

Exploring Reading Habits in the School of Life Sciences Before and After COVID-19

Jiexuan Liu*

Library of Nanjing Normal University, Nanjing Normal University

*Corresponding author: Jiexuan Liu, librarian, Nanjing Normal University. <https://orcid.org/0000-0002-7378-6863>.

Submitted: 02 January 2025 Accepted: 08 January 2025 Published: 13 January 2025

doi <https://doi.org/10.63620/MKJPNR.2025.1060>

Citation: : Liu, J. X. (2025). Exploring reading habits in the School of Life Sciences before and after COVID-19. *J of Psych and Neuroche Res*, 3(1), 01-11.

Abstract

This study examines reader borrowing records from Nanjing Normal University library (2014-2023), analyzing 36,557 records from 2,122 readers. It focuses on extracting book titles in MARC format, performing word segmentation, and visualizing keyword frequency through a word cloud map. A chi-square test evaluates gender differences in borrowing patterns across liberal arts and science categories. Factor analysis applies KMO and Bartlett's tests for multivariate suitability and identifies common factors via maximum variance rotation. A structural equation model investigates correlations among latent variables, enhancing understanding of borrowing trends and demographics in academic libraries. The study shows differences in the reading preferences of male and female borrowers before and after the pandemic. There was a consistent gender imbalance in borrowing frequency, with females outnumbering males, but in the five years following the outbreak, men's borrowing rate exceeded that of women. Four main factors—Humanities, Rationality, Health, and Security—were found to significantly affect book choices, with Security showing the most robust linkage to Humanities.

Keywords: Biology, Book, Factors, Structural Equation

Introduction

Biology is a dynamic and multifaceted field that explores the myriad aspects of life, ranging from microscopically to macroscopically. It profoundly impacts various sectors, including agriculture, medicine, and environmental protection. As the cornerstone of the natural sciences, biology addresses fundamental questions about life and intersects with various disciplines, underscoring the importance of collaborative and multidisciplinary research. This trend is increasingly recognized in scientific studies and publications that connect diverse fields, such as social sciences, natural sciences, and technology, with core disciplines like communication and computer science facilitating interdisciplinary collaborations [1]. The evolution of biology as a field has paralleled advancements in physics and chemistry, especially during the 19th century, which laid the groundwork for experimental biology and the emergence of specialized disciplines such as physiology, bacteriology, and biochemistry. Notably, the methodologies employed span observational and comparative approaches to experimental techniques, leading to groundbreak-

ing discoveries, including the development of cellular theory, and expanding into areas like embryology, cytology, and genetics by the late 1800s [2].

In the educational landscape, biology learning encapsulates the exploration of students' perceptions and experiences within their courses, significantly influenced by their scientific identity. This multifaceted construct involves how students perceive themselves as science learners and practitioners and their recognition and competence in the field. Recent efforts have focused on adapting instruments to measure discipline-specific science identities, capturing essential aspects such as competence, performance, interest, and confidence [3]. Understanding biological concepts poses unique challenges, as these concepts are often characterized by complexity and counterintuitive processes, such as photosynthesis, energy transformations, and evolution. Moreover, students frequently encounter misconceptions influenced by everyday observations and cultural discourses, complicating their grasp of scientific knowledge [4]. As students

navigate their biology education, they must synthesize information from diverse texts to build a comprehensive understanding of physiological systems and other biological phenomena. This intricate interplay between knowledge acquisition and identity development in biology highlights the need for practical educational approaches to promote deeper conceptual understanding and address prevalent misconceptions.

Biology learning presents unique challenges for students, particularly as they navigate the intricate web of information required to understand various physiological systems and their interactions within the human body. This complexity underscores the necessity of integrating knowledge from multiple texts to build a cohesive understanding of biological concepts [5]. Conceptual change is central to the educational process, highlighting two primary forms of transformation: knowledge enrichment and knowledge restructuring. Knowledge enrichment allows students to expand their existing frameworks without overhauling their core beliefs. In contrast, knowledge restructuring involves a deeper reevaluation of pre-existing knowledge structures, effectively correcting misconceptions and fostering a more accurate comprehension of scientific phenomena [6]. To effectively guide students in transforming their understanding, educators must recognize the challenge posed by intuitive reasoning, which often leads to misconceptions, especially in areas like evolution. Research indicates that the strategies employed in reading and comprehension significantly impact students' metacognitive skills and their ability to engage with the material [7]. Furthermore, incorporating primary scientific literature into biology education enables students to engage directly with contemporary research, enhancing their appreciation for the nature of scientific inquiry and its empirical foundations [3]. This multifaceted approach necessitates assessing students' prior knowledge and misconceptions, enabling educators to tailor instruction that encourages critical evaluation and synthesis of scientific information. Fostering an environment that supports rigorous analysis alongside foundational reading skills is essential for cultivating a deep and lasting comprehension of biology. Recent studies highlight that emphasis on discipline-specific epistemic beliefs further enhances students' understanding of scientific principles, equipping them for future academic success [8].

The significance of this research lies in its multifaceted approach to understanding the complexities of learning and teaching scientific concepts, particularly in the context of evolving educational landscapes shaped by recent global events. This research contributes to the knowledge that seeks to improve pedagogical strategies by systematically examining the transition from misconceptions to a solid understanding of scientific concepts. Recognizing and addressing these misconceptions can enhance students' comprehension and retention of scientific material. The focus on diverse student backgrounds and needs underscores the importance of inclusive education. By tailoring educational approaches to various demographics, including gender and socio-economic factors, this study aims to promote equity in learning outcomes, particularly in STEM fields where disparities persist. Investigating the shifts in educational content and teaching methods pre- and post-pandemic allows for a critical understanding of how these changes have influenced learning environments. The findings will provide valuable insights to help educators design responsive curricula that better address

students' evolving needs in a post-pandemic world. By highlighting the barriers female students face in STEM subjects, this research can inform policies and practices that promote gender equity in education. Identifying specific obstacles enables stakeholders to implement targeted strategies encouraging female participation and success in these critical fields. Exploring latent variables and their role in predicting student engagement with external learning resources adds depth to our understanding of how students interact with scientific materials. This knowledge can lead to developing more effective educational tools that align with student behaviors and preferences. Analyzing reading interests and habits across different education levels helps illuminate the specific needs of biology students and researchers. Understanding these preferences can inform the creation of tailored reading materials and resources that enhance the academic journey at various stages of education. Ultimately, this research aims to provide a framework for improving educational strategies, resources, and support systems in the biological sciences. By recognizing and addressing the diverse needs of students and researchers, the findings can lead to more effective and responsive educational environments. This research holds significant potential to influence teaching and learning practices within the scientific community, providing valuable insights that can foster a more inclusive, effective, and equitable educational landscape.

