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Anticipating future explorations in science and technology literature for university liberal arts majors

Jiexuan Liu: *Librarian of Nanjing Normal University, Nanjing, Jiangsu, China.*

ABSTRACT: *Scientific literacy emerges as a vital competency for aspiring preservice educators, underscoring the need for a multidimensional approach to literacy that transcends disciplinary boundaries and fosters a holistic understanding of knowledge. This study investigates the borrowing behaviors of 4,864 students across the teacher education, fine arts, and psychology departments at Nanjing Normal University from 2014 to 2023. A total of 15,859 science and technology book transactions were recorded, culminating in an overall borrowing of 38,783. The analysis employs chi-square tests to explore the relationship between gender and borrowing frequency, particularly in light of the COVID-19 pandemic. A ranking of book categories based on the Chinese Library Classification System is conducted, and the findings are analyzed through SPSS to evaluate the degree of correlation among various levels of borrowing data. Correspondence analysis is utilized to visualize patterns in borrowing across different majors, providing insights into preferences for specific literature and resources. The study further delves into topological structures of borrowing practices using Gephi to create network diagrams, revealing statistical connectivity among readers within a major. Annual borrowing averages for science and technology books are calculated, and predictions for future borrowing trends are visualized using Excel scatter plots, facilitating an understanding of science and technology book reading of liberal arts students, as well as evolving academic resource utilization. The results highlight distinctive borrowing patterns and the impact of demographic factors on students' library usage, contributing valuable insights to academic resource management.*

Key words*: Book, Liberal Arts, Reading, Science, Technology.*

1. Introduction

Integrating emerging technologies in the arts and humanities has become pivotal in reshaping educational experiences. With advancements such as virtual reality, the Internet of Things, and mobile learning, these fields are witnessing significant transformations that enhance creativity, pedagogy, and management. These technologies foster interactive and collaborative learning environments and improve accessibility to educational resources, making learning more inclusive and engaging (Usca et al., 2024). Reading comprehension is a fundamental skill that serves as a cornerstone for academic achievement and lifelong learning. It encompasses a purposeful process of extracting meaning from texts, necessitating individuals to identify relevant information while exercising critical and analytical thinking throughout their reading pursuits. Villanueva (2022) underscores the significance of utilizing extensive metacognitive reading techniques that enhance awareness and regulation of one's reading practices. Such techniques considerably improve students' capacity to comprehend and engage with complex texts, enabling them to approach reading not as a passive activity but as an active and strategic engagement. This perspective elucidates that comprehension transcends merely deciphering words on a page; it also involves the capacity to reflect on one's understanding and adapt strategies to achieve better outcomes.

The landscape of reading comprehension exhibits notable variations across different academic disciplines, presenting distinct challenges for students. For instance, individuals majoring in science and technology may find greater comfort navigating the narratives and concepts in humanities and social science literature. The straightforward structures and clarity inherent in these texts often resonate with those trained in scientific

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disciplines. The logical progression and accessible language frequently bolster students' confidence, enabling them to engage with works that may initially appear foreign. Conversely, students pursuing degrees in liberal arts often confront a steeper learning curve when faced with the dense intricacies of scientific and technological literature. The complexity of scientific concepts, specialized jargon, and rigorous methodologies can present formidable barriers. However, it is vital to recognize that numerous liberal arts students are enthusiastic about bridging this divide. Their willingness to confront challenging scientific texts enriches their educational journeys and cultivates a valuable interdisciplinary perspective that is increasingly essential in today's globalized and interconnected environment.

As one contemplates the future of the academic landscape, a crucial inquiry emerges: How might these dynamics shift to enhance comprehension across disciplines? One promising avenue could involve the integration of science and technology themes within liberal arts curricula. Fostering a culture of curiosity and open dialogue between these fields holds significant promise. The evolving domain of science diplomacy emphasizes the necessity for scientific freedom and collaborative endeavors across borders. Porsdam H. and Porsdam M. S. (2023) propose a framework for science diplomacy that integrates scientific advice in policy formulation, leveraging scientific cooperation to strengthen international relations and facilitating global scientific collaboration. Collectively, these discussions accentuate the vital integration of effective educational practices, critical reading skills, and global scientific engagement in promoting a comprehensive understanding of science and its societal implications. The intersection of STEAM (Science, Technology, Engineering, Arts, and Mathematics) education emphasizes integrating robust conceptual knowledge with effective pedagogical skills, particularly for preservice teachers. By recognizing and addressing the unique challenges preservice teachers face in these domains, promoting interdisciplinary learning, and fostering a shared commitment to intellectual curiosity and dialogue, educational institutions can cultivate a richer, more inclusive understanding of the interconnected nature of these fields.

Scientific literacy emerges as an essential competency for prospective preservice teachers; however, many encounter challenges in navigating the intricacies of primary research literature. Hubbard et al. (2022) observe a trend wherein undergraduate readers often gravitate towards narrative interpretations, unlike more seasoned researchers who prioritize critical data analysis. This discrepancy highlights the necessity for a structured approach to developing scientific reading skills throughout an individual's academic trajectory. Ben-Horin et al. (2023) delineate six key pedagogical principles to enrich arts education within the STEAM framework. They advocate for student engagement in artistic processes that enhance their understanding and appreciation of the arts and the surrounding world. This integration may manifest in various formats, including joint courses and collaborative projects that foster critical thinking and problem-solving across diverse domains. Such collaboration enriches students' academic experiences and equips them with a broader skill set, rendering them more competitive in the job market and better prepared to navigate the complexities of contemporary professional landscapes.

The imperative of engaging with future explorations in science and technology literature for university liberal arts majors is profound. Such engagement is essential as it cultivates interdisciplinary knowledge, enabling students to establish insightful connections across diverse fields and employ multifaceted perspectives to address complex challenges. This synthesis of disciplines enriches critical thinking capabilities, fostering the ability to analyze and assess information rigorously—skills that are indispensable in both academic pursuits and practical applications in the real world. Furthermore, immersion in science and technology literature stimulates creative thought, empowering students to transcend conventional boundaries and develop innovative solutions to contemporary issues. In a rapidly evolving landscape marked by technological advancements and societal transformations, the fostered capacity for innovation is paramount, equipping liberal arts students with the tools necessary to conceive novel strategies in response to the pressing dilemmas confronting society today. Additionally, this scholarly exploration promotes responsible civic engagement. A comprehensive understanding of the ramifications of scientific and technological progress enables students to contribute meaningfully to the discourse surrounding policy, ethics, and societal impact. This thoughtful approach to civic leadership is essential in cultivating a well-informed citizenry capable of navigating the complexities of contemporary life.

The significance of this study is highlighted by the observation that liberal arts students, through active engagement with literature in science and technology, are allowed to develop as informed and innovative thinkers. Central to this development is the role of libraries, which are vital in nurturing an academic

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environment that encourages thorough scholarly exploration. Libraries act as extensive knowledge repositories, offering diverse resources, including books, journals, and digital materials that stimulate intellectual curiosity for students and faculty members. By facilitating access to these resources, libraries empower learners to engage deeply with interdisciplinary topics, promoting a holistic understanding of complex issues. Educators have the potential to significantly enhance the learning experience by thoughtfully integrating science and technology literature into the curriculum. Such integration broadens students' academic horizons and equips them with essential tools and critical thinking skills that are increasingly necessary in our interconnected global society. This approach encourages students to draw connections between disparate fields, fostering a more innovative mindset adaptable to various challenges. Higher education institutions can better prepare students to navigate complex real-world problems and thrive in an increasingly interconnected technological world by prioritizing interdisciplinary collaborations and flexible curricula.

2. Previous Researches

The interplay between technology, science, and society is a critical area of inquiry that underscores these domains' profound and evolving impact on human existence. Historically, scientific discoveries and technological innovations have fundamentally transformed daily life, shaping moral values, social structures, and cultural ideologies. A predominant area of influence is communication and interaction. The advent of technologies such as the printing press, telegraph, and, more recently, the internet has fundamentally redefined human connectivity and information exchange. These advancements have facilitated the dissemination of knowledge and cultural exchange and fostered greater social cohesion while presenting challenges related to misinformation and digital privacy. The reciprocal relationship between technology and society indicates that each exerts influence over the other. As societies evolve, their technological requirements also transform, which fosters further innovations that reshape social configurations. The relationship between cultural values and technological capabilities has significant implications for governance, ethics, and the trajectory of societal development (Alemayehu Tegegn, 2024).

