need to first understand the learning process and how learning occurs; librarians should be more like educators. Supporting students and faculty, supporting learning and scholarship is the library's mission" [15]. Mathews argued that libraries should consider more core

questions about how they support learners and help individuals in institutions become more successful [16]. Information resource services and information literacy cultivation not only highlight the distinctive advantages of academic libraries but also centrally reflect their main functions. Therefore, they can be identified as the basic forms of learning support services in academic libraries.

These basic forms are the constituent elements of learning support services and can function independently or jointly. Library learning support service activities often incorporate both basic forms. For example, exploratory information resource searching differs from general information queries in that the search process is exploratory and iterative. Users not only interact with information but also need to integrate obtained information with their own knowledge structures, ultimately acquiring needed resources while enhancing relevant cognition including information literacy. Similarly, information literacy education embedded in professional courses or academic research processes provides more vivid, concrete, and comprehensive contexts, improving the relevance and effectiveness of information services and forming user partnerships [17], while also deepening students' understanding of concepts and issues and fostering critical information literacy cultivation. Furthermore, diversified cultural service activities are essentially related to information resource services or information literacy education, often containing both forms simultaneously. For instance, classic book reading lectures not only introduce specific collection classics and recommend related resources but also enhance students' abilities in text comprehension, analysis, selection, summarization, reasoning, judgment, and evaluation, comprehensively demonstrating both basic forms.

1.3 Analysis of Supporting Conditions

Space, technology, or personnel in libraries can often provide certain services independently, such as offering reading and study rooms, software support or equipment rental, or professional consultation and learning assistance. However, if these services are not combined with information resource services or information literacy education, they fail to reflect libraries' distinctive advantages and only realize certain functions rather than fulfilling main functions. Therefore, space, technology, and personnel should be regarded as supporting conditions for learning support services, leveraging their value through basic forms and permeating all aspects of library services throughout the learning support process.

1.3.1 Space Although learning spaces are an emerging and common service content in academic libraries both domestically and internationally, merely providing space cannot reflect libraries' distinctive advantages. Only when serving as information commons or learning commons and carrying specific content such as information resource services, information literacy education, or cultural activity organization do they become characteristic learning support services; otherwise, they are essentially no different from ordinary classrooms or seminar

rooms. From the perspective of learning sciences, a learning environment refers to the combination of conditions that support learners' knowledge construction and dynamic learning activities, including both material conditions (e.g., information resources, cognitive tools) and non-material conditions (e.g., situational tasks, interactive relationships, scaffolding strategies). Learning commons are not directly equivalent to learning environments—they are place-based concepts that can integrate various resources and provide exchange platforms, primarily referring to material conditions that facilitate the creation of meaningful learning environments. Therefore, space is one of the supporting conditions for the smooth implementation of learning support services.

1.3.2 Technology Technology has transformed the boundaries of traditional libraries, not only providing material conditions for learning culture innovation but also enabling the realization of innovative learning concepts and methods. Technology application makes it more possible for spaces to become meaningful learning environments, supporting basic forms to better serve learners' activities. Technology includes both materialized technologies (tools, equipment) and intellectual technologies (strategies, techniques, methods). "When technology serves as a learning tool (when learners learn with technology or learn with and about technology), the nature of learning fundamentally changes" [18]. Technology helps introduce authentic tasks and problems into spaces to create authentic contexts, search for desired information resources more quickly and accurately, facilitate anytime-anywhere communication and collaborative learning, and promote dialogue and reflection through cognitive tools, becoming intelligent learning partners that foster meaningful learning and higher-order thinking skills. Technology is integrated into all aspects of learning support services and constitutes one of its supporting conditions.