Previous Researches

The landscape of biology education has evolved significantly, reflecting an increasing recognition of interdisciplinary approaches that enhance learning outcomes. The intersection of art and biology emerges as a valuable framework for promoting more profound understanding and innovative thinking in both fields. The convergence of art and biology challenges traditional educational boundaries and provides a rich context for students to engage with complex scientific ideas. highlight how integrating creativity and critical thinking from the arts can enhance biology education, fostering innovative problem-solving skills in students [9]. This approach is essential in an era where effective science communication is vital, particularly for engaging non-expert audiences. Further evidence of the benefits of this interdisciplinary methodology is found in the transformative nature of projects that combine artistic practices with ecological and engineering principles [10]. The work of emphasizes that such collaborations can yield impactful solutions to environmental challenges, showcasing how creative endeavors can raise awareness and drive societal changes. Although the results of these projects may not be quantifiable through conventional scientific metrics, their societal value and ability to address pressing issues are notable.

In education, integrating art into STEM to create STEAM has been posited to enhance student engagement and understanding of scientific principles. argue that this approach fosters a more holistic educational experience, allowing students to appreciate the interconnectedness of various knowledge domains [11]. This broader perspective enriches the learning experience and prepares students to tackle complex problems creatively. Moreover, the role of engagement in conservation biology is particularly relevant. assert that incorporating artistic practices into conservation efforts can evoke emotional responses that promote biodiversity [12]. Such engagement underscores the importance of participatory science and interdisciplinary programs

in advancing the understanding of human-nature relationships and encouraging behaviors that support conservation initiatives. Philosophy complements this interdisciplinary approach by providing critical perspectives on the scientific process. Biology's historical and philosophical foundations enrich science communication, offering a comprehensive framework for explaining scientific concepts to diverse audiences. notes that effective communication requires a deep comprehension of scientific principles, which can be enhanced through historical and philosophical inquiry [13]. This understanding promotes an appreciation of biology's intrinsic value beyond its practical applications in agriculture and medicine.

The literature suggests that integrating art, philosophy, and biology creates a dynamic educational environment that fosters creativity, interdisciplinary collaboration, and critical engagement. This synthesis enhances students' learning outcomes and prepares them to confront societal and environmental challenges with innovative approaches. As the field of biology education continues to evolve, the merging of these disciplines holds significant promise for shaping the future of learning and understanding in the biosciences. The intersection of various scientific disciplines, including biology, physics, chemistry, and mathematics, has advanced our understanding of complex biological phenomena. It synthesizes critical contributions from these fields and highlights their collaborative potential.

In evolutionary biology, integrating philosophical frameworks has significantly enhanced both disciplines. Philosophy provides conceptual clarity and aids in understanding how evidence influences the acceptance of hypotheses. Kaplan (2016) noted that evolutionary biology has, in turn, opened new avenues in philosophy, addressing traditional philosophical questions and resolving some long-standing issues [14]. This reciprocal relationship underscores the importance of cross-disciplinary dialogue in advancing our ideas about evolution and its implications. Education plays a crucial role in bridging biology and social issues. Incorporating social perspectives into biology education enhances students' scientific literacy, enabling them to make informed decisions and understand the connection between science and society. Tran et al. (2024) argue that improving scientific literacy involves empowering students to recognize societal inequalities and the science-society relationship [16]. This integration is essential for cultivating critical thinking and scientific literacy among students, positioning them to engage thoughtfully with contemporary issues. Lempke (2014) explored the relationship between students' beliefs about intelligence and their performance in biology courses, revealing the negative impact of fixed (entity) beliefs on persistence in STEM fields [16]. Their findings highlight the necessity of fostering a growth mindset to bolster student retention in STEM disciplines. Furthermore, the study underscores the importance of biology course grades and domain knowledge in influencing dropout rates, suggesting that targeted support in biology can enhance persistence in these fields. Mathematical and computational models are fundamental within systems biology. Sordo Vieira and Laubenbacher (2022) stressed the significance of model credibility, especially when these models guide experiments, drug development, or optimize patient treatments [17]. The complex nature of biological systems presents challenges in replicating behaviors and properties, necessitating precise model specification and dissemination

standards [18]. Greenbaum and Carja (2024) reviewed population biology, noting its heavy reliance on mathematical models and theoretical developments to understand biological population dynamics [18]. Their work illustrates the value of integrating mathematical frameworks in ecological and evolutionary research, driving significant advancements within the field.

Interdisciplinary collaboration is also prominent in protein science. Woolfson (2023) highlighted how computational methods have revolutionized predictions and designs of protein structures. Physics provides insights into coiled-coil backbone structures, chemistry explores sequence-to-structure relationships, and biology reveals functional adaptations. The collaboration between different disciplines is driving innovations in synthetic biology. The potential of physics to enhance our understanding of biological systems is further emphasized by Farnsworth (2022) and Marko (2020) [19, 20]. Farnsworth posits that new physical laws may be necessary to fully comprehend living systems, particularly regarding the accumulation of information in biological systems versus non-living ones. Marko illustrates the application of physics in studying processes within living cells, especially in chromosome biology, highlighting the importance of physical concepts in illuminating the mechanisms of cellular function. Zhu et al. (2024) discuss the transformative impact of photochemistry on medicinal chemistry, where light-induced reactions expand the range of chemicals available for drug discovery and development [21]. Integrating photochemical techniques in chemical biology, particularly in spatiotemporal drug activation and targeted delivery, promises to revolutionize therapeutic strategies and offer more effective treatments [22]. Emphasizes the importance of genetic and environmental factors influencing human behaviors, including criminal tendencies. The advancements in biology, genetics, and neuroscience contribute to this discourse by providing a clearer picture of how these factors intertwine. This body of research champions a holistic approach in criminology that marries biosocial perspectives with social learning theory, facilitating a deeper understanding of criminal behavior beyond simple attributions of nature or nurture. The implications of such an integrated perspective extend into medical practice as well [23]. Introduce the concept of Biosocial Medicine, advocating for a comprehensive integration of an individual's biology and personal history. This innovative approach shifts the focus from generic, population-level studies to a patient-centered clinical care model. Such a framework recognizes the uniqueness of individual patients and aims to transform clinical research and practice, ensuring that healthcare delivery is tailored to the specific needs of each individual.