The intersection of public trust and scientific advancement is essential for achieving overarching scientific objectives, particularly in fields that operate beyond mainstream public discourse (Goldenberg, 2022). Existing research indicates that the success of scientific endeavors frequently hinges on the efficacy of scientists' engagement with various stakeholders, including policymakers, media representatives, and the general public. Effective communication strategies can enhance public comprehension of scientific topics, fostering increased support for research initiatives. By cultivating positive relationships with the public, scientific institutions can create an environment conducive to innovative research, even in areas that may not be subject to extensive public scrutiny. Collins (2022) posits that science functions as a crucial check and balance on political power, emphasizing the necessity of evidence-based decision-making in governance. This intrinsic role situates science as a knowledge repository and an institution capable of fostering a more informed and engaged citizenry. The discourse surrounding the influence of internal versus external values in scientific practice has emerged as a focal point in the philosophy of science. While science is heavily anchored in its internal values—such as objectivity, rigor, and reproducibility—there exists considerable contention regarding the degree to which social values from the broader public should impact scientific research and policymaking.

2.1. Teacher Education and STEAM

The evolving landscape of the engineering profession calls for a re-evaluation of how education is structured, particularly in light of the transformative impacts of the Fourth Industrial Revolution. Amidst the increasing emphasis on technical expertise within STEM fields, a pressing need exists to incorporate the liberal arts into engineering training. As articulated by Winebrake (2015), the future of engineering education should not only focus on technical problem-solving but also foster critical thinking, ethical reasoning, and social responsibility. This holistic approach aims to cultivate 'empowered engineers'—individuals who are skilled problem solvers and well-informed and engaged citizen-leaders. Furthermore, Loumpourdi (2021) emphasizes the importance of integrating liberal arts into employee development curricula to prepare individuals for the challenges of the Fourth Industrial Revolution. Educational curriculums can nurture autonomous, reflective thinkers capable of addressing complex global issues by reconciling STEM disciplines

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with social sciences, humanities, and arts. However, the prevailing trend of prioritizing specialized technical skills over a broader educational framework poses a significant barrier to achieving this integration, leading to a loss of the humanistic aspects of science. Acknowledging the influence of non-behavioral factors in teacher development is essential for enhancing professional competencies. Research indicates that traits such as agreeableness, conscientiousness, open-mindedness, and intrinsic and altruistic motivations, significantly contribute to teachers' professional growth. Conversely, negative emotionality has been identified as a barrier to competency development (Ballová Mikušková et al., 2023). By considering these insights, educational institutions can better inform their selection and training processes, leading to more effective teaching practices.

Various researchers have prominently highlighted the necessity for a comprehensive educational framework that effectively addresses the complexities of the 21st century. Specifically, the domains of STEAM are instrumental in cultivating interdisciplinary thinking and enhancing problem-solving capabilities (Wiegand & Borromeo Ferri, 2023). Consequently, teacher education prepares future educators with the requisite skills to effectively integrate these disciplines within their pedagogical practices. Mathematical modeling—entailing the simplification and transformation of intricate real-world issues into solvable mathematical constructs—emerges as critical for understanding and addressing authentic societal challenges. The competencies necessary for proficient modeling encompass problem comprehension, simplification, mathematization, mathematical operations, and interpretation (Wiegand & Borromeo Ferri, 2023). These competencies' mastery is vital for educators and learners as they establish a foundational framework for navigating real-world challenges.

Beyond technical competencies, a holistic approach to science education underscores the importance of intentional, self-directed learning. Scholars advocate for establishing an environment conducive to learners' recognition of informational discrepancies, resolution of cognitive dissonances, and development of self-efficacy regarding their capacity for independent learning (Fortus et al., 2022). Key factors contributing to scientific literacy and lifelong learning include (a) an intrinsic desire to understand scientific concepts, (b) a belief in one's ability to acquire and apply scientific knowledge, (c) a mastery orientation towards scientific inquiry, (d) a commitment to continuous learning, and (e) a favorable perception of science as a discipline. It is imperative to foster positive attitudes towards science and intrinsic motivation for exploring and comprehending the scientific domain, thereby cultivating future generations equipped to address contemporary challenges.

Prior research has identified various challenges and needs associated with the professional development of educators, particularly within the context of STEM education. It has been observed that initial professional development often occurs in isolation, focusing on short-term projects that typically provide limited support for the practical implementation of new ideas in everyday classroom settings. This scenario indicates that educators at all career stages require additional exploration time and more comprehensive professional development opportunities. Engaging with specialists and peer educators is crucial for enhancing their understanding and capacity for implementation, thereby ensuring the integrity of the STEM curriculum alongside interdisciplinary subject areas. However, a significant gap persists in research concerning how educators acquire the requisite knowledge and skills for effective engagement in curriculum design.

Successfully implementing STEM education requires educators to possess knowledge across multiple disciplines and understand strategies for effectively integrating this knowledge. Various methodologies exist for achieving disciplinary integration. One approach involves utilizing real-life issues that connect multiple disciplines, while another centers on problem-solving that intersects scientific and mathematical knowledge to develop solutions or create products. For instance, addressing environmental challenges necessitates a scientific understanding of the issues, mathematical data collection and presentation skills, and engineering or technological expertise for devising innovative solutions (Stevenson et al., 2024).

Moreover, it is imperative to acknowledge that the distinctive characteristics of each STEM discipline shape their unique bodies of knowledge. As STEM comprises four interrelated disciplines, meaningful integration must occur among them. This integration informs educators' mindsets, influencing the scientific inquiries they pursue and their interpretations of outcomes. Notably, scientific practice operates within a broader cultural context, where scientists are both affected by and influential to the culture surrounding them. Consequently, scientific knowledge is not absolute; it is reliable yet provisional, subject to revision as new evidence emerges or existing evidence is reinterpreted (Song et al., 2023).

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2.2. Arts and Science and Technology

Conventional perceptions that posit the arts and sciences as dichotomous realms have been scrutinized. Research indicates that meaningful learning in the scientific domain is facilitated when students harness rational thought and imaginative processes. This perspective accentuates the significance of creativity as a shared foundation in artistic and scientific pursuits, suggesting that interdisciplinary exploration enhances divergent thinking and innovative problem-solving capabilities (Kotler et al., 2024). Pollack (2001) contends that science should occupy a critical space within the liberal arts curriculum, not merely for its factual underpinnings but because it confronts profound questions intrinsic to our culture—questions that resonate with those posed in disciplines such as music and philosophy. Scientists, driven by a shared human impulse to impose order on chaos, play an essential role in this dialogue, probing deep, unresolved questions that reverberate across the liberal arts spectrum. The focus on interdisciplinary methodologies reveals the potential for enriching educational experiences that amalgamate arts and sciences elements, encouraging students to engage in critical and creative thinking across disciplinary boundaries.

The discourse surrounding the integration of science within the liberal arts has been a subject of extensive academic inquiry. Pollack (2001) posits the disconnect between the public's perception of science education and the actual pursuits of scientists. This perception frequently characterizes scientists as enigmatic figures, veiled in white coats, engaged in esoteric inquiries with questionable intentions. Consequently, public interest in science is often interpreted through skepticism, reducing it to a perilous endeavor associated with ambiguous motives. As Chen and Ding (2024) articulated, STEAM education seeks to lay a robust foundation for critical skills, including creativity, core competencies, and soft skills. Despite substantial efforts toward implementing STEAM education, the authors emphasize that significant constraints persist due to disparities in educational environments. These constraints encompass variations in teacher quality, instructional methodologies, cultural diversity, socioeconomic factors, and divergent perceptions and cognitive frameworks. Such complexities challenge the practical realization of STEAM principles within educational institutions, underscoring the necessity for a more nuanced understanding and approach to integrating these disciplines.

