

## Construction and Validation of a Service Needs Model for University Student Makers Based on Grounded Theory: Post-Print

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### Abstract

[Purpose/Significance] Addressing the current inadequacy of innovation and entrepreneurship services in maker spaces, this study investigates the service demands of university student makers to provide reference for maker space service provision. [Methods/Process] Using grounded theory as the research method, a service demand model for university student makers was developed through coding and analysis of initial interviews. Based on this model, a questionnaire was designed and distributed online to validate the model. [Results/Conclusion] The service demand model primarily includes two core service demands: information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand. The former specifically encompasses basic innovation and entrepreneurship knowledge, information service demand, knowledge service demand, and intelligence service demand; the latter includes environmental atmosphere, operational model, promotion and publicity, protection mechanisms, and professional guidance. The collected questionnaire data were analyzed through exploratory factor analysis using SPSS, ultimately confirming the validity of the model.

### Full Text

### Preamble

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**Construction and Validation of a College Student Maker Service Demand Model Based on Grounded Theory**

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## Abstract

**[Purpose/Significance]** In view of the current insufficient provision of innovation and entrepreneurship services in maker spaces, this study investigates the service demands of college student makers to provide references for maker space service development.

**[Method/Process]** Using grounded theory as the research method, a college student maker service demand model was developed through initial interviews and coding. Based on this model, a questionnaire was designed and distributed online to verify the model's validity.

**[Result/Conclusion]** The college student maker service demand model primarily includes two core service demands: information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand. The former specifically comprises dual-creation basic knowledge, information service demand, knowledge service demand, and intelligence service demand. The latter includes environmental atmosphere, operation mode, promotion, protection mechanism, and professional guidance. Questionnaire data were analyzed using SPSS exploratory factor analysis, ultimately confirming the model's validity.

**Keywords:** Grounded Theory; College Student Maker; Innovation and Entrepreneurship; Service Demand; Exploratory Factor Analysis

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With the rise of maker culture, numerous institutions including domestic and foreign incubators, investment agencies, and universities have established maker spaces. Currently, most maker spaces provide environmental support such as venues and equipment for makers or maker teams, while university maker spaces also offer partial funding and technical guidance. As college students constitute the primary source of makers and their enthusiasm for participating in innovation and entrepreneurship continues to grow, exploring their service demands during the innovation and entrepreneurship process holds significant practical importance for maker service research. Grounded theory is a qualitative research method that employs systematic procedures to develop and inductively derive grounded theories for explaining social phenomena, currently applied mainly in qualitative research. This paper investigates the service demands of college student makers during their innovation and entrepreneurship activities based on grounded theory, aiming to provide reference for maker space service development.

## 1. Research Status of College Student Maker Services

Domestic scholars have extensively discussed innovation and entrepreneurship services for college student makers. Based on research content, these studies can be broadly categorized into four types:

## 1.1 Education Service System Construction

Ming Junren et al. employed grounded theory to construct an influencing factor model of college students' willingness to participate in library maker spaces from the student perspective. Through quantitative research methods, they further validated the theoretical model and found that three main categories—participation attitude, participation norms, and perceived behavioral control—significantly influence college students' willingness to participate in library maker spaces [1]. These factors can be improved through innovation and entrepreneurship education, thereby enhancing participation willingness. Innovation and entrepreneurship education aims to cultivate talents with fundamental qualities and pioneering personalities, covering four aspects: innovation awareness, innovative thinking, innovative skills, and innovative emotions [2], which contributes to the output of maker innovation achievements and addresses issues such as backward platforms, lack of teachers, rigid curricula, and cultural deficiencies [3]. As college students are the primary source of makers, universities must update entrepreneurship education concepts, optimize resources, establish collaborative education mechanisms, improve support systems, and strengthen ecological development of innovation and entrepreneurship education to promote educational reform [4-5]. Addressing existing problems in university entrepreneurship education, Zhang Ting et al. proposed establishing scientific entrepreneurship education concepts, increasing funding, constructing scientific evaluation systems, and improving precise service mechanisms [6]. Currently, Tsinghua University's iCenter has pioneered multi-dimensional exploration of maker education platform construction concepts and mechanisms, focusing on building an industrial-level maker space based on “intelligent manufacturing + internet” and providing support conditions including incubation venues, technical training, product development, processing, and management consulting through a series of regular innovation and entrepreneurship education activities, creating a favorable atmosphere [7].