Environmental education also plays a crucial role in shaping behaviors and enhancing understanding of biosocial factors. In Malaysia, for instance. Abdullah et al. (2011) highlight the integration of environmental education across all subjects in both primary and secondary levels, with biology positioned as having a superior capacity to incorporate ecological knowledge compared to physics and chemistry [24]. This integration underlines the significance of educational systems in fostering a comprehensive understanding of how environmental factors interact with genetic predispositions, thus shaping behaviors from an early age. Future research pathways in this domain are also promising. Motsinger-Reif et al. (2024) outline the importance of investigating gene-environment interactions (GEIs) [25].

Their work underscores the necessity of understanding the intricate interplay between genetic and environmental factors in disease etiology, emphasizing the significance of GEIs across different stages of human development. This line of inquiry can enrich our understanding of personalized healthcare and disease prevention methodologies.

Overall, this literature underscores the importance of interdisciplinary approaches in advancing our understanding of biological phenomena. Researchers can uncover new dimensions of life's complexities by integrating insights from biology, mathematics, physics, chemistry, and other fields. The collaboration across disciplines fosters innovation and addresses some of the most pressing challenges faced in science today, paving the way for novel solutions in medicine, criminology, and beyond. This body of work highlights the transformative potential of cross-disciplinary collaboration in scientific research and education. The multidisciplinary approach to understanding human behavior, as articulated through the integration of biosocial perspectives, highlights the complexity behind the interactions of genetic and environmental factors. The ongoing research in these areas promises to unveil further insights into personalized care and the holistic understanding of criminal behaviors and health outcomes, reinforcing the need for comprehensive strategies in both fields.

Previous research on the connections between interdisciplinary subjects and biology has several limitations that should be considered. Many studies have concentrated on specific disciplines or a narrow range of biological themes, overlooking the broader interdisciplinary connections that could influence reading preferences. Various research methodologies have been employed, but these often need more consistency, making comparing findings across different studies difficult. Qualitative studies delve deeply into specific contexts but may need to generalize better, while quantitative studies miss nuanced insights. Previous research may have needed to adequately account for time's impact on reading preferences. For instance, reading habits can change significantly over time due to external factors such as societal shifts or technological advancements. Many studies may have relied on limited or non-representative samples, which could skew results. For example, focusing primarily on academic settings may not truly reflect the diverse interests and choices of the general population. Previous research often does not consider the impact of major external events (like the COVID-19 pandemic) on reading habits. As such, findings may become outdated or not fully representative in light of significant societal changes. Many studies only provide snapshots of reading preferences without examining how these preferences evolve. Longitudinal data could yield richer insights into trends and changes in reading habits. More exploration of how interactions among various disciplines might synergistically influence reading choices must be conducted. This gap hampers a comprehensive understanding of the dynamics at play. The shift towards digital media has transformed reading habits, yet many studies still need to adequately address the implications of this shift, particularly among

biology readers. Addressing these limitations in future research could enhance our understanding of reading preferences and the dynamic nature of interdisciplinary connections with biology.

Date and Methods

Word Cloud Map

The dataset encompasses 30,247 reader borrowing records between 2014 and 2018 and 6,310 from 2019 to 2023 at Nanjing Normal University library. The objective is to extract the title fields of the borrowed books in MARC format, conduct word segmentation, analyze keyword frequency, and generate a word cloud map.

Chi-Square Test

The dataset comprises 1,605 readers from 2014-2018 and 753 readers from 2019-2023. The borrowed books are categorized based on their classification number into liberal arts (classification number A-K) and science (N-X) according to their content, and the quantities of these two categories are counted separately. Establish a contingency table for gender and book categories and then perform a chi-square test on the two categories to determine their significant differences.

Factor Analysis

The dataset comprises 36,557 borrowing records from 2,122 readers from 2014 to 2023 is available. Create a pivot table that organizes the data by reader ID and book category, then cross-reference this with gender and education level information for the readers. Conduct a KMO (Kaiser-Meyer-Olkin) and Bartlett's test to assess the appropriateness of the dataset for factor analysis or other multivariate data analysis. Utilize maximum variance rotation to extract common factors and store the factor scores in SPSS.

Structural Equation Model

The variables for group observation are examined based on the analysis of the factors above. A structural equation is formulated to assess the covariance and correlation coefficients among latent variables using SPSS AMOS.

Results

Keywords of Book Titles

The titles of books contain valuable keyword information. At the School of Life Sciences, students and faculty have shown interest in humanities books with titles such as "China." The popularity of English as a topic peaked in the five years preceding the pandemic but has waned in the five years following. However, classic foreign literature and popular novels have consistently remained in demand. Title critical words like "China," "Biology," "Experiment," "Botany," "Biochemistry," and "Genes" have piqued the interest of faculty and students in science books. Other fields, such as advanced mathematics and cell science, were more popular in the years leading up to the pandemic. In contrast, ecology and information science gained more traction five years after the epidemic (see Figure 1).



Figure 1: Keywords

Between 2014 and 2018, the average cost of books within the liberal arts discipline was recorded at ¥32.41. This figure experienced a notable increase in the subsequent years, 2019 to 2023, where the average price rose to ¥41.77. In parallel, the domain of science books also witnessed a significant price adjustment. From 2014 to 2018, the average price stood at ¥54.81, which later escalated to ¥79.27 from 2019 to 2023. This data encapsulates the evolving economic landscape of educational resources, highlighting a trend towards increasing costs in both liberal arts and science disciplines over the examined periods. The liberal arts books published in the 2010s were well-received by students and faculty in the School of Life Sciences. Similarly, the science books released in the 2000s gained significant popularity from 2014 to 2018, and those published in the 2010s attracted considerable attention from 2019 to 2023.

Individual Book Borrowings

The number of borrowers, the total amount borrowed, the average individual borrowing, and the median and percentile values are significantly lower in the five years after the epidemic than in the five years before. The median value of book borrowing was 18.85 between 2014-2018 and 8.38 between 2019-2023. The maximum book borrowing was 485 between 2014-2018 and 145 between 2019-2023. The percentiles of 25%, 50% and 75% are 3, 7 and 19.5 between 2014-2018 and 2, 4 and 8 between 2019-2023.