Integrating the arts into educational frameworks has undergone significant transformation, as evidenced by numerous studies that elucidate the multifaceted benefits of perceiving art not merely as a skill but as an essential component of culture, empathy, and expression. Historically, initial professional development initiatives for educators tended to address art integration through conventional methodologies, such as drawing and digital design. However, as educators engaged in more profound professional development experiences, they increasingly embraced the Design Thinking framework, which facilitated embedding the arts within the broader problem statements that guided their instructional practices. This shift signifies a burgeoning recognition of the pivotal role that the arts can play in cultivating creative problem-solving abilities and critical thinking skills (Cook et al., 2020). These analyses highlight the imperative to bridge the chasm between liberal arts and science education, facilitating a holistic educational experience that nurtures creativity and critical inquiry across both fields.

2.3. Psychology and Science and Technology

Technological progress has led to significant improvements in healthcare and medicine. Biotechnology and medical technology discoveries have enhanced health outcomes, increased life expectancy, and improved the quality of life for many individuals. These advancements change individual lives and reshape entire communities and economies, as health is critical to productivity and well-being. There has also been a growing interest in using novel technologies in clinical psychology. While discussions about potential technological enhancements for clinical psychology are increasing, less emphasis has been placed on the ethical challenges that may arise from the widespread use of these technologies. Complex tasks were once reserved for humans, but artificial intelligence (AI) advancements have transformed diverse sectors, including education, healthcare, and business operations. As AI becomes more integrated into everyday life, it creates a need to understand its psychological implications.

A growing body of research in behavioral science has examined how AI induces different psychological consequences, focusing primarily on its role as a decision-maker and an interacting partner. First, algorithm aversion decreases when objectivity is prioritized. Individuals tend to perceive algorithms as more objective

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and less biased than humans. For instance, people attribute discriminatory actions made by algorithms (compared to humans) less to a prejudiced motivation. Relatedly, algorithmic decisions are viewed as less emotional, more accurate, and less driven by selfish motivations. Second, algorithm aversion diminishes when individuals are concerned about social judgment. Algorithms are believed to be less likely to exhibit social judgment, which promotes greater openness to their use. For example, demographic-based price discrimination conducted by algorithms (as opposed to humans) is perceived as fairer because algorithms are less likely to judge people. Furthermore, individuals are more willing to accept a work-tracking system operated by algorithms rather than humans, as it alleviates concerns about being judged. Additionally, people are more inclined to interact with chatbots instead of humans when concerned about being judged negatively by others (Williams & Lim, 2024).

Digital interventions hold the potential to significantly scale access to evidence-based interventions in ways that were unimaginable just a few decades ago. The discussion of effective digital interventions encompasses five key concepts: (a) knowledge is meant to be shared, (b) evidence-based interventions are essential, (c) treatment alone is not sufficient to reduce the prevalence of mental disorders; prevention is key, (d) non-consumable interventions have the most significant scalability potential, and (e) technology now allows for widespread dissemination of psychological interventions globally. By harnessing technology, it is now possible to think globally, act locally, and share findings on a global scale. This approach can assist in reducing human suffering beyond local settings and contribute to making healthcare a universal human right (Muñoz, 2022).

The transition from traditional to digital teaching methods has been a topic of considerable research and discussion in recent years. Previous studies have highlighted psychological educators' challenges in adapting their teaching habits swiftly in response to the increasing demand for multimedia-based instruction. One significant barrier identified in the literature was the lack of systematic knowledge and skills among faculty members to effectively utilize digital media in their teaching practices. Research indicates that the transformation to technology-based teaching practices often relied heavily on recorded lectures made available through various streaming platforms as a supplement or substitute for in-person interactions. The effectiveness of technological interventions requires careful examination of their outcomes and impacts, focusing not just on traditional criteria of truth and reliability but on the efficiency of problem-solving in educational contexts. In analyzing the various facets relevant to learning, dimensions such as the organization of information, level of abstraction, use of knowledge, locus of control, communication direction, and mode of activity have been emphasized as crucial factors (Niegemann, 2023). Technological progress has significantly transformed healthcare and medicine, leading to remarkable improvements in health outcomes, increased life expectancy, and enhanced quality of life for many individuals. Biotechnology and medical technology discoveries change individual lives and reshape entire communities and economies, as health is critical to productivity and overall well-being. Furthermore, a growing interest is in applying novel technologies within clinical psychology. Despite the increased discussions about the potential benefits of these technological advancements, the ethical challenges arising from their widespread use remain underexplored.

Previous research on science and technology literature (STL) faces several limitations that can hinder a comprehensive understanding of its impact on liberal arts education. Many studies exhibit a narrow focus, concentrating on specific genres or types of literature, which may overlook a broader range of texts that could offer valuable insights into how STL influences critical thinking and interdisciplinary learning. Additionally, there is often inadequate recognition of the diverse experiences and backgrounds of liberal arts students, leading to generalized conclusions that do not reflect the unique perspectives these students bring to the field. The rapidly changing technological landscape further complicates matters, as research can quickly become outdated. There is a notable lack of contemporary studies examining current technological advancements and their effects on student engagement with STL. Moreover, interdisciplinary barriers result in compartmentalized research efforts, restricting collaboration among disciplines and limiting the development of effectively integrated frameworks. Finally, the challenges of adequately assessing the impact of STL on learning outcomes can impede efforts to establish appropriate evaluation tools that capture the nuanced benefits of engaging with science and technology literature. Addressing these limitations could pave the way for more effective teaching strategies and a richer understanding of STL's role in the education of liberal arts majors.

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3. Date and Methods

The research sample includes 4,864 borrowers from the teacher education, fine arts, and psychology departments at Nanjing Normal University between 2014 and 2023. 15,859 books were borrowed, contributing to an overall borrowing tally of 38,783 from the three departments: teacher education with 19,627, fine arts with 13,462, and psychology with 5,694.

Chi-square tests are statistical methods utilized to evaluate whether there is a significant association between categorical variables. These tests assist researchers in determining if the observed frequencies across different categories deviate from what would be anticipated under a particular hypothesis. This analysis focuses on examining the independence of two categorical variables, gender and borrowing frequency (five years before and after COVID-19), to ascertain any relationship between gender and the impact of COVID-19. The test compares the observed frequencies presented in a contingency table with the expected frequencies derived under the assumption that the variables are independent.

Based on the first level classification number of the Chinese Library Classification System, calculate the borrowing volume of each category of books in three departments over the past ten years and rank the categories in descending order. The purpose is to calculate the degree of correlation between multiple level variables. Import the ranking table into SPSS. Navigate to the analyze menu, select nonparametric tests, and then choose legacy dialogs. Proceed to select the k-related samples option. Specify the test variables as the ranks of teacher education, fine arts, and psychology departments.

Correspondence analysis is a statistical technique used to analyze the relationships between categorical variables and to visualize these relationships in a two-dimensional space. This method is particularly useful in educational settings to understand the preferences of different student majors concerning various academic subjects. In this context, the data reveals distinctive preferences among different majors concerning specific types of literature and educational resources. Assign the following values to the classification numbers A through K: N = 1, O = 2, P = 3, Q = 4, R = 5, S = 6, T = 7, U = 8, V = 9, X = 10. Additionally, the departments are assigned as follows: Teacher education = 1, Fine Arts = 2, and Psychology = 3. To import these three departments' book circulation record forms into SPSS, select "Date" and weight the cases by frequency. Next, navigate to "Analyze," then select "Dimension Reduction," followed by "Correspondence Analysis." For the analysis, use the row variable for the book category (ranging from 1 to 10) and the column variable for the department (ranging from 1 to 3).

15,859 books are borrowed in the Chinese library classification categories N to X (science and technology). The bibliography is organized into three distinct categories by removing duplicates. The CNMARC and UNIMARC 6XX fields are extracted to analyze bibliographic themes.

Exploring topological structures in book borrowing practices reveals insightful patterns within an academic discipline. Use Gephi to draw borrowing network diagrams for three departments, with readers as nodes and corresponding borrowing relationships for readers' books as edges. Calculate the connectivity and connectivity of each node through statistical analysis and generate stable borrowing core diagrams for each department through topological network filtering.

Calculate the annual borrowing average of liberal arts books in three departments, use EXCEL to draw a scatter plot, and add trend lines to fit and predict the yearly borrowing average of the three departments in 2024.

