STEM Undergraduate Students: Library Use, Perceptions, and GPA

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Abstract

Purpose - This study aims to examine if differences exist in undergraduate students' library use, perceptions and GPA among STEM and non-STEM disciplines.

Design/methodology/approach - The current study used data from the 2018 student survey. Among 2,277 students who completed the survey (response rate=8%), only undergraduate students (*n*=1,265) were selected for this study because the current study aims to examine differences between STEM and non-STEM undergraduate students.

Findings - The findings from a Mann-Whiney U test revealed that STEM respondents perceived specific library resources (subject and course guide, library instructions and library workshops) as slightly less than non-STEM respondents. The results from ANOVA demonstrated that the mean scores in GPA for STEM respondents who never used online library, journals and databases were lower than respondents who used those library resources, regardless of STEM and non-STEM disciplines.

Originality/value - Revisiting the data collected and analyzing specific user groups will be valuable to academic libraries because this study will provide academic librarians with a deeper understanding of specific user needs and perceptions of library resources and services.

Keywords Undergraduate Students, STEM disciplines, Academic libraries, Survey, Assessment, Data reuse

Paper type Research paper

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Introduction

Every other year since Spring 2016 the [University name] library conducts a survey for undergraduate and graduate students in order to understand their needs concerning library resources and services, and to further measure the library's impact on students' academic success. The primary analysis of the 2018 student survey was conducted to examine the correlations between students' library use (e.g., library visits, resource use and library space satisfaction) and their GPA. The findings demonstrated correlations between students' overall library use and their academic success: Students' library in-person visits were negatively associated with their GPA, whereas their use of library resources was positively correlated with their GPA (citation withheld for blinding).

[University name] serves ethnically and economically diverse populations in the United States. In 2018 [University name] received a $1 million grant for a five-year project to enhance "flexibility and success in early STEM undergraduate education" through redesigning undergraduate programs and courses in STEM (Citation withheld for blinding). [University name] has 86 undergraduate programs comprising 66% of the total on campus undergraduate student enrollment in Spring 2018, based on the data from the Office of Institutional Research. Understanding STEM undergraduate students' needs, their perceptions of the library's resources, and its impact on their grades is critical to supporting their academic success. To accomplish this goal, the current study aims to revisit the 2018 student survey data and further investigate the differences in library use and the perceptions of library resources and services between undergraduate students from the Science, Technology, Engineering, and Mathematics (STEM) disciplines and non-STEM disciplines. Revisiting the data collected and analyzing specific user groups will be valuable to academic libraries because this study will provide academic librarians with a deeper understanding of specific user needs and their perceptions of library resources and services.

Literature review

Library Contributions to Students' Academic Success

An ongoing challenge for academic libraries is tangibly demonstrating the libraries' value to higher education. To support academic libraries with measuring their value, the Association of College & Research Libraries (ACRL) Value of Academic Libraries Initiatives issued the *Value of Academic Libraries: Comprehensive Review and Report* (Oakleaf, 2010) suggesting various ways to assess the library's value to students' academic success, such as grades (e.g., Grade Point Average, GPA), retention and degree attainment. As a result, many academic libraries are increasingly measuring their impact on student's academic success.

Several researchers examined whether students' library use based on usage data (e.g., database and instructions) is associated with their academic achievements (e.g., GPA) and retention and degree attainment. For example, a study undertaken at the University of Wollongong library in Australia by Cox and Jantti (2012) measured whether students' grades correlated with library resources. Employing library database usage data revealed the strong correlations between students' library resource use and their grades. Similar findings were also shown in another study conducted at the University of Minnesota in the USA examining whether first year undergraduate student's library use (e.g., databases and library workshops) correlated

with their retention and GPA (Soria *et al.,* 2013). They found that students' library resource use was positively linked to their GPA, whereas library instruction sessions were negatively correlated with their GPA. Moreover, several institutions participated in the Assessment in Action (AiA) project between 2013 and 2016 which showed that students' library use is associated with their GPA (Brown and Malenfant, 2018). Other researchers confirm in their studies the relationship between students' library use and their GPA (Blake *et al.,* 2017; Massengale *et al.,* 2016; Soria *et al*., 2017), and between students' library use and their degree attainment (Stone and Ramsden, 2013).