Gender Differences

In Table 1, it is evident that there has been a consistent gender imbalance in borrowing frequency and the number of borrowers. Females have consistently outnumbered males. However, in the five years following the epidemic, men's per capita borrowing volume surpassed women.

Table 1: Gender comparison

		Male	Female	Male: Female
Book borrowings	2014-2018	7660	22587	34/100
	2019-2023	2236	4074	55/100
Book borrowers	2014-2018	445	1160	38/100
	2019-2023	191	562	34/100
Mean values	2014-2018	17.21	19.47	88/100
	2019-2023	11.71	7.25	161/100

The chi-square test results for gender differences in the selection of humanities and science books confirm significant differences between men's and women's preferences for humanities and science books. In addition, the contingency coefficient has decreased compared to the pre-epidemic period (the contingency coefficient was 0.139 between 2014-2018 and 0.083 between 2019-2023, Approx. Sig. 0.000), suggesting that the correlation between gender and book preferences has weakened after the epidemic.

Latent Variable

The KMO and Bartlett's test yielded a value of 0.749 with a significance level 0.000, indicating that the data structure is suitable for factor analysis. Upon examining the scree plot in Figure 2 and factor scores in Table 2, it is evident that F1 has the most prominent eigenvalues, while F2, F3, and F4 exhibit significant characteristics. As such, the researchers identified and extracted the first four common factors. Expressly, F1 (HAPL) signifies humanities, F2 (PCM) represents rationality, F3 (MSP) is associated with health, and F4 (EAB) is indicative of security.

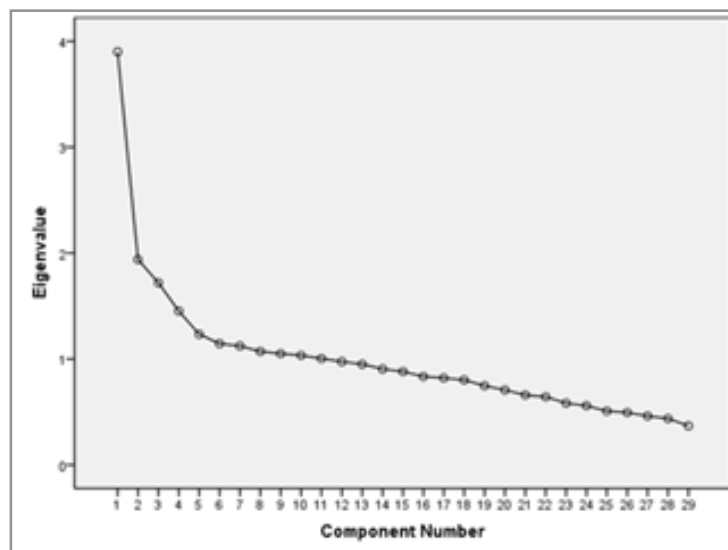


Figure 2: Scree plot

Table 2: Rotated component matrix

	Component			
	1	2	3	4
History	0.80	0.02	0.03	0.11
Art	0.65	0.15	0.01	-0.09
Philosophy	0.64	-0.03	0.18	0.12
Literature	0.54	0.11	0.26	0.06
Physics	0.02	0.78	0.01	-0.05
Chemistry	0.13	0.77	0.11	0.01
Math	-0.01	0.77	0.05	0.10
Medicine	0.09	0.12	0.72	0.03
Science theory	0.05	0.02	0.65	0.06
Psychology	0.36	0.01	0.52	-0.13
Environment	0.07	0.08	-0.13	0.65
Agriculture	0.07	-0.08	0.09	0.65
Biology	0.07	0.15	0.31	0.54

The reading knowledge structure, as illustrated in Figure 3, demonstrates a clear covariation relationship between F4 and the other three factors. Specifically, F4 exhibits the strongest covariation with F1, followed by F3, and a relatively weaker covariation with F2. Moreover, there is also a relatively weak

covariation relationship between F3 and F1. The estimated correlation coefficients between F3 and F1 are 0.57, F3 and F4 are 0.398, F1 and F4 are 0.328, F3 and F2 are 0.288, F2 and F4 are 0.248, and F1 and F2 are 0.215.