4. Results

4.1. Gender Comparison

At Nanjing Normal University, the borrowing patterns of books across different college majors reveal interesting trends, particularly among the liberal arts and science disciplines. Within the liberal arts framework, the School of Teacher Education, the School of Fine Arts, and the School of Psychology emerge as leading departments in borrowing science and technology books. Despite their relatively high borrowing rates within the liberal arts context, the average volume of science and technology book loans in these departments remains significantly lower than that observed in the science and technology majors. These liberal arts disciplines are in the upper middle class of borrowing rates regarding science and technology literature (see Figure 1).

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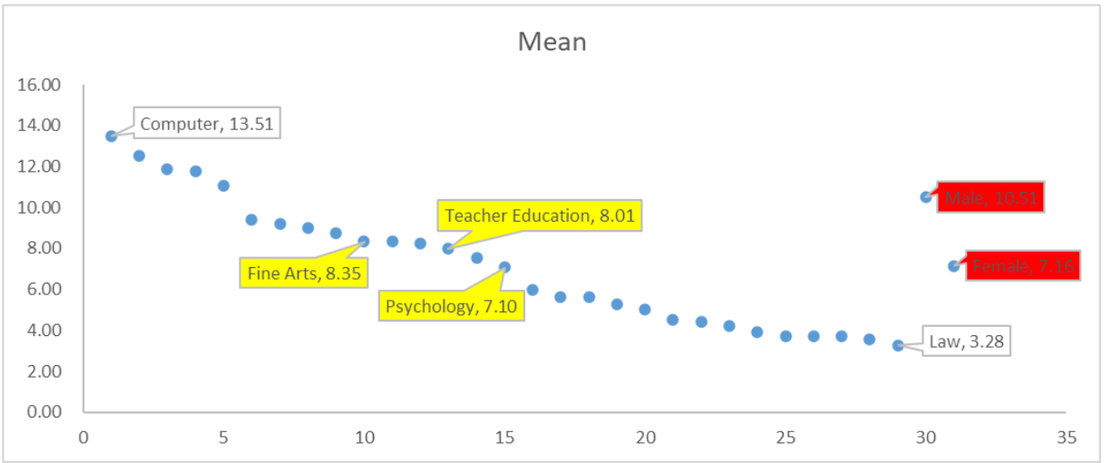


Figure 1. Means.

Diving deeper into the demographics of borrowers, the researcher finds notable distinctions between genders. Although the number of girls borrowing science and technology books is higher in volume and frequency, boys tend to borrow a more significant average number. (see Figure 1 and Table 1). This trend is particularly intriguing given that the enrollment numbers in teacher education and other normal universities skew significantly toward female students. In essence, while females are more active in participating in borrowing science and technology literature, males are capitalizing on this engagement to borrow more books on average.

Table 1. Categories of books borrowed.

Category	Male	Female	Total	Male : Female
N	291	443	734	66/100
O	2898	8485	11383	34/100
P	167	1091	1258	15/100
Q	204	1509	1713	14/100
R	674	4375	5049	15/100
S	17	162	179	10/100
T	3938	13977	17915	28/100
U	5	14	19	36/100
V	2	8	10	25/100
X	55	468	523	12/100
Total	8251	30532	38783	27/100

The findings presented in Tables 2 and 3 from the Chi-Square test yield a p-value (Approx. Sig. = 0.000) that indicates an exceedingly low probability of observing the data under the null hypothesis, which posits no association between gender and the time frame of five years before or after COVID-19. This result provides compelling evidence against the null hypothesis, thus leading to the conclusion that a statistically significant association exists between the variables under investigation. Furthermore, the Contingency Coefficient value of 0.021 reflects the strength of the relationship between these variables. Generally, values approaching 0 denote a weak relationship, while those nearer 1 signify a stronger correlation. The coefficient of 0.021 suggests a very weak association; however, given the statistical significance indicated by the p-value, this weak association warrants further consideration and analysis.

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Table 2. Crosstabulation.

	2014-2023		Total
	2014-2018	2019-2023	
Male	6556	1695	8251
Female	24870	5662	30532
Total	31426	7357	38783

Source: Contingency Coefficient 0.021. Approx.Sig.0.000.

Table 3. Chi-square tests.

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson chi-square	16.878[a]	1	0.000		
Continuity correction[b]	16.748	1	0.000		
Likelihood ratio	16.629	1	0.000		
Fisher's exact test				0.000	0.000
Linear-by-linear association	16.877	1	0.000		
N of valid cases	38783				

Note: a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 1565.19.
b. Computed only for a 2x2 table

4.2. Department Comparison

4.2.1. Favourite Book Categories

The findings in Table 4 indicate that Kendall's coefficient of concordance is 0.042, with an accompanying asymptotic significance (Asymp. Sig.) value of 0.657. This coefficient suggests a negligible level of agreement among the raters. In hypothesis testing, a conventional significance threshold is established at 0.05; given that the observed p-value of 0.657 far exceeds this threshold, it can be inferred that the results do not possess statistical significance. Thus, the observed variations in rankings or ratings among the judges are likely to be attributed to random chance. The low coefficient of concordance and the elevated p-value indicate a lack of strong consensus concerning the reading interests in science and technology among the three departments.

Table 4. Ranking of popular book categories.

Book category	Teacher education	Fine arts	Psychology
N	6	5	1
O	1	8	8
P	4	2	2
Q	3	4	6
R	5	3	5
S	8	6	4
T	2	1	3
U	10	9	10
V	9	10	9
X	7	7	7

4.2.2. Correspondence Analysis

The correspondence analysis results in Figure 2 elucidate the varying emphases placed on educational materials across distinct academic disciplines. Notably, students enrolled in teacher education programs exhibit a pronounced preference for subjects such as mathematics, physics, and chemistry, alongside educational theory and pedagogical methodologies. This pronounced interest indicates a foundational emphasis on the essential disciplines required for effective instruction in primary and secondary educational settings. The observed demand for educational literature in these domains suggests that teacher education

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curricula prioritize equipping future educators with a robust knowledge base and pedagogical strategies pertinent to STEM fields.

Conversely, students majoring in the arts display a particular affinity for categories such as Bioscience (S), Industrial Technology (T), and Transportation (U). This tendency can be ascribed to the interdisciplinary synergies between these fields and artistic practices. For example, Bioscience may resonate with those engaged in bio-art or environmental themes, while Industrial Technology could appeal to students focused on design innovation. Furthermore, the category of Transportation may connect to concepts of movement and design aesthetics within their artistic endeavors.

In contrast, psychology students prefer literature relevant to medicine and health (R). This trend likely reflects their commitment to comprehensively understanding the interplay between the human psyche and its implications for physical health and overall well-being. The confluence of psychological insights with medical knowledge emphasizes the significance of holistic approaches within psychology and healthcare.