Given that users' needs may vary due to various factors (e.g., disciplines and class status), it is important to understand the variations in perceptions and preferences of library users, such as those between STEM and non-STEM disciplines. Some researchers compared the relationships between library use and GPA with disciplines. For example, Allison (2015) examined the correlations between library use and GPA by disciplines. The results revealed a strong positive correlation between the library use of students in the humanities and their GPA, while there was a weak correlation between the library use of students from STEM and social science disciplines and their GPA (Allison, 2015). Other studies show that STEM respondents visit the library building less frequently than non-STEM respondents (Carroll *et al.,* 2016; Yu *et al.,* 2018). However, online use by STEM and non-STEM disciplines is mixed. A study conducted by Corlett *et al.,* (2016) showed that there were similar frequencies of "daily and weekly use of online library resources" between STEM and non-STEM respondents, whereas another study conducted by Yu *et al.,* (2018) revealed that STEM respondents accessed library resources from off campus more frequently than non-STEM respondents. Additionally, non-STEM undergraduate students had the highest preference for printed citation manuals, style guides, general and special references, and had the lowest rate of preference for eBooks in scholarly monographs (Carroll *et al.,* 2016). In terms of students' perceptions of the usefulness of library services, non-STEM respondents perceived a higher value than STEM respondents in the role of the library in preserving library resources, supporting developing research skills, providing assistance in finding resources, and using information ethically (Yu *et al.,* 2018).

With the increase in research on measuring the library's value, an ethical question was raised in a recent article arguing that using a large dataset containing personally identifiable information may harm students' privacy; additionally, a lack of knowledge on the application of statistical techniques may result in unreliable findings for decision-making, requiring a higher quality of advanced statistical analysis (Robertshaw and Asher, 2019). With that in mind, the current study using the locally developed survey aims to further examine the differences in undergraduate students' GPA based on their library use and perceptions of library resources by disciplines. The findings will be useful for librarians to better understand users' needs as well as improve services. The research questions guiding this study are as follows:

Research questions:

1. Are there significant differences in students' perceptions of the importance of library resources and services between undergraduate students in STEM and non-STEM disciplines?

2. Are there significant differences in GPA among groups by STEM and non-STEM disciplines and library use: (1) non-STEM students who never used the library; (2) non-

STEM students who used the library once or more; (3) STEM students who never used the library; (4) STEM students who used the library once or more?

3. How do STEM students want to use library funding compared to non-STEM students?

Methods

The current study used data from the 2018 student survey. The purpose of the online survey was to explore students' needs in the university libraries and measure the impact of library use and students' academic achievement. The survey was distributed in Spring 2018 to 28,725 undergraduate and graduate students in all 15 colleges; among them, 18,886 were undergraduate students (66% of the entire undergraduate university population). While a total of 2,277 students completed the survey (response rate=8%), double the response rate of the 2016 survey, only undergraduate students (n=1,265, response rate=7%) were selected for this study because the current study aims to examine the differences between STEM and non-STEM undergraduate students. Survey respondents reflect the university's population (citation withheld for blinding). Additionally, according to Cochran's formula (1977), a minimum required sample size for this study is 384 at a 95% confidence level. Given the sample size for the current study is 1,265, this means that the minimum sample size is achieved to further run the statistical analysis with confidence of the results.

Instrument

The survey was developed by the [Committee name] representing several units, including research instruction, collection development, scholarly communications, and library administration (citation withheld for blind review). Prior to distributing the survey, it was pilot tested by several students. The 2018 survey was significantly revised using variations of survey questions (e.g., item formats and response scales) (citation withheld for blinding). The survey questions included students' overall experience with library use: frequency of students' library visits in person or online; frequency of resources use; students' perceptions of library resource use; and satisfaction with library space. For more information on the procedures of survey development and full survey questions, please refer to (citations withheld for blinding).

Variables

Prior to conducting the survey, students' demographics such as gender, ethnicity and GPA were obtained from the Office of Institutional Research (OIR) and directly imported to Qualtrics (citation withheld for blinding). Variables from the 2018 student survey were selected based on the research questions and displayed, as follows:

- Students' perceptions of the importance of library resources and services: Thirteen library resources and services were included in the current study: journals, databases, print books, textbooks, eBooks, subject and course guides, digital images, streaming media, DVDs on reserve, patient care tools, library instruction arranged by your professor, library workshops that you self-selected to attend. Each was coded from (0) I don't use this tool/service to (4) very important.
- Frequency of students' in-person and online library visits and use of six library resources (journals, databases, print books, textbook, eBooks, and subject and course guides): each variable was coded from (0) never to (4) daily.