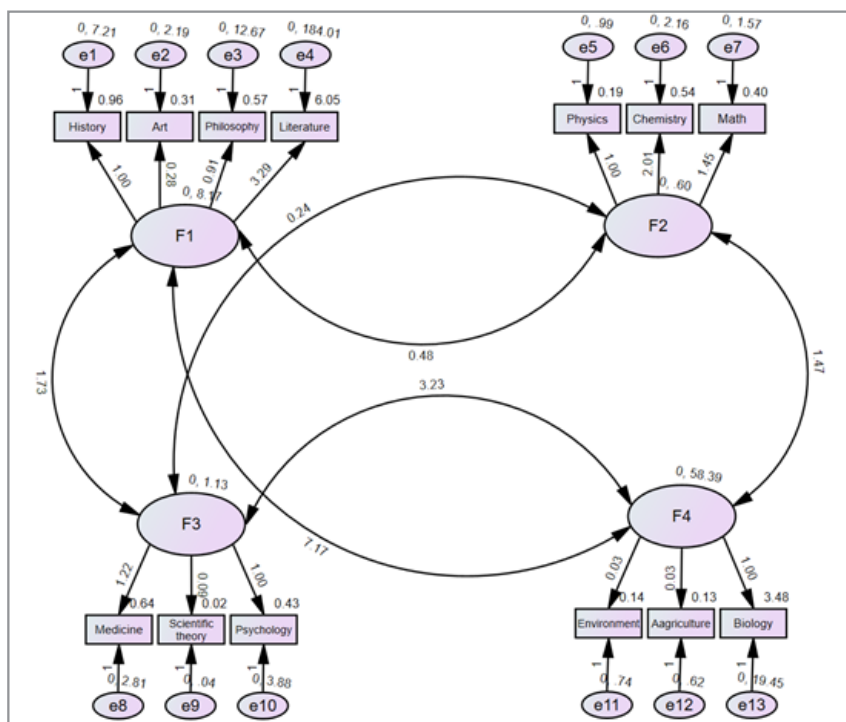


Figure 3: Structural equation model

Discussion

Reading Knowledge Structure

The School of Life Sciences at NNU is dedicated to the specialized training of individuals aspiring to become primary and secondary school biology teachers and researchers. This institution has established a comprehensive curriculum that focuses on the biological sciences and integrates a broad spectrum of knowledge indicative of the wide-ranging interests of its faculty and prospective educators. Raimondi et al. (2020) address the fundamental skill of comprehending and critically analyzing scientific literature within scientific fields [26]. This eclectic academic environment is reflected in the diversity of books borrowed from the university's library, which spans virtually every major category available, showcasing the expansive intellectual curiosity of the community. Analysis of the borrowing patterns of these books offers intriguing insights into the borrowers' psychological underpinnings and academic levels. There is a pronounced preference for humanities and social sciences literature, underscoring a holistic approach to education that transcends the confines of traditional science teaching. By focusing on what has already been understood, resource-oriented prompts help maintain topic-related information in an activated state of working memory. This not only facilitates comprehension but also enhances metacognitive accuracy, similar to the benefits of retrieval practice. Elsner and Großschedl (2024) suggest that these prompts can significantly impact learning outcomes by improving the learner's ability to evaluate their understanding accurately [27].

The popularity of these genres suggests that the educators and researchers at the School of Life Sciences value a well-rounded understanding of the world, integrating perspectives from economics, education, and law into their biological studies. This

interdisciplinary approach is crucial for developing well-informed, versatile teachers capable of inspiring a new generation of students. The substantial borrowing volume of humanities and social sciences books indicates a strong connection between human behavior and biological systems. This relationship highlights how various human activities play a critical role in shaping biodiversity and the health of ecosystems. The interactions between cultural practices, societal values, and environmental policies profoundly influence the conservation and degradation of natural habitats, demonstrating the intricate link between humanity and the biological world. Understanding this dynamic is essential for developing effective strategies to address the challenges facing our planet's ecosystems.

As noted, researchers in the social sciences, including humanities, law, ethics, and policy, are increasingly engaged in evaluating the implications of emerging technologies on society. The historical context of research on the ethical, legal, and social implications of genetic sequencing from the human genome project in the late 1980s and 1990s paved the way for ongoing discussions about responsible research and innovation in synthetic biology [28]. These dialogues highlight the necessity of integrating human knowledge with biological diversity. The intergovernmental science-policy platform on biodiversity and ecosystem services underscores the importance of qualified competencies from social sciences and humanities in achieving its objectives. As integral components of the planet's biodiversity, humans play a crucial role in influencing ecological changes, directly impacting human quality of life. Recognizing that nature and human culture are inseparable allows for more profound assessments of biodiversity and the development of effective conservation policies. The importance of social science

and humanities approaches emerges as essential for contextualizing biodiversity within broader societal frameworks. By exploring historical and societal environments, one can critically assess the metrics and analytical concepts that inform biodiversity measurements. Furthermore, social science and humanities insights can illuminate how norms, human behavior, and societal changes affect biodiversity, enhancing our understanding of its contributions to overall well-being and quality of life [29]. By employing a biocultural approach, which emphasizes the interplay between human biology and culture, researchers can better evaluate the complex entanglements that shape human experiences. This approach blends various methodologies from social sciences with physiological assessments, providing a comprehensive framework to explore the dynamic interactions between human behavior, technology, and biological contexts [30].

Moreover, the data reveals that the outbreak of the global epidemic has had minimal impact on the thematic interests of the book borrowers, with the keywords of book titles remaining broadly consistent before and after the crisis. This stability indicates a strong, underlying continuity in the academic and intellectual pursuits of the community despite the disruptive external circumstances. As time progresses, the evolving landscape of scientific inquiry is mirrored in the shifting hot topics and keywords associated with science books. This dynamism reflects the school's commitment to staying at the forefront of scientific research and education, constantly updating its curriculum and resources to include discoveries and methodologies [31]. Focus on the correlation between teacher engagement and student teachers' intention to quit their degree programs. The study found that highly engaged teachers excelled in all areas except knowledge. Student teachers with highly engaged mindsets showed lower intentions of quitting. By fostering an environment that encourages exploration across a wide range of subjects, the School of Life Sciences at Nanjing Normal University is shaping educators and researchers who are not only experts in biology but also knowledgeable and thoughtful citizens of the world.

Reading Psychological Structure

University students engage in various reading activities for academic purposes, such as class preparation, exam study, essay writing, and presentations. According to a survey by Lyu et al. (2024), Students may employ various strategies to understand information [32]. Archila et al. (2024) highlight a prevalent passive learning approach, where students are expected to absorb information without actively developing the skills to engage critically with scientific articles [33].

In the School of Life Sciences at NNU, the psychological structure that underpins teachers' and students' approach to reading and interacting within the academic environment is built upon four key pillars: Humanity, Rationality, Health, and Security. A complex network of relationships exists among these fundamental elements, with Security emerging as a crucial factor due to its strong covariation relationships. Notably, Security shows the most robust covariation relationship with Humanity, indicating that the sense of safety and well-being is closely linked to cultivating and expressing humanistic values. Security also exhibits a strong covariation relationship with Health, underscoring the importance of interdisciplinary expansion. However, the relationship between Security and Rationality could be more robust,

implying the symbiotic and exclusive relationship between the fundamental development of biology and the uniqueness of biology in mathematical chemistry. Additionally, the analysis has identified a relatively weak covariation relationship between Humanity and Health. This finding is intriguing as it suggests that while both components are vital to the overall psychological structure, their interdependence could be more robust than expected. This could indicate the pathways through which humanistic values impact Health, or vice versa, could be more direct. In terms of correlation, the relationship between Humanities and Health is highlighted as the strongest, underscoring a significant link between these two aspects. This strong correlation suggests that humanistic values and Health are deeply interconnected, with each positively influencing the other. The relationship between Humanity and Security is also described as intense, emphasizing the importance of a safe and secure environment in fostering a culture of empathy, compassion, and well-being. Despite its importance in fostering scientific literacy, university courses often fail to explicitly develop students' critical reading skills. In contrast, the pairwise correspondence between other factors, such as Rationality and the other elements, is relatively weak. This indicates that rationality, while a crucial component of the psychological structure, may interact differently with the other elements, possibly due to its unique role in critical thinking and decision-making processes.

Overall, this detailed exploration of the psychological structure at the School of Life Sciences at NNU reveals a nuanced and complex landscape of relationships among Humanity, Rationality, Health, and Security. These insights not only shed light on the dynamics within the school but also offer valuable guidance for developing library collections to enhance the educational environment and support the well-being of teachers and students.