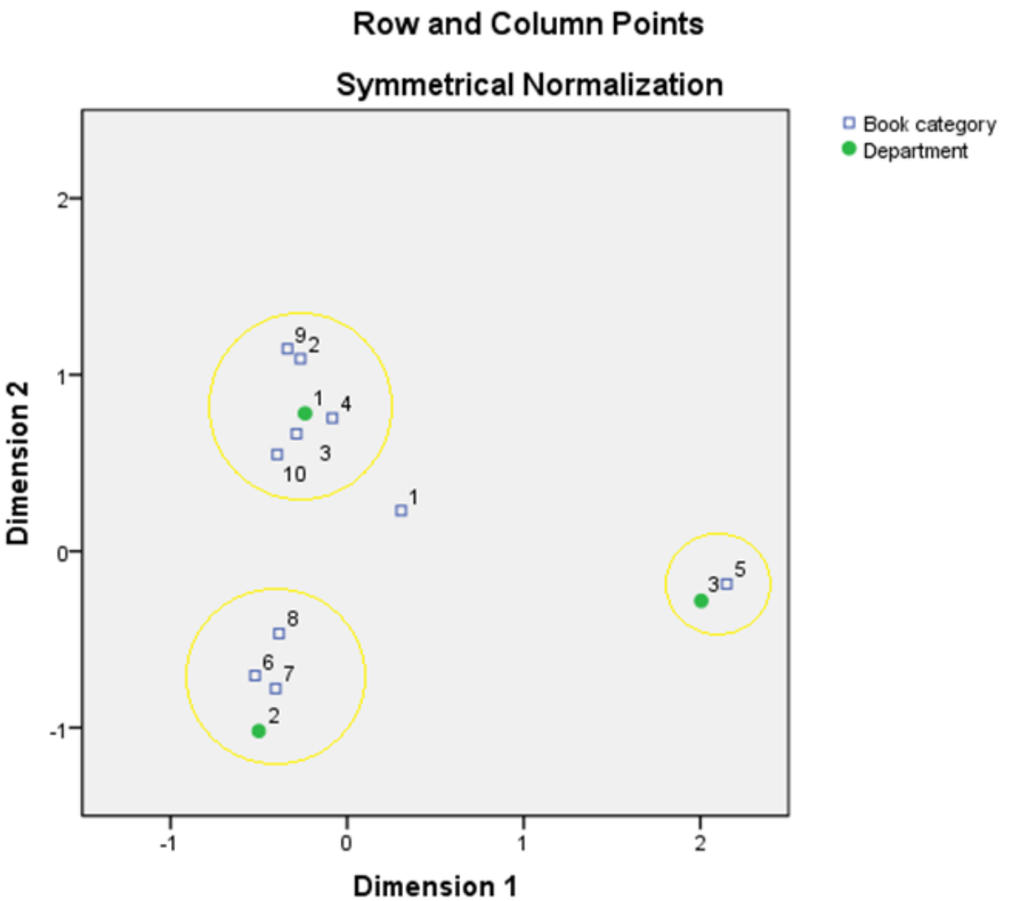


Figure 2. Correspondence of book category and department.

4.2.3. Subject of Books

The literature across various educational disciplines emphasizes the distinct pathways and professional requirements essential for both educators and students. This body of work highlights the critical importance of specialized resources in amplifying knowledge and skill development in science, technology, the arts, and psychology. The principal objective of teacher education programs is to equip prospective educators with the requisite competencies to instruct learners across a broad spectrum of subjects. As a result, a substantial demand exists for comprehensive resources, including textbooks and reference materials encompassing key areas like mathematics, physics, and chemistry (refer to image (a) in Figure 3). These resources reinforce foundational concepts and provide instructional materials tailored for various entrance examinations, which

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are pivotal for preparing students for advanced education. Moreover, educators often pursue research project guides, problem sets, and competition questions to foster students' critical thinking and problem-solving capabilities. In addition, resources that focus on algorithms, scientific experimentation, and programming languages are highly esteemed, particularly in the contemporary digital era, where technology plays a fundamental role in educational environments.

In contrast, the literature for those pursuing degrees in fine arts explores a more creatively inclined spectrum. The focal points for these educators and students include essential topics such as architectural design, which encompasses the principles of aesthetics and functionality within constructed environments. Literature on landscape design educates students on planning outdoor spaces, considering ecological impacts and community needs. Resources in industrial design are vital for understanding product development that balances usability and visual appeal. Furthermore, proficiency in graphic software and image processing tools has become increasingly critical, as these subjects represent cornerstones of modern artistic endeavors. Texts on animation and landscape planning not only serve to inspire creativity but also provide the technical competencies necessary for the successful execution of projects. Similarly, literature on production technology assists aspiring designers in comprehending the practical elements of bringing their concepts to fruition (refer to image (b) in Figure 3).

Within the realm of psychology, the literature demonstrates a profound engagement with the confluence of mental health and medical science. Both educators and students prioritize texts that explore various therapeutic practices, including divine therapy and psychological counseling, which address the spiritual and emotional dimensions of well-being. Scholarly works focusing on mental disorders such as depression, psychosis, and personality disorders are indispensable for a nuanced understanding of human behavior and the complexities of mental health challenges. Treatment methodologies, including psychoanalysis and behavioral therapy, are examined comprehensively, equipping future professionals with the necessary tools to assist distressed individuals. Additionally, emerging interests such as hypnotherapy and human factors engineering underscore the significance of understanding the interactions between individuals and systems. Resources detailing psychological diagnosis and rehabilitation training provide essential insights into the assessment and recovery processes for individuals grappling with psychological difficulties (refer to image (c) in Figure 3).

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Figure 3. Subject terms of books.

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4.2.4. Core Structure of Book Borrowing

Figure 4 illustrates the topological structures influencing book-borrowing practices, providing valuable insights within various academic disciplines. Notably, the teacher education major exhibits a more dynamic and less stable borrowing pattern, as evidenced by a narrower 4-core topological structure. The observed variability in borrowing practices suggests that students in this field may engage with diverse resources, reflecting the ever-evolving nature of curricula and pedagogical practices. Furthermore, this major's reliance on science and technology literature fluctuates significantly according to specific teaching methodologies or subject matter. This fluidity indicates that, while certain core materials are deemed essential, an imperative exists to adapt to contemporary educational trends, emerging technologies, and evolving educational standards, rendering the borrowing behavior of teacher education majors the most unstable among the examined disciplines.

The fine arts major demonstrates a comparatively stable and well-defined 5-core topological structure about borrowing science and technology texts. This stability implies that students within this discipline possess consistent preferences and established pathways that guide their borrowing habits. The core resources likely comprise foundational texts pivotal to interdisciplinary studies, effectively bridging creative expression with scientific inquiry. The materials encompassed within this 5-core structure are frequently utilized and deemed essential in supporting students' artistic and academic endeavors.

The psychology major occupies an intermediary position between the other two disciplines. It features a borrowing pattern that aligns more closely with the fine arts concerning stability, albeit remaining less delineated than the core structures observed in fine arts. Psychology majors' proclivity to engage with science and technology texts may mirror their necessity for empirical data and research methodologies. However, the extent of this engagement may vary depending on specific areas of specialization within psychology, including clinical, cognitive, or developmental psychology.

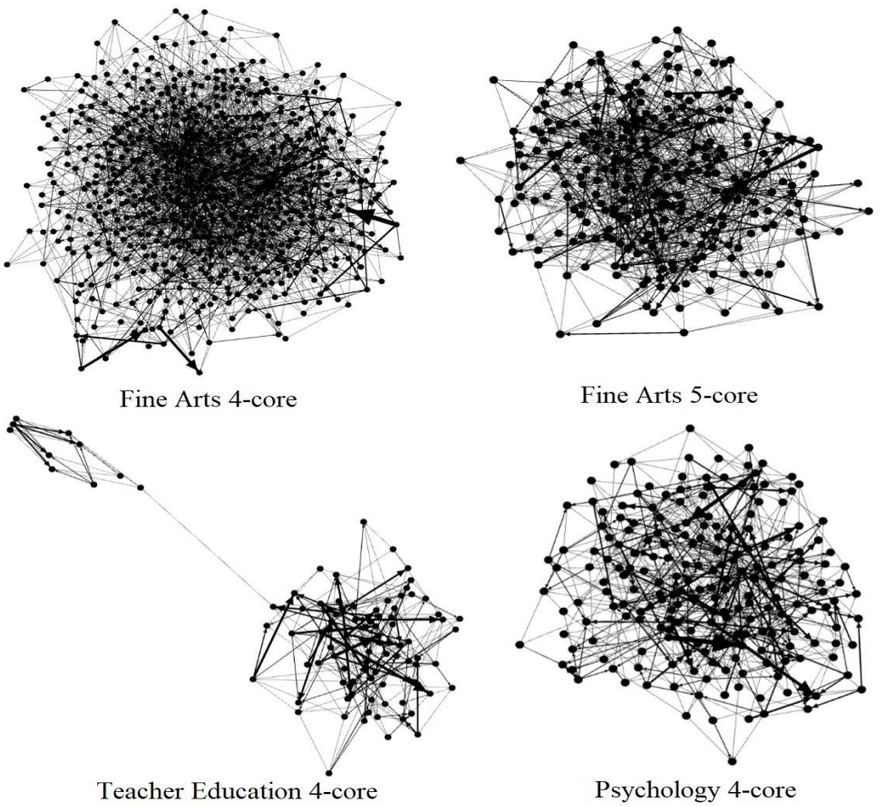


Figure 4. Topological structures.