1.3.3 Personnel In learning environments, different subjects need to provide appropriate scaffolding for learners to help them successfully traverse the "zone of proximal development" and achieve knowledge construction. Scaffolding providers can be professional teachers, librarians, senior students, or other more experienced learners. Learning scaffolding not only provides timely intellectual support but also enables students to understand the thinking processes of more experienced providers, promoting their comprehension and understanding and helping them achieve higher-level understanding [1]. Librarians play multiple roles in the learning support service system, including upgraded traditional roles (e.g., consultation navigators, resource architects) and new role definitions (e.g., learning engineers [19], community coordinators who transform communities into knowledge creation venues). Intellectual support from personnel can be provided directly (e.g., consultation, training) or indirectly (e.g., through retrieval system guides, specialized information portals), making it another supporting condition for learning support services.

Of course, the implementation of learning support services in academic libraries also requires organizational, policy, and financial support and guarantees. How-

ever, these cannot independently constitute a support service and are therefore not listed as supporting conditions.

1.4 Analysis of Activity Mechanisms

Activity theory, also known as cultural-historical activity theory, emphasizes that the basic mode of activity involves a subject transforming an object through mediating tools to satisfy the subject's needs [20]. These mediating tools are artificial products—including tools, symbols, methods, and organizations—that embody collective human wisdom and carry certain cultural-historical characteristics. Activity theory posits that analyzing behavior must consider its most fundamental context, be goal-oriented, and combine situational and behavioral factors with internal and external activities as the basic unit of analysis. "Activity is the most basic meaningful context for understanding individual behavior" [21]. The use value of information services often exists in the form of "activities" [22], where "information service activities include the production of information service products and the alignment of service behaviors" [23]. Therefore, using activity as the basic unit of analysis makes it easier to understand relevant needs and information behaviors from specific contexts, thereby better achieving service goals.

Learning support services typically manifest as a series of behaviors and operations—namely, activities. These activities create student-centered learning environments where students participate as subjects, promoting meaningful learning within certain contexts. Learning support service activities are characterized by their complexity, integrating multiple elements, creating multi-dimensional contexts, providing diverse forms of support, generating multi-level interactions, and producing diversified learning outcomes through participants' engagement. To better understand the mechanisms of learning support services in academic libraries, the author previously proposed an analytical framework comprising three constituent elements (resources [including information resources and tools], context, and scaffolding) and three interactive mechanisms (individual, individual-material, and individual-group levels), with support methods including timely resource provision, timely scaffolding, and dynamic community formation [1]. This framework facilitates clearer understanding of the operational mechanisms of library learning support service activities.

1.4.1 Single Basic Form Support Mechanism

(1) **Resource service form-dominated activities** focus on resource delivery, with the advantage of broad coverage and large service capacity, providing foundational literature and information guarantees for extensive user populations. Libraries primarily passively wait for users to search for and acquire needed information resources based on their own contexts or tasks. Limited by difficulties in identifying contextual problems and constrained by their own knowledge accumulation and professional exper-

tise, libraries often struggle to provide timely scaffolding support. In this process, learners mainly interact with material elements such as information resources and tools, with minimal dynamic, real-time interaction with other learners or librarians, making genuine learning communities difficult to form. Information acquisition does not equate to knowledge construction; library services remain limited to information transfer without intervening in learners' processes, representing superficial support.

(2) **Quality cultivation form-dominated activities** based on the old Standards are relatively mature, emphasizing skills training and focusing on abilities to find, select, understand, acquire, and evaluate information. For individual learners, this education is neither continuous nor consistently interactive and supportive, affecting cultivation effectiveness. The new Framework emphasizes organic integration of information literacy with academic research activities, threading information generation, dissemination, analysis, and processing mechanisms throughout the research process to cultivate both information awareness and skills as well as critical thinking and innovative spirit. However, successful cases of deep implementation remain rare.