Gender Differences

The subject of gender differences in educational contexts is multifaceted, touching on aspects of motivation, subject preference, and the impact of societal and academic structures. Exploring motivational profiles and their influence on learning behaviors reveals significant insights into how interventions can be tailored and support provided to enhance student outcomes across genders. A noteworthy finding in this context, as identified in a study by Kikas and colleagues in 2024 highlights a distinct preference pattern among students; girls were predominantly inclined towards biology, while boys showed a greater preference for physics [34]. This division not only underscores the emergence of gender differences early on in educational paths but also raises concerns about the potential discouragement girls might feel towards physics, paralleling the "not a math person" stereotype. This phenomenon could reduce girls' effort and interest in physics, suggesting a need for targeted interventions to combat such stereotypes.

The study delved deeper into different genders' reading habits and preferences. This suggests that women follow and understand narratives and arguments sequentially more effectively when engaging with reading material than their male counterparts. Furthermore, the study highlighted a noticeable trend in the convergence of reading choices among female readers. This phenomenon indicates that women tend to select books within a similar range or genre, unlike males, who exhibit greater diver-

sity in their reading selections. Men are more likely to explore a more comprehensive array of topics and narratives that do not necessarily follow a linear path. Moreover, the study pointed out that while both genders prefer borrowing books related to the humanities, there are distinct differences in their interests within this broad category. Although both male and female readers have experienced a significant decrease in borrowing volume due to the epidemic's impact, the decline in borrowing volume for women is higher than that for men.

Examining performance across genders in various academic domains further complicates the gender discourse. Girls consistently outperformed boys in reading literacy across different cohorts and countries. However, the landscape shifts when considering mathematics and science, where no definitive patterns of sex-based differences were discernible. Additionally, the study by Oberleiter and colleagues in 2023 elucidates how girls' reading performance benefits from higher levels of gender equality across several domains, including health, education, economy, and politics, alongside relative accessibility to educational systems [37]. These socioeconomic factors, however, exerted a lesser influence on girls' achievements in mathematics and science. The research also pointed out an absence of significant correlations between disparities in reading literacy performance and governmental education spending, inviting a deeper reflection on the mechanisms underlying these phenomena and their implications for educational policy and practice. In addressing these challenges, students who demonstrate high motivation and persistence in specific subjects could greatly benefit from more rigorous tasks and dedicated guidance from teachers. This approach could facilitate a more in-depth and systematic exploration of the subject, potentially through engagement in extra-curricular science programs, thereby nurturing a more balanced representation of genders across various scientific fields.

The study provides insightful observations into the reading patterns of men and women, revealing gender-based preferences and behaviors in selecting and engaging with reading material. Additionally, the specific areas of interest within the humanities further underscore the differences in the types of knowledge and narratives that appeal to each gender. The development of the modern scientific method and numerous academic disciplines, traditionally rooted in a masculine perspective emphasizing objective rationality and a clear distinction between social and natural sciences, contrasts sharply with a feminist perspective. The latter advocates for effectual rationality, interconnectedness, and a holistic view, fostering a broader spectrum of ideas and truths. Rhoten and Pfirman's 2007 research illuminates how this divergence influences academic pursuits, revealing that women, especially at the graduate level, are likelier to venture into innovative work within emerging interdisciplinary fields rather than engage in the competitive dynamics prevalent in established disciplines [35].

Education Level Differences

In a parallel observation, Callinan (2005) explores the behaviors and preferences of undergraduate biology students concerning the use of university libraries [36]. The study delineates the primary motivations behind library visits, which predominantly include studying course material and borrowing books. An interesting trend emerges when comparing the habits of first-year

students to those in their final year, with the latter group showing a higher propensity for utilizing e-library resources. Conversely, first-year students prefer internet-based resources, such as online lecture notes. The exploration of library resources is not limited to digital formats, as final-year students also enjoy engaging with the short-term loan section and seeking personal assistance from librarians. The study also touches on students' various browsing strategies, from the traditional method of perusing physical books on shelves to navigating online databases for articles relevant to their studies. A notable positive experience shared by a senior student involves the beneficial assistance received from a librarian, underscoring the value of human interaction and guidance in the academic research process [37].

The study delved deeper into the educational patterns and behaviors concerning borrowing books, revealing that rational thinking significantly impacts the selection of books related to mathematics, physics, and chemistry. This trend is especially prevalent among undergraduates pursuing a degree in biology, highlighting the integral role these subjects play in their education. Furthermore, it was observed that during the undergraduate phase, there is a pronounced preference for books that offer training in problem-solving. This inclination suggests that such materials are highly valued for their contribution to developing critical thinking and analytical skills. As individuals progress in their educational journey, particularly those who are part of the faculty with advanced qualifications such as doctoral degrees or postdoctoral research experience, there is a noticeable shift in reading preferences. This demographic is strongly inclined towards professional and biosafety literature, indicating a deepening focus on specialized knowledge within their fields. Additionally, the study noted that professional differentiation becomes more pronounced with the advancement of educational levels. This means that as educators and researchers further their studies and delve into their respective areas of expertise, their choice of reading material becomes more aligned with their specialized interests, reflecting a broader trend of specialization in academia.

According to Hubbard et al. (2022), developing adeptness in navigating and understanding primary research literature is not merely advantageous but crucial for those immersed in the scientific field [38]. The nuances in how individuals approach the reading of literature, especially within the scientific community, reveal a fascinating spectrum of methodologies and preferences that underscore the complexity of the learning and research processes in academia. This study highlights a dichotomy in reading strategies, where a segment of readers leans towards a rigorous critique of the empirical data presented. In contrast, another segment might give more weight to the narrative or explanatory text provided by the authors. A noteworthy observation from this research is the preference for a narrative-focused approach among undergraduate students, in contrast to a more data-driven analysis preferred by individuals further along in their scientific careers, such as researchers. The shift towards a critical interpretation of data becomes even more pronounced among post-doctoral researchers and academics, suggesting that the ability to evaluate data critically may be a hallmark of maturity and experience in scientific reading. Furthermore, the context in which the reading takes place plays a significant role in shaping the approach to literature. Factors such as time constraints and the degree of alignment between the reader's expertise and the

paper's topic can significantly influence how a piece of literature is read and understood. Inexperienced readers, in particular, may find it challenging to fully engage with scientific literature without a solid foundation of prior knowledge, highlighting the importance of background knowledge in comprehending complex scientific texts [39].