- How to spend funding: Students were asked to rank how they would spend funding to improve the library. They were asked to select three of the ten responses provided, including online journals, books, computers, quiet study space, group study space, electrical outlets, whiteboards, drink/food options, additional comfortable furniture, and other.

Data analysis

All data was analyzed using SPSS 26. Three steps were involved in forming groups. Based on the disciplines, 86 academic programs were divided into STEM and non-STEM disciplines. As a result, 34 programs were coded as (1) STEM disciplines and the rest were coded as (0) non-STEM disciplines. Examples of STEM disciplines include chemistry, engineering, rehab sciences, statistics, computer science, physics, mathematics and nursing.

Extra steps were involved in forming groups to address the second research question. Of those users who never used the library, respondents who answered "never" to the questions related to physical and online library use and use of six library resources (journal, database, print books, text book, eBooks, and subject and course guides, respectively) were coded as (0) non-users; those who responded from once a month to daily were coded as (1) library user. Library user groups were coded by library visits (in person and online) and by use of six library resources, as follows:

1. (0) no-in-person library visit vs. (1) in-person library visits
2. (0) no-online use vs. (1) online use
3. (0) no-journals use vs. (1) journals use
4. (0) no-databases use vs. (1) databases use
5. (0) no-print book use vs. (1) print books use
6. (0) no-textbooks use vs. (1) textbooks use
7. (0) no-eBooks use vs. (1) eBooks use
8. (0) no-subject and course guides use vs. (1) subject and course guides use

The last step was to combine both STEM and non-STEM disciplines with library use (in-person visits, online use, journals, databases, print books, textbooks, eBooks, subject and course guides). Four groups were formed for each type of library use. To illustrate how each group was coded, two examples are displayed below. The first example is for the group who visited or never visited the library in-person by STEM and non-STEM disciplines; the second example is for the group who used or never used journals by STEM and non-STEM disciplines. The rest of the groups were coded in the same way.

- (1) non-STEM students who never visited the library in person; (2) non-STEM students who visited the library once or more in person; (3) STEM students who never visited the library in person; (4) STEM students who visited the library once or more in person.
- (1) non-STEM students who never used journals; (2) non-STEM students who used journals once or more; (3) STEM students who never used journals; (4) STEM students who used journals once or more.

To examine if there are any statistical differences in undergraduate students' perceptions of library resources and services between STEM and non-STEM disciplines, a Mann-Whiney U

(MWU) test was employed. The MWU test compares the medians of two groups and can be used when two variables are not normally distributed. To compare the mean differences in GPA (dependent variable) between one independent variable (four groups by discipline and library use), a one-way Analysis of Variance (ANOVA) was employed per library use.

Results

Demographics of STEM and non-STEM student respondents

STEM respondents were slightly more female than male, whereas the majority of the non-STEM respondents were female (See Table I). Many STEM respondents were White (33%) and Asian (30%), followed by Hispanic (23%) and African American (6%). On the other hand, among non-STEM respondents, 36% of respondents were Hispanic, followed by White (31%), Asian (19%) and African American (8%). Less than half of STEM respondents were seniors, and the fewest were freshmen. However, non-STEM respondents were almost equally represented by all years of undergraduate students. More STEM respondents were transfer students than non-STEM respondents. However, more non-STEM respondents were first generation students than STEM respondents. The average age of STEM and non-STEM respondents was 21 years old.

Table I.
Demographics of STEM and non-STEM respondents

		STEM (*n*= 622)	non-STEM (*n*= 643)
Gender			
	Female	328 (52.7%)	465 (72.3%)
	Male	293 (47.1%)	178 (27.7%)
	Other	1 (0.2%)	-
Race/Ethnicity			
	White	202 (32.5%)	199 (30.9%)
	African American	35 (5.6%)	50 (7.8%)
	Asian	187 (30.1%)	124 (19.3%)
	International	32 (5.1%)	13 (2%)
	Hispanic	143 (23%)	232 (36.1%)
	Other	23 (3.7%)	25 (4%)
Class			
	Freshman	76 (12.2%)	140 (21.8%)
	Junior	162 (26%)	190 (29.5%)
	Sophomore	104 (16.7%)	153 (23.8%)
	Senior	280 (45%)	160 (24.9%)
Transfer			
	Yes	231 (37.1%)	204 (31.7%)