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4.2.5. Prediction of per Capita Book Borrowing Volume

Figure 5 illustrates the analysis of book borrowing patterns within the School of Teacher Education, the School of Fine Arts, and the School of Psychology, revealing a significant downward trend. Each department has recorded a decrease in the per capita volume of books borrowed, indicating a potential decline in student engagement with library resources. A two-cycle moving average fitting method was employed to gain a deeper understanding of this trend, demonstrating a strong correlation and reliability in the data patterns observed across the three schools. This methodological approach enables smoothing fluctuations, thereby highlighting the underlying trend. The data further suggests that the borrowing volume of books in science and technology disciplines reflects specific periodic characteristics, indicating the existence of cyclical patterns in students' borrowing behaviors. These patterns may be associated with academic calendar events, course offerings, or broader trends related to technology utilization for research and academic purposes. Projections for 2024 estimate that the average per capita borrowing volume across these departments will be approximately three books per student. This anticipated figure underscores the continuing decline in borrowing rates, prompting inquiries into the factors influencing these trends, such as the availability of digital resources, curriculum modifications, or student study habits. Understanding and addressing these factors will enhance student engagement with library resources.

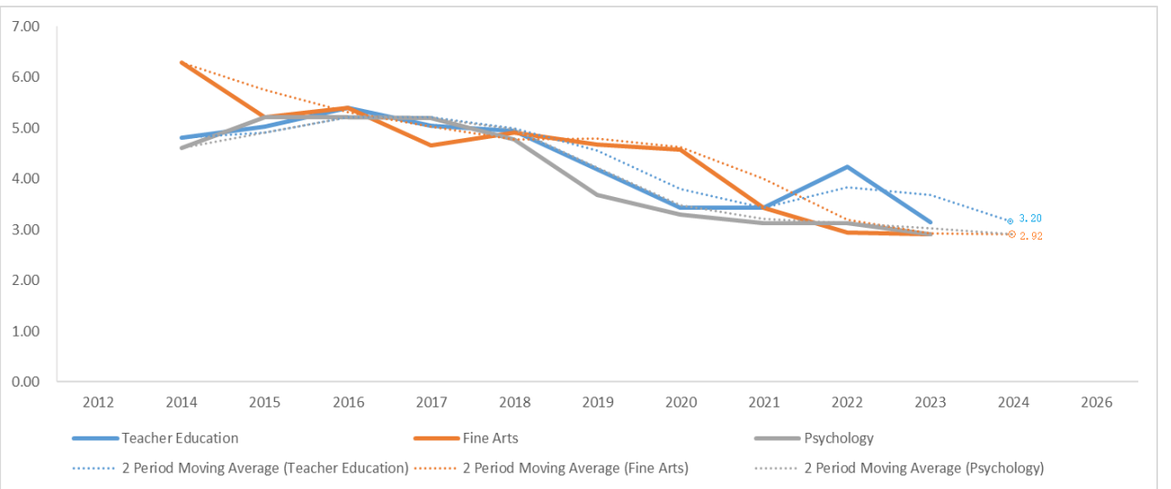


Figure 5. Per capita book borrowing volume.

5. Discussion

5.1. Gender Differentiation

Gender influences educational fields and resource use at Nanjing Normal University. A detailed examination of the borrowing patterns reveals significant gender differences. While more female students borrow science and technology texts, male students tend to check out a higher average number of these materials. This observation is fascinating in light of the higher enrollment rates of female students in teacher education and related disciplines. Hence, although females are more actively borrowing science and technology literature, males use this resource to borrow more texts on average. This contrast raises essential questions about the motivations and accessibility issues that might drive these differing borrowing habits. Are male students more motivated by intrinsic interests in science and technology, or do socio-cultural factors affect their behavior? On the other hand, what accounts for the higher borrowing frequency among female students despite their lower average checkout numbers? These dynamics call for further investigation to develop a more nuanced understanding of the relationship between gender, educational pathways, and resource utilization at Nanjing Normal University.

While the data does affirm a significant relationship between gender and specific aspects related to COVID-19, the weak relationship suggests that there are other variables at play. This raises important questions about what other factors might influence the relationship between gender and experiences related to COVID-19. Gender roles and societal expectations may have shaped how different demographics coped with the pandemic. For example, women often bear a disproportionate burden concerning caregiving and service

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roles during crises, and men may have exhibited higher risk-taking behaviors. Given the weak association suggested by the contingency coefficient, further qualitative research could help unpack the complexities of gender dynamics during this health crisis. Investigating the statistical data and personal narratives could provide a richer understanding of how gender has influenced experiences and outcomes related to COVID-19. Exploring social constructs and their implications on human behavior and occupational practices has garnered significant attention across multiple fields. The categorization of 'gender' and 'sex' exemplifies how societal norms shape our understanding of reality, further necessitating critical examination of these constructs in light of their biological claims (Pouliot-Morneau et al., 2024).

5.2. Inter Professional Penetration

Based on the data analysis and the findings, the discussion regarding the favorite book categories among the three departments suggests that each department may have distinct and varied interests in reading, which is reflected in the rankings or ratings each rater assigns. we can infer that the differences observed in the book preferences among the departments are not statistically significant. This implies that any variations in the rankings are likely due to random chance rather than a meaningful divergence in reading interests. Different curricula, faculty interests, and departmental objectives may contribute to each department's unique preferences. For instance, one department may lean towards popular science fiction or technological innovations, while another might prioritize classic literature or research-focused publications. Furthermore, the absence of strong agreement on book categories could point to broader trends in reading habits within the academic community. It might reflect a diversity of thought and perspective across disciplines, where each department prioritizes books that align with their academic goals and scholarly pursuits. Future research could benefit from qualitative methods such as interviews or focus groups to cultivate a better understanding of these diverse reading interests. These methods may elucidate the underlying motivations behind book preferences and help identify common themes or interests that may not have been captured in the quantitative analysis.

The correspondence analysis results reveal significant trends in the educational preferences of students across various academic disciplines, highlighting the specialized interests that shape their educational journeys. Starting with teacher education programs, it is evident that students prioritize subjects critical for effective teaching, particularly in STEM fields like mathematics, physics, and chemistry. This aligns with a broader educational goal of preparing future educators to excel in core subjects that form the foundation of primary and secondary education. The emphasis on educational theory and pedagogical methods further indicates that these students are not only focused on content knowledge but also on mastering the skills necessary to impart that knowledge effectively. The demand for educational resources in these areas underscores a strategic curricular approach that fosters a robust knowledge base among future teachers, equipping them with the tools to enhance student learning outcomes in science and math. The preferences of art students suggest a fascinating interdisciplinary intersection. Their affinity for Bioscience, Industrial Technology, and Transportation highlights how scientific and technological advancements increasingly inform artistic practices. This trend suggests that the arts are evolving to incorporate a broader range of influences, leading to innovative forms of expression that bridge traditional boundaries. For instance, the connection between Bioscience and bio-art illustrates how environmental concerns and scientific concepts can inspire creative endeavors. Industrial Technology and Transportation reflect a desire to explore the aesthetics of design and movement. This interdisciplinary approach exemplifies the potential for cross-pollination between the arts and sciences, enriching both fields and enhancing creative problem-solving skills.

The focus of psychology students on medical and health-related literature presents an intriguing view of their academic priorities. These students demonstrate a commitment to a holistic understanding of health by emphasizing the connections between mental health and physical well-being. This trend may reflect the growing recognition of the importance of integrating psychological insights into medical practice, aligning with contemporary movements toward collaborative care that recognize the multifaceted nature of health. Their preferences suggest an awareness of the critical role of psychological factors in medical outcomes, thus advocating for a more comprehensive approach to education in psychology and healthcare.

The emphasis on specialized resources across educational disciplines highlights the necessity for tailored materials to maximize knowledge absorption and skill acquisition. This is particularly crucial in fields like science and technology, as students need to understand theoretical concepts and practical applications. The

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availability of resources designed for entrance examinations and project-based learning encourages a more hands-on approach to education, which can significantly enhance student engagement and preparedness for future challenges. The focus on creatively inclined subjects such as fine arts illustrates that education is not solely about technical knowledge; it also requires fostering creativity and aesthetic sensibility. This raises important questions about how educational institutions balance these two aspects. Can a more structured approach to teaching fine arts benefit students, or does it risk stifling their creativity? Integrating graphic software and animation tools suggests blending art with technology, challenging the traditional boundaries between disciplines.