1.4.2 Synergistic Effect of Two Basic Forms Meaningful learning support service activities often require comprehensive support and compound services that adapt to different content needs and dynamically respond to process-based changes. Ecological psychology's theory of "affordance-effectivity" helps further understand the relationship between the two basic forms. Affordance, proposed by ecological psychologist J.J. Gibson, refers to properties of learning environment entities that support specific types of perception and behavioral possibilities for learners, providing options for choice. How much affordance learners perceive is closely related to their own effectivity, which includes five subcapabilities: information perception, interaction, self-planning, self-monitoring, and self-efficacy [25], responsible for perceiving affordances and taking corresponding actions. Matching and balancing these two aspects creates a more ecological learning environment.

From a static perspective, libraries can create diverse cognitive affordances based on information resources—the higher learners' effectivity levels (particularly information literacy), the better they perceive, select, and utilize resource affordances, while rich information resources and diverse retrieval systems provide vivid "practice fields" for information literacy cultivation. From a dynamic perspective, as activities progress, learners' dynamic needs for information resources drive deeper exploratory searches, continuously acquiring more resources while deepening understanding and enhancing effectivity. This improved capacity increases affordance recognition, enabling more effective resource utilization. Simultaneously, libraries can organize and reveal information resources more deeply based on learners' evolving effectivity levels, providing more targeted cognitive affordances to meet increasingly sophisticated resource needs. Therefore,

the resource service form (emphasizing "giving fish") and the quality cultivation form (emphasizing "teaching fishing") can dynamically interact, mutually promote, and achieve synergistic effects.

1.4.3 Deep Integration Through Activity Organization The above analysis indicates that enhancing the core competitiveness of library learning support services, constructing the activity system, and improving service effectiveness require deep integration of the two basic forms (resource service and quality cultivation) with the three supporting conditions (space, technology, personnel), making activity design and organization crucial. Learning support services exist both within current activities and through potential activity combinations, with rich and diverse content requiring enhancement through deliberate design and organization.

Designing learning support service activities must consider multiple elements including subjects, context (tasks or problems), resources, and scaffolding—not simply an information transfer process, but creating a learning support service activity system through organic integration of the two basic forms and three supporting conditions to establish authentic learning environments that facilitate genuine learning and achieve goals. This requires designing authentic learning contexts with certain complexity, introducing rich and organized learning resources and tools, strengthening the aggregation, organization, and utilization of generative resources, promoting flexible and diverse exchanges and interactions, providing timely scaffolding support, and enhancing information literacy cultivation integrated into all stages. Simultaneously, libraries should play the role of "coordinator," encouraging various levels of participation, attending to shared pursuits and values, and gradually forming communities of practice through collaborative knowledge creation.

2. Construction of the Learning Support Service Activity Model

Based on the above research and analysis, the two basic forms and three supporting conditions can be combined into various learning support service activities, forming the activity system of learning support services in academic libraries. With support from the three conditions, the two basic forms can independently support student learning while also complementing each other and achieving synergistic effects, collectively constructing the academic library learning environment and promoting meaningful learning for more students. Therefore, this paper proposes a double-helix model for academic library learning support service activities to better understand the system and its functions (see [Figure 1: see original paper]).

2.1 Structure of the Double-Helix Model

The DNA double-helix structure discovered by Watson and Crick in 1953, commonly applied in bioengineering, is a fundamental unit in biological structures consisting of two strands and bonds that, through mutual integration, generate tremendous biochemical reactions [26]. Similarly, the learning support service activity system in academic libraries exhibits a comparable double-helix structure, with two outer strands: one being the resource service chain and the other the quality cultivation chain. These two strands can function independently while also dynamically interacting, intertwining, and synergistically coupling to form a double-helix-like structure. Activity design and organization function like the "bonds" in the double helix, crucial for promoting the effective functioning of the two basic forms and ultimately facilitating meaningful learning and higher-order thinking skills. Space, technology, and personnel constitute the supporting conditions for the double-helix operation, integrating with the basic forms and permeating all aspects of support services.