First generation			
	Yes	116 (18.6%)	185 (28.8%)

STEM and non-STEM students: Perceptions of the importance of library resources and services

The MWU test revealed statistically significant differences in students' perceptions of the importance of three library resources and services between STEM and non-STEM respondents: subject and course guides (*U*= 8519.5, *z* = -2.25, *p <.05, r=.13*), library instructions (*U*= 87422, *z* = -2.85, *p < .001, r=.10*), and library workshops (*U*= 39303.5, *z* = -3.36, *p < .001, r=.13*). While there were statistically significant differences in those three resources between STEM and non-STEM respondents, the effect size (magnitude of difference) is small (*r*=.1) according to Cohen's (1988) criteria. Although the effect size is small, it is important that STEM respondents perceived library resources (subject and course guides, library instructions and library workshops) as slightly less important than non-STEM respondents. However, no statistical significance was found in the differences in the perceptions of other library resources and services between STEM and non-STEM respondents. Table II displays the MWU test results.

Table II.
Differences in perceptions of the importance of library resources between STEM and non-STEM students

	STEM (non-STEM)[a]					
	n	Median[b]	*U*	*z*	*P*	*r*[c]
Journals	302 (372)	4 (4)	56102.5	-0.03	.98	.00
Databases	297 (370)	4 (4)	53798.5	-0.52	.60	.02
Print books	119 (136)	3 (3)	7306.5	-1.40	.16	.09
Textbooks	152 (120)	4 (4)	9040	-0.14	.89	.01
eBooks	182 (205)	3 (3)	18112.5	-0.53	.59	.03
Subject and course guides	124 (161)	3 (3)	8519.5	-2.25	.03*	.13
Special collections	60 (86)	3 (3)	2228	-1.47	.14	.12
Streaming media	77 (98)	3 (3)	3732.5	-0.13	.90	.01
DVDs	32 (36)	2 (2)	517.5	-0.75	.45	.09
Patient care tools	26 (26)	3 (3)	330	-0.15	.88	.02
Blackboard	565 (580)	4 (4)	162477.5	-0.38	.70	.01
Library instruction	397 (493)	3 (3)	87422	-2.85	< .001***	.10
Library workshops	279 (332)	2 (3)	39303.5	-3.36	< .001***	.13

[a] Results from non-STEM respondents are provided in parentheses.
[b] Response "I don't use this resource" was dropped from the analysis
[c] Value of *r* represents an effect size statistic by calculating *r*= z/square root of N where N= total number of cases.
*$p < .05$ *** $p < .001$

STEM vs. non-STEM students: Differences in GPA based on their library use

ANOVA was conducted to examine if there are any differences in students' GPA by their library use among STEM and non-STEM respondents. Table III displays the descriptive statistics for four groups based on their library use. The STEM students who never used the library (online use, journals, databases, print books and subject and course guides), except for in-person visits and textbooks, had the lowest GPA. In terms of which group had the highest GPA, STEM respondents who used journals and databases had the highest GPA, whereas non-STEM respondents who visited the library and used subject and course guides had the highest GPA. In terms of online user groups, both STEM and non-STEM respondents who used the online library had a higher GPA than those who never used the online library. These findings suggest that for STEM students who never used the library, their GPA suffered more than those non-STEM students who never used the library.

Table III.
Descriptive statistics for groups by disciplines and library use

	n	*M*	*SD*	95% Confidence Interval for Mean	
				Lower Bound	Upper Bound
In-person visits (n=1,185)					
1. Non-STEM/ no-visit	39	3.21	0.72	2.98	3.45
2. Non-STEM/ visit	563	3.24	0.61	3.19	3.29
3. STEM/ no-visit	37	3.21	0.69	2.98	3.44
4. STEM/ visit	546	3.20	0.61	3.15	3.25
Online visits (n=1,007)					
1. Non-STEM/ no-online	168	3.20	0.60	3.11	3.29
2. Non-STEM/ online	349	3.29	0.61	3.23	3.36
3. STEM/ no-online	174	3.08	0.61	2.98	3.17
4. STEM/ online	316	3.29	0.60	3.22	3.35
Journals (n=1,188)					
1. Non-STEM/ no-journals	210	3.21	0.62	3.12	3.29
2. Non-STEM/ journals	392	3.26	0.60	3.20	3.32
3. STEM/ no-journals	258	3.09	0.63	3.02	3.17
4. STEM/ journals	328	3.29	0.58	3.23	3.35
Databases (n=1,174)					
1. Non-STEM/ no-databases	208	3.25	0.60	3.17	3.33
2. Non-STEM/ databases	387	3.24	0.61	3.18	3.31
3. STEM/ no-databases	255	3.09	0.64	3.01	3.17
4. STEM/ databases	324	3.29	0.57	3.23	3.35
Print books (n=1,175)					
1. Non-STEM/ no-print books	455	3.25	0.60	3.20	3.31
2. Non-STEM/ print books	141	3.22	0.64	3.11	3.32