The connections between disciplines, especially in psychology, reveal a growing need to understand human behavior in a way that incorporates mental health and technological advancements. As psychology students increasingly study therapeutic practices alongside the impact of human factors engineering, a deeper understanding of mental health and technology interplay is essential in today's digitally driven world. As future educators and professionals emerge, the stress and challenges associated with academic environments can negatively influence well-being. Thus, incorporating mental health education into teacher training and curriculum development is necessary. How can educational institutions better equip future educators to address these classroom challenges? The evolution of educational requirements in the digital era prompts a re-examination of traditional educational frameworks. With rapidly advancing technology and a changing job market, how can educational systems adapt to promote technical skills and creative thinking? There is a growing need to rethink teaching methodologies and resources to be relevant and engaging for today's students, preparing them to navigate an increasingly complex world.

Bedewy and Lavicza's (2023) introduction of the STEAM + X framework highlights the importance of transcending traditional boundaries between disciplines, allowing for a richer, more integrated educational experience. As technology continues to reshape learning environments, especially after the COVID-19 pandemic, the role of advanced tools such as augmented reality and 3D printing in enhancing mathematical understanding and creativity becomes increasingly vital. The emphasis on real-world problem-solving through visualizations and modeling signifies a growing trend in educational research, pointing towards significant shifts in student and teacher behaviors. The question underscores these shifts, "Can you create?" and suggests promising pathways for integrating novel technologies within the classroom and beyond. This evolution in educational practices enhances students' engagement and facilitates crossing subject boundaries—a key aspect of STEM education (Haas et al., 2023).

5.3. Within a Major

The analysis of topological structures in book-borrowing practices across different academic disciplines sheds light on students' varying needs and behaviors within these fields. By contrasting the teacher education, fine arts, and psychology majors, we can observe how their unique educational focuses influence their resource engagement. The teacher education major's dynamic borrowing patterns reveal a significant aspect of modern education's fluidity. As teaching methodologies and curricula evolve, students in this field must remain flexible in resource use. The narrower 4-core structure suggests that while key texts are recognized as essential, reliance on a broader range of literature is crucial. This adaptability is vital for incorporating contemporary educational trends and technology into their learning processes, reflecting that effective teaching strategies must continually adapt to a rapidly changing landscape. In this context, addressing persistent challenges in teacher professional development—such as moving away from transmissive teaching methods, generating a significant shift in teaching beliefs, and ensuring scientific rigor in evaluating teacher training programs—will be crucial for fostering meaningful change (Romero-Ariza et al., 2021). Furthermore, the concept of agency within professional settings underscores the paradox of autonomy and the complexities educators face in a digitized environment (Roumbanis Viberg et al., 2021).

On the other hand, the fine arts major's 5-core structure illustrates a more stable and defined approach to borrowing science and technology texts. This stability indicates that students in this discipline tend to have established preferences that support their artistic and academic growth. By bridging creative expression with scientific inquiry, these foundational texts are likely indispensable tools in their studies, which may lead to a broader understanding of interdisciplinary connections. The intersection of contemporary art practices with health reveals a complex discourse that challenges traditional evaluative frameworks, suggesting a wider context for understanding the contributions of arts in healthcare (Broderick, 2011). In contemporary design

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education and practice, a persistent gap exists between the academic insights design scholars provide and the practical needs of design practitioners. This disconnect has been identified as the research-practice gap, characterized by challenges such as abstraction, communication barriers, and misalignments in knowledge needs, which hinder the effective transfer and application of knowledge. Design academics often struggle to engage meaningfully with design practice, while practitioners create valuable local knowledge unrecognized by academia (Smeenk et al., 2024). In addressing this gap, it is crucial to support local knowledge production, particularly when involving citizens and policymakers as non-professional designers who require generative tools for their social design projects.

Psychology majors sit in an intermediary position, reflecting a blend of stability and variability in their borrowing behaviors. Their engagement with science and technology texts emphasizes the discipline's reliance on empirical data and research, which is crucial in clinical and cognitive psychology. However, the less delineated borrowing patterns suggest that psychology students might still explore different pathways and resources to support their specific areas of interest. The unique topological structures of borrowing reflect each discipline's distinct educational priorities and practices. Libraries and educational institutions should consider these patterns when allocating resources and designing support systems, as understanding these differences can lead to more effective strategies for meeting students' diverse needs. Such insights can ultimately enhance the educational experience, ensuring students can access the right materials to support their academic endeavors and professional development. The intricate relationships between social constructs, professional development, and the underlying systems that influence agency and change emphasize the need for comprehensive analyses in diverse contexts such as education and healthcare.

Moreover, understanding professional learning as both learning in and for professional practice adds another layer to this dialogue. The theory of practice architectures, developed in educational contexts, provides a framework for examining the complexity of learning through relational aspects such as power, trust, recognition, and agency (Salo et al., 2024). This multifaceted approach highlights the importance of recognizing educators' social dynamics and professional growth within specific sites and timeframes. As educators grapple with fostering inclusive and effective learning atmospheres, a greater understanding of social dynamics can provide invaluable insights. Realizing this potential can yield multiple advantages: interventions targeting social processes can lead to several positive outcomes, seemingly minor changes elicit disproportionately large effects, and fostering positive interaction patterns can create lasting shifts in the classroom culture (Gehlbach, 2010).

5.4. Development Trend

The reported trend of decreased per capita borrowing across these departments signals a shift that could indicate broader changes in how students access and utilize information. One noteworthy aspect of the analysis is using a two-cycle moving average fitting method, which effectively smooths out short-term fluctuations to reveal more stable trends. This approach enhances the reliability of the findings and underscores the importance of adopting robust methodologies in data analysis. The strong correlation identified across the three departments suggests that this decline in borrowing is not an isolated issue but may reflect a systemic shift in student behaviors. The presence of cyclical patterns, particularly in science and technology disciplines, indicates the influence of environmental factors such as the academic calendar, course offerings, and technological advancements. These cyclical characteristics imply that students adapt their resource utilization based on specific events or requirements throughout the academic year, raising questions about traditional library resources' relevance in meeting their needs. The projected decline to an average borrowing volume of three books per student in 2024 further highlights the urgency of this situation. It compels educational institutions to examine the potential factors contributing to this trend. The growing reliance on digital resources is one likely explanation, as students may prefer online materials that provide immediacy and ease of access. Additionally, shifts in curriculum and study habits could further influence borrowing behaviors, suggesting that libraries may need to reassess their offerings and services.

The introduction of AI alters interaction dynamics among students, teachers, and educational technology, necessitating a more collaborative approach to its integration. A deeper understanding of AI fundamentals and ethical considerations is paramount, as findings suggest that many pre-service teachers view AI as a mechanical tool rather than a dynamic collaborator in education. This necessitates transforming teachers'

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roles, transitioning from traditional leaders to supportive collaborators, and enabling student-centered learning experiences (Guan et al., 2024).

In addition to the technological advancements in education, there is a significant emphasis on supporting teacher well-being within schools. Promoting teacher well-being is vital, as it contributes to a positive educational environment for educators and students. Professional development programs designed to enhance well-being can be particularly effective at the school level, ensuring all staff members benefit from these initiatives (Vo & Allen, 2022). Traditional professional learning has often concentrated on refining teaching practices; however, prioritizing holistic student development through school-based well-being interventions has shown promising results, indicating that similar approaches could beneficially impact teachers (Vo & Allen, 2022). This introduction highlights the interconnection between AI integration in education and the well-being of teachers, setting the stage for a broader discourse on enhancing educational practices for the future. The importance of teachers' professional learning highlights the interplay between leading practices and their effects on school development, prompting further exploration of the dynamics between development leaders and teacher leaders (Sülau et al., 2024).