2.2 Characteristics of the Double-Helix Model

2.2.1 Subjectivity-Driven Activities Activities serve as both the basic unit of analysis and the focus of system advancement. Library learning support service activities create student-centered learning environments where students, as subjects, can integrate and coordinate various material, social, and psychological elements including resources, tools, space, technology, scaffolding, cognition, emotion, and strategies. Academic libraries should strengthen conscious activity design, centering on talent cultivation goals and institutional realities to create authentic contexts, preset rich resources, and integrate multiple conditions including space, technology, and personnel. Through learners' active participation, libraries can drive sustained and in-depth activity development, enabling coordinated resource service and quality cultivation forms, promoting multi-level and multi-angle exchanges, coordinating progressive stages, organically connecting elements, and facilitating dynamic interactions among subjects, thereby achieving better learning outcomes with improved design and reduced input.

2.2.2 Non-Linear Spiral Progression Cognitive development is non-linear rather than linear. "Human cognition is not a straight line (that is, it does not proceed along a straight line), but infinitely approximates a series of circles, a curve similar to a spiral" [27]. Promoting meaningful learning and cognitive development involves achieving a spiral upward state of cognition. When encountering problems or confusion, learners may return to previous stages for improvement—not a complete restart but a revisiting with new questions and reflections, demonstrating higher-level cognition accompanied by higher-level evolution. This non-linear spiral progression appears both in activities dominated by a single basic form and in the synergistic interaction between the two forms.

2.2.3 Synergistic Support Services The resource service and quality cultivation forms are relatively independent with distinct emphases while also mutually promoting and synergistically enhancing each other, constituting the "double helix" of academic library learning support service activities. By designing and organizing learning activities based on authentic contexts or complex tasks and fully utilizing supporting conditions (space, technology, personnel), libraries can promote organic linking, integrated interaction, and complementary advantages between the two forms, achieving a multiplier effect of "1+1>2" that stimulates stronger learning motivation and better support outcomes.

2.2.4 Symbiotic Integrated Development Learning support service environments shape learners, while learners dynamically transform the environment through their growth and development, becoming organic components of the environment and generating new resources through knowledge externalization, forming a symbiotic relationship. Simultaneously, "through interaction with learning content and communities, learners form knowledge networks and social networks, and the superposition of multi-dimensional interactive behaviors of 'people-knowledge-people' and 'knowledge-people-knowledge' facilitates the formation of social knowledge networks" [28]. Through knowledge links connecting to human links, social networks based on knowledge networks are formed, driving different learners to explore common topics, generating broader and deeper social interactions, promoting the 共同成长 of multiple subjects, and achieving spiral expansion of both knowledge and social networks. Through conscious design, active context and task creation, and platform building for interaction, libraries enable learners to gradually clarify shared enterprises through mutual participation, enhancing belonging and cohesion through joint improvement of information and professional literacy, and supporting the formation of more learning communities through symbiotic learning support service activity systems.

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The System and Modeling of Learning Support Services in Academic Libraries

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Abstract: [Purpose/significance] This paper outlines the system of learning support services in academic libraries and builds a model accordingly, as an effort to better understand the overall structure and operation mechanism of learning support services provided by academic libraries. [Method/process] It summarized the basic forms and supporting elements of learning support services of academic libraries based on research and main functions. Meanwhile, it tried to build a model for learning support services of academic libraries by analyzing the operation mechanism of learning support services with activity as the basic unit. [Result/conclusion] Space, technology and personnel are the 3 supporting elements of learning support services, which should be aligned with the basic forms of learning support services offered by academic libraries—resource service and quality development. The various combinations of the 2 basic forms and the three supporting elements constitute the system of learning support services of academic libraries, and full integration is deemed necessary according to activity organization. Thus, the paper managed to build a double-helical model for learning support services of academic libraries, which displayed activity-driven subjectivity, non-linear logical progression, synergistic support

services, symbiotic and integrated development and other characteristics in its mechanism.

Keywords: academic libraries; learning support services; basic form; supporting element; double-helical model

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