3. STEM/ no-print books	455	3.19	0.60	3.14	3.25
4. STEM/ print books	124	3.24	0.67	3.12	3.36
Textbook (n=1,175)					
1. Non-STEM/ no-textbooks	468	3.28	0.60	3.22	3.33
2. Non-STEM/ textbooks	129	3.14	0.65	3.02	3.25
3. STEM/ no-textbooks	426	3.20	0.60	3.14	3.26
4. STEM/ textbooks	152	3.22	0.64	3.11	3.32
eBooks (n=1,170)					
1. Non-STEM/ no-eBooks	383	3.27	0.56	3.22	3.33
2. Non-STEM/ eBooks	210	3.20	0.68	3.11	3.29
3. STEM/ no-eBooks	398	3.18	0.62	3.12	3.24
4. STEM/ eBooks	179	3.27	0.60	3.18	3.36
Subject and course guides (SCG) (n=1,173)					
1. Non-STEM/ no-SCG	437	3.24	0.62	3.18	3.30
2. Non-STEM/ SCG	159	3.27	0.58	3.18	3.36
3. STEM/ no-SCG	452	3.20	0.60	3.14	3.25
4. STEM/ SCG	125	3.23	0.65	3.11	3.34

Table IV presents the ANOVA results. The results indicate statistically significant differences in GPA for four groups in online use (F (3, 1003) = 6.16, $p < .001$, eta squared=.02), journals (F (3, 1184) = 5.94, $p < .001$, eta squared=.01), and databases (F (3, 1170) = 5.58, $p < .001$, eta squared=.01). However, for the rest of the library uses, there was no statistical difference in GPA between the four groups. Despite reaching statistical difference, the magnitude of difference in mean scores between the groups were small according to Cohen's (1988) criteria. Nonetheless, it is meaningful to see how STEM student's GPA differs from non-STEM students based on their use of library resources detail.

Table IV.
Comparison of students' GPA by discipline and library use

		Sum of Squares	*df*	Mean Square	*F*	*P*	Eta squared[a]
STEM and Non-STEM by in-person library visits	Between Groups	0.39	3	0.13	0.34	.80	.00
	Within Groups	444.29	1181.00	0.38			
	Total	444.67	1184.00				
STEM and Non-STEM by online use	Between Groups	6.74	3	2.25	6.16	< .001***	.02
	Within Groups	365.76	1003.00	0.37			
	Total	372.50	1006.00				
STEM and Non-STEM by journals	Between Groups	6.57	3	2.19	5.94	< .001***	.01
	Within Groups	436.80	1184.00	0.37			
	Total	443.37	1187.00				
STEM and Non-STEM by databases	Between Groups	6.17	3	2.06	5.58	< .001***	.01
	Within Groups	430.94	1170.00	0.37			

	Total	437.11	1173.00				
STEM and Non-STEM by print books	Between Groups	0.87	3	0.29	0.77	.51	.00
	Within Groups	441.22	1171.00	0.38			
	Total	442.09	1174.00				
STEM and Non-STEM textbooks	Between Groups	2.48	3	0.83	2.21	.09	.00
	Within Groups	438.69	1171.00	0.38			
	Total	441.17	1174.00				
STEM and Non-STEM by eBooks	Between Groups	2.18	3	0.73	1.95	.12	.00
	Within Groups	433.64	1166.00	0.37			
	Total	435.82	1169.00				
STEM and Non-STEM by subject and course guides	Between Groups	0.78	3	0.26	0.70	.55	.00
	Within Groups	435.61	1169.00	0.37			
	Total	436.40	1172.00				

[a] Value of *Eta squared* represents an effect size statistic by calculating *Eta Squared*=Sum of squares for between-groups/total sum of squares.