## 1.2 Service Innovation Approaches

In the big data context, addressing maker librarians' needs for real-time data analysis, cross-disciplinary collaborative information resource sharing, and scientific data open integration, scholars have constructed an embedded information service mechanism for maker groups. They proposed deepening embedded maker services by establishing data service management systems, forming professional data maker service teams, and enhancing information service capabilities for maker groups [8]. Meanwhile, a precise maker service model for university libraries has been established, providing targeted, personalized, and comprehensive knowledge consulting services and academic guidance for makers of different levels and disciplinary backgrounds across four stages: maker demand, maker planning, maker implementation, and maker outcomes [9]. The library of Nanjing University of Technology leverages its resources and professional advantages

to provide one-stop services for makers across three stages—initial, practice, and completion—through novelty searches, document delivery, journal promotion, thematic services, and patent information services [10]. Additionally, scholars have proposed promoting the construction of college student entrepreneurship park ecosystems to provide innovation and entrepreneurship services for college student makers [11]. Through studying distinctive entrepreneurship service practices in U.S. university libraries, scholars have summarized implications for domestic university libraries, including grasping the essence of dual-creation, strengthening overall planning, enhancing project implementation, improving communication and coordination, extending library service scope through entrepreneurship services, improving service mechanisms, implementing campus services based on typical cases, and integrating collaboration to build an entrepreneurship service ecosystem [12-13].

### 1.3 Service System and Platform Construction

From the perspective of construction elements, Liu Guang et al. proposed building an incubation chain of “entrepreneurship incubation base—college student entrepreneurship park—university science park” [14]. From the construction level perspective, Li Kunyi constructed a “ladder-type” entrepreneurship ability enhancement model for college students based on maker spaces and proposed four implementation paths corresponding to the four stages of entrepreneurship ability enhancement [15]. Cheng Junqing et al. proposed a “three-stage” progressive design approach encompassing enlightenment, advancement, and practice [16]. From the service platform perspective, Dong Tongqiang et al. constructed an intelligent embedded service platform for university libraries oriented toward maker groups, including modules for embedded information collection, demand analysis, personalized customized services, and service feedback [17].

### 1.4 Maker Space Service Evaluation System Construction

Chen Qi et al. systematically established a maker space service capability maturity evaluation system from three perspectives—development service capability, entrepreneurship service capability, and service management—based on CMM thinking [18]. Li Yanping et al. employed grounded theory to extract structural dimensions and functional models for evaluating maker space development quality, constructing an evaluation index system comprising 6 first-level indicators, 19 second-level indicators, and 54 third-level indicators [19].

Overall, current research on maker space services primarily focuses on dual-creation education, service method innovation, innovation and entrepreneurship service system construction, and evaluation system development, with limited investigation into the specific innovation and entrepreneurship demands of college student makers. Since services arise from demands, only by clarifying the specific needs of college student makers can we provide targeted services that effectively promote their innovation and entrepreneurship.

## 2. Research Methods and Process for Maker Space Service Demand

### 2.1 Research Method

Grounded theory is a qualitative research method that collects raw data, conducts hierarchical induction and coding, and derives theories from data to explain social phenomena. It is a bottom-up approach to constructing substantive theory, which involves identifying core concepts that reflect phenomena through systematic data collection and then building relevant theories through relationships among these concepts [20]. This study employs grounded theory to investigate the knowledge service demands of college student makers through relaxed and in-depth interviews. Interview content was recorded through text and audio, followed by detailed summarization. Through three levels of coding—open coding, axial coding, and selective coding—a college student maker service demand model was constructed and tested for theoretical saturation. Based on the grounded theory model, hypotheses were formulated, variables defined, and a questionnaire designed to obtain sample data. SPSS software was used to test the questionnaire's reliability and validity and conduct exploratory factor analysis to verify the reasonableness of the established model.