Conclusion

The data presented highlights a dynamic shift in both book borrowing trends and the economic landscape of educational resources within the School of Life Sciences over the past decade. The declining interest in English literature following the pandemic contrasts with the sustained demand for classic foreign literature and popular novels, suggesting a potential shift in academic focus or a changing student demographic. The significant interest in specific key terms like "China," "Biology," and "Ecology" indicates an increasing interconnection between humanities and sciences, potentially reflecting global issues such as environmental sustainability and international relations that resonate with current events. The noticeable rise in average book prices may relate to rising publication costs, inflation, and a shift toward more specialized or high-quality academic texts. The simultaneous price increase across disciplines may reflect a general uptick in demand for educational resources or institutions prioritizing investment in high-caliber academic materials, particularly post-pandemic when educational resources may be increasingly essential for remote learning. The reduced number of borrowers and the amount borrowed post-pandemic raises questions about accessibility and student engagement. The median value dropping implies that while borrowing rates have declined, this may also correlate with changes in study habits or increased reliance on digital resources. The stark contrast in maximum borrowing numbers suggests that while the demographics of borrowers might remain stable, the intensity of borrowing has notably decreased.

The observation that women have historically outnumbered men in borrowing is noteworthy. However, the shift towards higher per capita borrowing volumes among men post-epidemic suggests a reconfiguration of academic engagement. This change could be analyzed through shifting cultural norms, changes in curriculum, or evolving social behaviors. The chi-square test results backing the significance of gender preferences in the literature indicate a nuanced cultural dialogue about what subjects are more appealing or accessible to different genders, which merits further exploration. The KMO and Bartlett's test results suggest a strong potential for meaningful insights via factor analysis. Identifying four common factors (humanities, rationality, health, security) reveals undercurrents in the student body's interests and concerns. The strong covariation relationships among these factors highlight potential interdisciplinary connections. For example, the linkage between health and humanities suggests that students may seek health narratives grounded in human experience. At the same time, the connection between security and other factors indicates a broader preoccupation with safety in both a personal and academic sense. These findings underline the need for academic institutions to adapt their resource offerings to align with their student populations' evolving interests and needs. Focusing on interdisciplinary studies that bridge humanities with sciences could create a more holistic educational experience. Furthermore, understanding the factors driving borrowing trends and gender dynamics can enhance library services

and educational outreach programs, ultimately fostering a more inclusive and engaged academic community.

The current study has several limitations that should be acknowledged. First, the exclusive reliance on borrowing records from the biology department of Nanjing Normal University significantly constrains the generalizability of the findings. This institution, which focuses primarily on teacher education, may not reflect the borrowing behaviors of students and faculty from top-tier research universities or colleges with different academic focuses. Consequently, this limitation restricts the applicability of the conclusions drawn from this specific context. Second, the gender distribution within normal universities, where there tends to be a higher population of female students than males, may introduce a bias in the research results. This demographic imbalance can influence borrowing trends, leading to conclusions that may not accurately represent institutions with more evenly distributed or male-dominated gender ratios. Another critical factor is the temporal aspect of the data collection, which spans five years within the context of the COVID-19 pandemic. The unique circumstances surrounding the pandemic, including restrictions on access to physical resources, likely altered standard borrowing behaviors. While the study recognizes these external influences, it does not fully isolate their effects, making it difficult to determine how much of the observed behavior was due to the pandemic versus inherent borrowing trends. Finally, future research should explore various institutions with varying characteristics to understand better borrowing patterns across different academic contexts. Additionally, employing methodologies that account for and isolate the impact of significant external factors, such as sources of student enrollment, departmental academic planning, and employment trends, will enhance the robustness and relevance of findings in this study area.

Ethics Declarations

None.

Declaration of Interests Statement

The authors have no known or foreseeable financial or material interests, obligations, and/or personal relationships or associations that are potent enough to influence the outcomes of the data and reporting in the article.

Data Availability

The data supporting this study's findings are available on request from the corresponding author. Due to ethical restrictions, the data are not publicly available.

Competing Interests

The author declares no competing interests related to the work submitted for publication.

References

1. Fan, Y. L., Lehmann, S., Blok, A. (2022). Extracting the interdisciplinary specialty structures in social media data-based research: A clustering-based network approach. *Journal of Informetric*, 16(3), 101310.
2. Lickliter, R., Honeycutt, R. H. (2015). Biology, development, and human systems. *Handbook of Child Psychology and Developmental Science*. <https://doi.org/10.1002/9781118963418.childpsy105>