5.5. Library Response

The term "library" originates from the Latin word "liber," signifying "book." Libraries play a crucial role in providing a wide array of educational materials, including collections of books, electronic resources, periodicals, multimedia content, and referral services. Moreover, the term encompasses the physical space that houses these resources (Shukla et al., 2013; Abumandour, 2021). Several researchers have explored the correlation between students' library usage and academic achievements, including GPA, retention rates, and degree attainment. Findings indicate a robust positive correlation between library utilization among humanities students and their GPA, while a weaker correlation is observed in STEM and social science disciplines (Allison, 2015; Scoulas, 2021). Additional studies have highlighted that STEM students frequent library facilities less than their non-STEM counterparts (Hackman et al., 2016; Yu et al., 2018; Scoulas, 2021). However, online engagement patterns reveal mixed results, with non-STEM undergraduates exhibiting a marked preference for printed citation manuals, style guides, and specialized references, alongside a lower inclination toward eBooks in scholarly monographs (Hackman et al., 2016; Scoulas, 2021). In evaluating students' perceptions of library service utility, it has been found that non-STEM respondents assign more excellent value to the library's role in preserving resources, developing research skills, and providing assistance in resource discovery and ethical information usage compared to their STEM peers (Yu et al., 2018; Scoulas, 2021).

The evolving landscape of academic and public libraries presents a critical opportunity for enhancing student engagement and promoting academic success, especially within STEM fields. As evidenced by the findings of Scoulas (2021), the distinct needs and perceptions of STEM students regarding library resources underscore the necessity for targeted strategies that bridge gaps in usage and access. Furthermore, the initiatives highlighted by Abumandour (2021) regarding the role of public libraries in e-learning signify the importance of these institutions in promoting STEM literacy and broadening educational opportunities. By integrating digital literacy components and fostering collaborative partnerships, libraries can adapt to today's learners' changing demands and ensure that they remain vital contributors to the educational journey. Ultimately, prioritizing understanding and supporting users' needs will cultivate an enriching environment that enhances academic performance and lifelong learning in a technology-driven society.

6. Conclusion

The findings of this study illuminate significant trends and patterns in the borrowing behaviors of liberal arts students concerning science and technology literature. The analysis reveals marked differences in how students from various disciplines engage with these materials, highlighting the influence of demographic factors and the effects of the COVID-19 pandemic on borrowing habits. Specifically, chi-square tests indicate a noteworthy relationship between gender and borrowing frequency, suggesting that gender dynamics influence students' interactions with science and technology texts. The ranking of book categories and correspondence analysis demonstrate distinct department preferences, with teacher education students exhibiting a higher engagement with technology-related literature than their fine arts and psychology peers. Given that liberal arts students show an interest in science and technology literature, academic institutions

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must cultivate this curiosity by integrating relevant themes into their curricula and providing specialized resources. Enhancing interdisciplinary dialogue will facilitate students' navigation of complex texts and prepare them for a workforce that increasingly values cross-disciplinary skills. The visualized predictions of borrowing trends provide valuable insights for effective academic resource management, enabling libraries better to align their collections with students' evolving interests. By fostering an academic environment that encourages exploration across disciplines, universities can significantly enhance students' educational experiences and professional readiness, ultimately promoting a more holistic understanding of the interconnected nature of knowledge in today's society.

The stable 5-core structure of the fine arts major underscores its reliance on a defined set of essential texts that merge artistic creation with scientific insights. This stability reflects a clear framework within which students navigate their academic pursuits, providing a solid foundation for exploring complex interdisciplinary themes. In contrast, the psychology major demonstrates a more fluid borrowing pattern, indicating a balance between foundational texts and the variability introduced by specialized areas. This suggests that while psychology majors recognize the importance of empirical and research-based literature, their engagement with these resources may vary significantly based on their specific fields of study. The fluctuating 4-core topology of the teacher education major emphasizes the need for adaptability in an ever-evolving educational landscape. As teaching methodologies and pedagogical theories continue to evolve, the variability in borrowing habits reflects the necessity for educators to remain current with trends and innovations in both education theory and practice.

The projected average borrowing rate of approximately three books per student in 2024 underscores a broader trend of diminishing engagement with traditional library resources. This decline prompts critical inquiries into the evolving landscape of student research methodologies and learning habits. Factors contributing to this trend include the increasing availability of digital resources, shifts in curricular demands, and the evolution of academic study behaviors that warrant comprehensive examination. In light of these developments, it is essential for educational institutions to rigorously adapt their library services and resource offerings to meet the changing needs of students across diverse academic disciplines. In the contemporary, rapidly evolving academic environment, libraries must transcend conventional roles and actively engage students in meaningful interactions with the resources they provide. This objective can be pursued through strategic initiatives, including enhanced digital access, targeted workshops, and tailored support systems.

Enhanced digital access constitutes a cornerstone of modern library services. As many students favor online research over physical library visits, libraries must invest in robust digital platforms that facilitate seamless access to a wide array of resources. These resources should encompass e-books, online journals, databases, and digital archives, ensuring that students from all disciplines can readily locate and utilize pertinent materials from any location and at any time. Furthermore, the library's digital interface must be user-friendly and have advanced search functionalities that accommodate diverse academic backgrounds and needs. Additionally, targeted workshops are crucial for fostering a deeper connection between students and the extensive knowledge available through library resources. By offering discipline-specific workshops, librarians can impart essential research skills tailored to the various fields of study. Topics covered in these workshops may include effective literature reviews, citation management, data analysis, and the use of specialized databases pertinent to specific academic disciplines. Engaging students in hands-on learning experiences enhances their research capabilities and cultivates confidence in navigating library resources effectively. Moreover, tailored support systems are integral to creating a supportive academic environment. Libraries can implement personalized research consultations, whereby students receive one-on-one assistance from librarians with detailed knowledge of their specific disciplines. This approach addresses students' unique challenges, enabling them to overcome barriers to proficiently accessing and utilizing library resources. Furthermore, establishing collaborative partnerships with academic departments can facilitate more effective integration of library resources into the curriculum, thereby reinforcing the library's value within the milieu of the academic journey.

Lastly, as libraries anticipate the future exploration of science and technology literature relevant to university liberal arts majors, they must proactively curate collections that bridge the gap between liberal arts and STEM disciplines. This may involve acquiring interdisciplinary texts that investigate the intersections of the arts, humanities, and scientific inquiry, empowering liberal arts students to engage with contemporary advancements and contribute thoughtfully to discussions surrounding technology and society. Overall,

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understanding students' distinctive borrowing behaviors and preferences across various disciplines is vital for effectively allocating resources. This can be achieved through conducting surveys and analyzing circulation data to identify patterns and trends in resource utilization. By tailoring collections to reflect the interests and needs of diverse academic programs, libraries can provide relevant and sought-after materials, enriching the academic experience for all students and promoting a culture of inquiry and collaboration.

7. Limitations

While this study provides valuable insights into the borrowing behaviors of university students within the teacher education, fine arts, and psychology departments at Nanjing Normal University, several limitations must be acknowledged: The research is limited to a specific population of 4,864 students from three departments at one university over a ten-year span. This confinement may not fully represent the borrowing behaviors of liberal arts students across different institutions or regions, potentially limiting the generalizability of the findings. The study focuses solely on teacher education, fine arts, and psychology, which may not reflect the borrowing trends of other liberal arts disciplines. Different fields may exhibit unique borrowing patterns and preferences, which are not captured within this analysis. The inclusion of data before and after the COVID-19 pandemic introduces potential confounding factors. Changes in library access, academic routines, and student engagement during the pandemic could have influenced borrowing behaviors in ways not fully accounted for in the study. The analysis primarily employs quantitative measures, utilizing chi-square tests and SPSS for statistical evaluation. This focus may overlook qualitative factors influencing borrowing behaviors, such as personal interests, motivations, and experiences, that could provide a deeper understanding of students' engagement with science and technology literature. The study does not delve into the psychometric properties of the borrowing practices or survey instruments used. Consequently, potential biases in self-reporting or borrowing motivations might impact the accuracy of the findings. Future predictions based on past borrowing trends may not account for evolving academic landscapes, emerging technologies, or shifting curricular priorities that could affect student engagement with science and technology literature. The reliance on the Chinese Library Classification System for categorizing books may introduce biases based on its classification criteria. Factors such as cultural context and the evolving nature of science and technology literature are not necessarily captured in a rigid classification framework. Acknowledging these limitations is essential for contextualizing the findings of this study and outlining areas for future research that can address these constraints and enhance our understanding of academic resource utilization among liberal arts students.

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