### 2.2 Research Subjects and Data Collection

This study targeted college student makers at Fuzhou University, employing random sampling. To ensure interview validity and reliability, interview locations were set up at Fuzhou University Science Park's Yangguang Maker Space, Sanqian Maker Space, Mechanical Maker Space, and Zhicheng College Creative Park. Interview instructions were distributed to teams in these maker spaces, and college student makers willing to participate were randomly selected. Following grounded theory requirements, interview records from 32 college student makers were compiled. Basic information about these 32 subjects is presented in Table 1 .

Open-ended interviews were conducted in a conversational manner, with text and audio records preserved throughout. Interviews focused on seven aspects: whether participants engaged in independent innovation and entrepreneurship; what type of maker they were; what service demands existed during the innovation and entrepreneurship process; whether they used services provided by maker spaces and how; what services their maker spaces provided and whether these met current needs or facilitated innovation and entrepreneurship; and what services they believed maker spaces should provide and their specific content. After open-ended interviews, data were compiled to obtain leading questions for semi-structured interviews. A total of 11 interview sessions were conducted, each lasting 2-3 hours with 2-3 participants, yielding rich and reliable sample data.

## 2.3 Data Coding and Analysis

The key to successfully applying grounded theory lies in three-level coding: open coding, axial coding, and selective coding. Researchers must maintain high theoretical sensitivity throughout the coding process. To ensure scientific rigor, concepts and categories were first extracted through manual coding. Interview data and partial coding results were sent to domain experts via email, and their feedback was incorporated to complete subsequent coding, ensuring scientific validity.

**2.3.1 Open Coding** Open coding involves re-examining and organizing raw data to extract new concepts from participants' original statements. Through segmentation, recombination, and conceptual extraction of data statements, 364 original statements were obtained. These were labeled, initially conceptualized, and categorized into 151 preliminary concepts and 9 categories, as shown in Table 2 (representative statements are displayed due to space limitations).

**2.3.2 Axial Coding** Axial coding's main task is to discover and establish various connections among conceptual categories to demonstrate the organic relationships among different parts of the data. Through data refinement, two main categories were identified: information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand. The logical relationships among these main categories and subcategories are presented in Table 3 .

**2.3.3 Selective Coding** Selective coding systematically processes the relationships among categories identified through open and axial coding, selecting core and subordinate categories to build grounded theory based on categorical relationships. Through hierarchical coding, it was found that all main categories revolve around college student maker service demands. Therefore, "college student maker service demand" was defined as the core category. The relational structure among main categories and representative participant statements are shown in Table 4 .

## 2.4 Theory Construction and Saturation Testing

Based on the categories obtained through three-level coding, a college student maker service demand model was constructed, as shown in Figure 1 [Figure 1: see original paper]. This model identifies two main categories—information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand—as the most critical service demands for college student makers.

To ensure research reliability, theoretical saturation testing was conducted. Theoretical saturation refers to the point when no additional data can further develop a category's characteristics [21]. To test saturation, three additional col-

lege student makers were interviewed and their data coded, yielding no new categories, indicating that theoretical saturation had been achieved.

### 3. Validation of College Student Maker Service Demand Model

#### 3.1 Model Mechanism Explanation

College student maker service demands can be summarized into two main categories: information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand. Based on these two main categories, two fundamental propositions were developed.