3. Teshera-Levy, J., Atchison, T., Callis-Duehl, K., Gould, T., Lichti, D., Scemama, J.L., Stiller, J., & Vance-Chalcraft, H.D. (2023). Transfer-bound community college students' biology identity and perception of teaching. *Journal of Microbiology & Biology Education*, 24(3), e00116-23. <https://doi.org/10.1128/jmbe.00116-23>
4. Vančugovienė, V., Södervik, I., Lehtinen, E., McMullen, J. (2024). Individual differences in secondary school students' conceptual knowledge: Latent profile analysis of biology concepts. *Learning and Individual Differences*, 111, 102436.
5. Firetto, C. M., Van Meter, P. N. (2018). Inspiring integration in college students reading multiple biology texts. *Learning and Individual Differences*, 65, 123-134.
6. Aleknavičiūtė, V., Lehtinen, E., Södervik, I. (2023). Thirty years of conceptual change research in biology – A review and meta-analysis of intervention studies. *Educational Research Review*, 41, 100556.
7. Pickett, S. B., Nielson, C., Marshall, H., Tanner, K. D., Coley, J. D. (2022). Effects of reading interventions on student understanding of and misconceptions about antibiotic resistance. *Journal of Microbiology & Biology Education*, 23(1).
8. Karakoç, I., Rugg, R., Gu, P. (2022). Beyond comprehension: Reading requirements in first-year undergraduate courses. *Journal of English for Academic Purposes*, 55, 101071.
9. Mahtani, T., Brotman, Y. S., Ashok, A. (2020). Promoting interdisciplinary learning: A cross-course assignment for undergraduate students in advanced biology and drawing courses. *Journal of Microbiology & Biology Education*, 21(1).
10. Levy, S. (2024). Showing and doing: Art & science collaborations for environmental sustainability. *Nature-Based Solutions*, 6, 100135.
11. Wessner, D. R., Newman, L. R., Pascucci, M. J., Tsudis, N. (2024). Incorporating art into a biology course: a student-curated art exhibition about COVID-19. *Journal of Microbiology & Biology Education*, 25(1), e0014223.
12. Tribot, A. S., Faget, D., Richard, T., Changeux, T. (2022). The role of pre-19th century art in conservation biology: An untapped potential for connecting with nature. *Biological Conservation*, 276(Suppl C), 109791.
13. Stotz, K. (2009). Experimental philosophy of biology: Notes from the field. *Studies in History and Philosophy of Science Part A*, 40(2), 233-237.
14. Kaplan, J. M. (2016). *Philosophy, evolutionary biology and encyclopedia of evolutionary biology*. Academic Press, 236-245.
15. Tran, S., Tirado, J., Miyasato, H., Lee, S. W. (2024). Students' perceptions of social issues in biology courses. *Journal of Microbiology & Biology Education*, 25(1), e0019423.
16. Lempke, S. D. (2014). Changes in implicit theories of ability in biology and dropout from STEM majors: A latent growth curve approach. *Contemporary Educational Psychology*, 39(3), 233-247.
17. Sordo Vieira, L., Laubenbacher, R. C. (2022). Computational models in systems biology: Standards, dissemination, and best practices. *Current Opinion in Biotechnology*, 75, 102702.
18. Greenbaum, G., Carja, O. (2024). The new society for modeling and theory in population biology. *Trends in Ecology & Evolution*, 39(10), 885-888.
19. Farnsworth, K. D. (2022). How an information perspective helps overcome the challenge of biology to physics. *Biosystems*, 217, 104683.
20. Marko, J. F. (2020). Physics and biology (of chromosomes). *Journal of Molecular Biology*, 432(2), 621-631.
21. Zhu, W. F., Empel, C., Pelliccia, S., Koenigs, R. M., Proschak, E., & Hernandez-Olmos, V. (2024). Photochemistry in medicinal chemistry and chemical biology. *Journal of Medicinal Chemistry*, 67(6), 4322-4345.
22. Fox, B. (2017). It's nature and nurture: Integrating biology and genetics into the social learning theory of criminal behavior. *Journal of Criminal Justice*, 49, 22-31.
23. Horwitz, R. I., Lobitz, G., Mawn, M., Conroy, A. H., Cullen, M. R., Sim, I., & Singer, B. H. (2021). Biosocial medicine: Biology, biography, and the tailored care of the patient. *SSM - Population Health*, 15, 100863.
24. Abdullah, S. I. S. S., Halim, L., Shahali, E. H. M. (2011). Integration of environmental knowledge across biology, physics and chemistry subject at secondary school level in Malaysia. *Procedia - Social and Behavioral Sciences*, 15, 1024-1028.
25. Motsinger-Reif, A. A., Reif, D. M., Akhtari, F. S., House, J. S., Campbell, C. R., Messier, K. P., Fargo, D. C., & Woychik, R. (2024). Gene-environment interactions within a precision environmental health framework. *Cell Genomics*, 4(7), 100591.
26. Raimondi, S. L., Marsh, T. L., Guenther, M. F. (2020). Does repetition matter? Analysis of biology majors' ability to comprehend journal articles across a major. *Journal of Microbiology & Biology Education*, 21(1), 21.
27. Elsner, S., Großschedl, J. (2024). Can metacognitive accuracy be altered through prompting in biology text reading? *European Journal of Psychology of Education*, 39(2), 1465-1483.
28. Shapira, P., Youtie, J., Li, Y. (2015). Social science contributions compared in synthetic biology and nanotechnology. *Journal of Responsible Innovation*, 2(1), 143-148.
29. Stenseke, M., Larigauderie, A. (2018). The role, importance and challenges of social sciences and humanities in the work of the intergovernmental science-policy platform on biodiversity and ecosystem services (IPBES). *Innovation: The European Journal of Social Science Research*, 31(1), 10-14.
30. Fuentes, A. (2023). Humans are biocultural, science should be too. *Science*, 382, 6672.
31. Westphal, A., Schulze, A., Schlesier, J. Lohse-Bossenz, H. (2024). Who thinks about dropping out and why? Cognitive and affective-motivational profiles of student teachers explain differences in their intention to quit their teaching degree. *Teaching and Teacher Education*, 150, 104718.
32. Lyu, B., McCrudden, M. T. Bohn-Gettler, C. (2024). The effects of purpose instructions and strategy-focused instructions on reading processes and products. *Reading and Writing*, 37(8), 2127-2150.
33. Archila, P. A., Ortiz, B. T. & Truscott de Mejía, A. M. (2024). Beyond the passive absorption of information: Engaging students in the critical reading of scientific articles. *Science & Education*. <https://doi.org/10.1007/s11191-024-00507-1>

34. Kikas, E., Puusepp, I., Aus, K. (2024). Expectancy-value-cost motivational profiles in biology and physics: Their relations with gender, self-reported satisfaction of needs, and learning behavior. *Learning and Individual Differences*, 115. 102520. <https://doi.org/10.1016/j.lindif.2024.102520>
35. Rhoten, D., Pfirman, S. (2007). Women in interdisciplinary science: Exploring preferences and consequences. *Research Policy*, 36(1). 56-75.
36. Callinan, J. E. (2005). Information-seeking behaviour of undergraduate biology students: A comparative analysis of first year and final year students in University College Dublin. *Library Review*, 54(2), 86-99.
37. Oberleiter, S., Fries, J., Schock, L. S., Steininger, B., Pietschnig, J. (2023). Predicting cross-national sex differences in large-scale assessments of students' reading literacy, mathematics, and science achievement: Evidence from PIRLS and TIMSS. *Intelligence*, 100. 101784. <https://doi.org/10.1016/j.intell.2023.101784>
38. Hubbard, K. E., Dunbar, S. D., Peasland, E. L., Poon, J., Solly, J. E. (2022). How do readers at different career stages approach reading a scientific research paper? A case study in the biological sciences. *International Journal of Science Education, Part B*, 12(4), 328-344.
39. Woolfson, D. N. (2023). Understanding a protein fold: The physics, chemistry, and biology of α -helical coiled coils. *The Journal of Biological Chemistry*, 299(4), 104579.