*** $p < .001$

Post-hoc comparisons using the Tukey HSD tests were further conducted in the three areas of library use (online use, journals and databases) in order to further identify which group differences occurred. The results from multiple comparisons revealed the group differences were similar across the three areas of library use (online use, journals and databases).
That is, the mean score in GPA for STEM respondents who never used the online library (*M*= 3.08, *SD*= 0.61), journal articles (*M*= 3.09, *SD*= 0.63) and databases (*M*= 3.09, *SD*= 0.64) were lower than students who used the library [online library for STEM (*M*= 3.29, *SD*= 0.60) or non-STEM (*M*= 3.29, *SD*= 0.61); journal articles for STEM respondents (*M*= 3.29, *SD*= 0.58) or non-STEM (*M*= 3.26, *SD*= 0.60); databases for STEM (*M*= 3.29, *SD*= 0.57) or non-STEM (*M*= 3.24,

SD= 0.61)]. However, the mean score in GPA for non-STEM respondents who never used the online library, journals and databases did not differ significantly from the other groups. The findings indicate that STEM students' use of a specific resource (online use, journals and database) has a greater impact on their GPA than it does with non-STEM students' use of these resources.

STEM vs. non-STEM students: Priorities of spending funds on library resources

The top three library resources identified by respondents in the STEM disciplines were ranked: more electrical outlets (44%), more quiet study space (32%) and more drink options (31%). On the other hand, non-STEM respondents identified the top three resources needed were: additional comfortable furniture (40%), more electrical outlets (35%) and more computers (34%). Other resources were listed by STEM and non-STEM respondents in Figure 1. While both STEM and non-STEM respondents wanted the library to use funding to have more electrical outlets, there were differences in the other priorities of library resources between STEM and non-STEM respondents: quiet study spaces and drink options for STEM respondents, and additional comfortable furniture and computers for non-STEM respondents.