**3.1.1 Proposition 1: College Student Maker Service Demands Include Information-Knowledge-Intelligence Service Demand** Information-knowledge-intelligence service demand comprises four specific service components: (1) Dual-creation basic knowledge forms the foundation for college student makers' innovation and entrepreneurship, including basic concept recognition of makers, innovation and entrepreneurship, and dual-creation education, as well as awareness of their own service demands; (2) Information service demand refers to needs for national policies, competitions, and industry information during innovation and entrepreneurship; (3) Knowledge service demand primarily concerns deep knowledge mining and tacit knowledge transfer needs; (4) Intelligence service demand includes competitiveness assessment, innovation assessment, and infringement risk assessment. Based on this, the following hypotheses were formulated:

- H1: College student maker service demands include information-knowledge-intelligence service demand
- H1a: College student makers' mastery of dual-creation basic knowledge is related to their service demands
- H1b: Information service demands in college student makers' innovation and entrepreneurship are related to their service demands
- H1c: Knowledge service demands in college student makers' innovation and entrepreneurship are related to their service demands
- H1d: Intelligence service demands in college student makers' innovation and entrepreneurship are related to their service demands

**3.1.2 Proposition 2: College Student Maker Service Demands Include Innovation-Entrepreneurship Environment Service Demand** Innovation-entrepreneurship environment service demand includes five specific components: (1) Environmental atmosphere refers to maker spaces' hardware conditions, including venues, equipment, funding, and technical guidance; (2) Diversified operation modes facilitate innovation and entrepreneurship, such as holding exchange meetings and expert lectures; (3) Promotion and publicity can attract more aspiring individuals to join college student maker teams,

thereby popularizing dual-creation education; (4) Protection mechanisms require maker spaces to provide confidential spaces for college student maker teams to ensure project protection; (5) Professional guidance refers to guidance from professional mentors or expert professors in maker spaces. Based on this, the following hypotheses were formulated:

- H2: College student maker service demands include innovation-entrepreneurship environment service demand
- H2a: Maker space environmental atmosphere is related to college student maker service demands
- H2b: Maker space operation mode is related to college student maker service demands
- H2c: Maker space promotion and publicity is related to college student maker service demands
- H2d: Maker space protection mechanism is related to college student maker service demands
- H2e: Maker space professional guidance is related to college student maker service demands

All propositions and hypotheses are summarized in Table 5 .

### 3.2 Questionnaire Survey

A “College Student Maker Service Demand” questionnaire was developed, comprising three parts: (1) An introduction explaining the survey purpose and basic professional concepts; (2) Control variables including sample characteristics: major, maker type, industry category of entrepreneurial projects, maker service demands, importance ranking of different services, services provided by current maker spaces, and satisfaction levels; (3) Variable measurement scales using Likert scales to measure dual-creation basic knowledge, information service demand, knowledge service demand, intelligence service demand, environmental atmosphere, operation mode, promotion, protection mechanism, and professional guidance. Variable definitions and measurement indicators are shown in Tables 6 and 7 .

The questionnaire was distributed online to college student makers, with 235 questionnaires issued and 234 valid questionnaires collected.

### 3.3 Survey Results Analysis

SPSS 20 analysis revealed the questionnaire variables’ reliability and validity test results shown in Tables 8 and 9 , confirming scale validity. Bartlett’s sphericity test and KMO measure indicated suitability for exploratory factor analysis, as shown in Table 10 .

Exploratory factor analysis yielded a rotated component matrix shown in Table 11 , revealing two principal component factors. Based on item content, the first component was named information-knowledge-intelligence service demand,

and the second was named innovation-entrepreneurship environment service demand.

The internal consistency alpha coefficient for the 5 items of “innovation-entrepreneurship environment service demand” was 0.900, as shown in Table 12 . In Table 13 , corrected item-total correlation values ranged between 0.728-0.764, and no Cronbach’s Alpha value exceeded 0.900 when any item was deleted, indicating excellent consistency reliability for the 5 items.

The internal consistency alpha coefficient for the 6 items of “information-knowledge-intelligence service demand” was 0.877, as shown in Table 14 . In Table 15 , corrected item-total correlation values ranged between 0.573-0.754, and no Cronbach’s Alpha value exceeded 0.877 when any item was deleted, indicating excellent consistency reliability for the 6 items.

The internal consistency alpha coefficients for the two dimensions—“information-knowledge-intelligence service demand” and “innovation-entrepreneurship environment service demand”—were 0.900 and 0.877 respectively, both exceeding 0.80. The overall scale’s internal consistency alpha coefficient was 0.918, as shown in Table 16 , indicating excellent reliability for the “College Student Maker Service Demand” scale. Therefore, the exploratory factor analysis results are consistent with the grounded theory research conclusions, validating the reasonableness of the constructed college student maker service demand model.

#### 4. Discussion of Results

This study employed grounded theory to theoretically explore college student maker service demands, constructing a demand model containing two main categories—information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand—through three-level coding analysis. The model’s nine specific service content items reflect current issues in college student makers’ innovation and entrepreneurship.

The first main category, “information-knowledge-intelligence service demand,” reveals problems in creative idea mining, transformation, and innovative practice. Dual-creation basic knowledge is essential for college student makers, representing their self-quality. Understanding makers and innovation-entrepreneurship helps makers clarify their starting points and objectives, while awareness of service demands enables them to identify deficiencies and seek timely assistance. Popularizing basic knowledge requires maker spaces to conduct dual-creation education. Information service demand, knowledge service demand, and intelligence service demand further specify the service needs during innovation and entrepreneurship, requiring maker librarians to possess better professional competencies to provide not only basic consulting services but also targeted information, knowledge, and intelligence services for specific problems.

The second main category, “innovation-entrepreneurship environment service demand,” imposes additional requirements on maker spaces beyond venues and equipment. As maker subjects, college students possess professional knowledge advantages but face shortages in funding and technology. Maker spaces’ environmental atmosphere, operation mode, promotion, protection mechanisms, and professional guidance can provide better innovation and entrepreneurship environments.

Therefore, maker spaces can improve innovation and entrepreneurship services and provide theoretical references for maker space construction by addressing these two main categories:

1. **Popularize basic knowledge and design service systems.** Conduct dual-creation education to popularize basic knowledge about makers and innovation and entrepreneurship; distinguish between project demands and makers’ service demands to help makers identify their demand types and seek targeted solutions; design detailed service systems for different types of maker spaces by leveraging university, social, and library resources, enabling different maker spaces to fulfill their respective roles and collaborate to support college student makers.
2. **Equip resources and improve spatial environment.** Provide more support in funding, equipment, and venues; invite technical personnel to guide college student makers; hold exchange meetings and expert lectures to stimulate creativity through discussion and learning; strengthen promotion to increase student awareness of maker spaces and equipment; organize more activities to integrate more students into maker spaces; establish confidentiality mechanisms to provide independent spaces and necessary protection measures for makers or teams with confidentiality needs, ensuring intellectual property protection.

This study investigated college student maker service demands using grounded theory. The entire process from interviews to model construction strictly followed grounded theory procedures, ensuring research rigor and reasonableness. Questionnaire data validated the model’s reasonableness through exploratory factor analysis, confirming that college student maker service demands mainly include information-knowledge-intelligence service demand and innovation-entrepreneurship environment service demand. These two main categories encompass nine specific service content items with universal applicability for providing innovation and entrepreneurship services to college student makers and offering reference value for maker space service design.

This study has certain limitations. Future research can expand sample size and scope, further improve questionnaire design, and incorporate additional analytical methods. The research findings provide a foundation for subsequent knowledge service system design. As college student makers’ innovation and entrepreneurship activities advance, the next research direction concerns how to design services addressing these demands.

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## Author Contributions

Zeng Weiqing: Data collection and analysis, manuscript writing, content revision;

Liu Minrong: Provided manuscript revision suggestions;

Chen Zhenbiao: Designed theoretical and methodological framework.

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

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