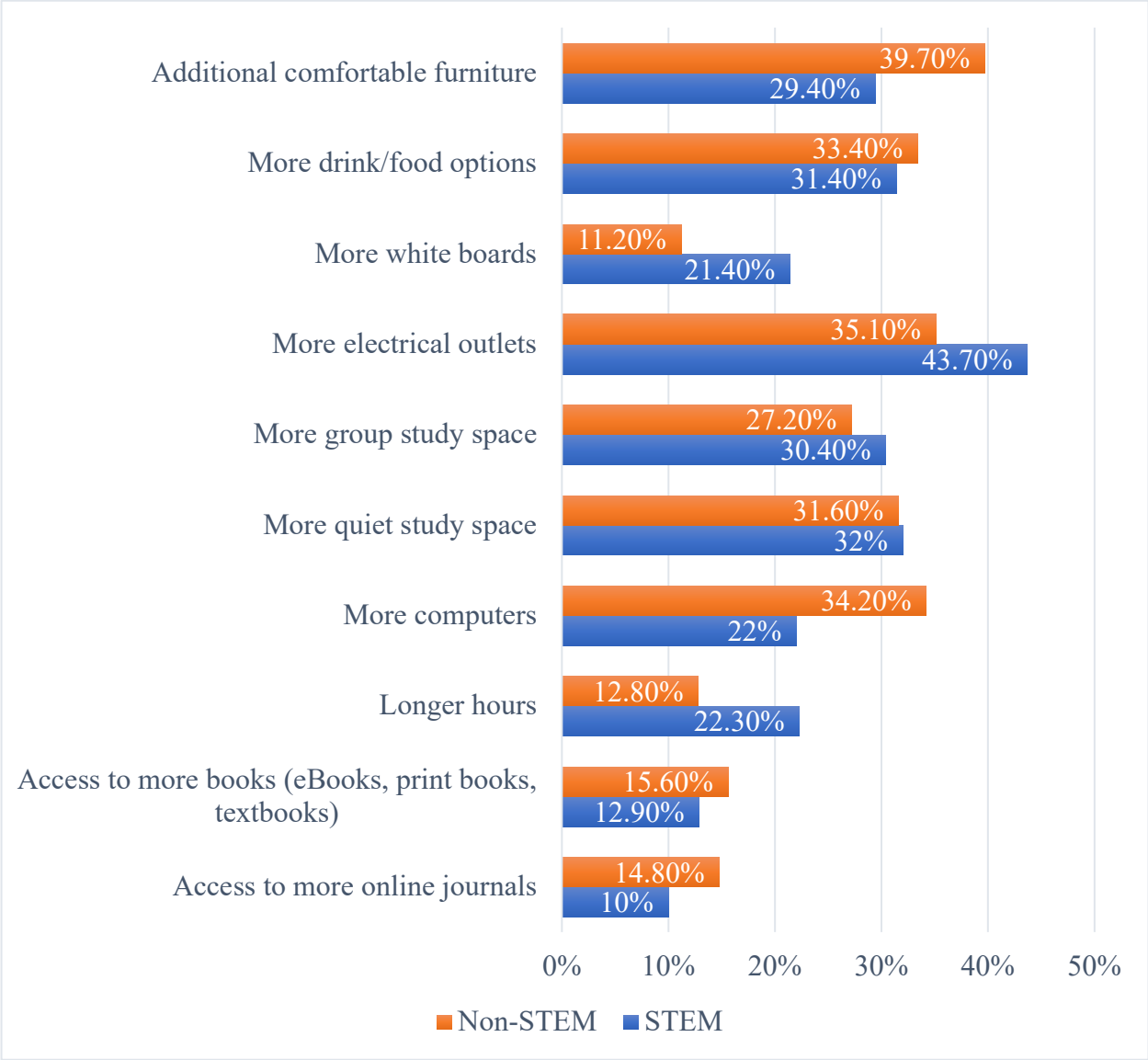

Figure 1. STEM and non-STEM students' feedback on how to use library funding

Discussion

The current study expanded on the previous study from 2018 to examine if there are any differences in undergraduate students' perceptions of library resources between STEM and non-STEM students, and differences in their GPA and library use. Furthermore, the top three library resources identified by STEM and non-STEM students for funding were investigated.

Despite obtaining statistically significant results, the effect sizes are small. That is, the degree of difference in perceptions of library resources between STEM and non-STEM

respondents is minimal. Nonetheless, it is important to know that students' perceptions of library resources vary by STEM and non-STEM disciplines. The findings revealed that STEM respondents considered specific library resources (subject and course guides, library instructions and library workshops) less important than non-STEM respondents. However, there were no statistical differences in how STEM and non-STEM respondents value other resources. This finding is similar to another study indicating that STEM respondents perceived less value in supporting developing research skills and providing assistance in finding resources than non-STEM respondents (Yu *et al.,* 2018). The only difference in this study was a focus on undergraduate students, whereas Yu *et al.,* examined only graduate students. Also, in Yu *et al.*'s study the degree of difference between STEM and non-STEM respondents was not clear because the effect size was not reported. Nevertheless, the current study's finding provides evidence that students' preference of specific library resources varies between STEM and non-STEM disciplines.

The ANOVA results demonstrated that the mean scores in GPA for STEM respondents who never used the online library, journals and databases were slightly lower than respondents who used the online library regardless of disciplines. While the current study shows that the effect size is small, it is noteworthy that this finding is aligned with the previous literature indicating that students' library resource use (e.g., online use, journals and database) was positively associated with their GPA (Goodall and Pattern, 2011; Scoulas and De Groote, 2019) and academic engagement (Soria *et al.,* 2017). What is striking in the current findings is that STEM respondents' use of journals and databases is critical to their GPA. That is, STEM respondents who never used journals and databases recorded the lowest GPA, and STEM respondents who used journals and databases had the highest GPA. This finding is valuable for librarians to be aware of the importance of acquiring and maintaining journals and databases for STEM student's academic success. However, librarians should exercise caution when interpreting and incorporating the findings into decision-making; Robertshaw and Asher (2019) raised concerns about relying on findings with no or low effect sizes to make "high-impact decisions" (p. 76). Although research findings with a small effect may not be practical for making immediate decisions, this information still allows library administrations and subject liaisons to better understand a specific group's needs for improving students' experiences and academic performance. Additionally, ongoing assessment of STEM students' needs should be conducted to verify if the patterns of their experiences remain the same or change over time. The University library has scheduled a student survey for Spring 2021 and will continue exploring and comparing the patterns of STEM students' needs before and after COVID-19 on an ongoing basis. The last finding showed similarities and differences between STEM and non-STEM respondents in terms of the top three areas identified to improve the library. Both STEM and non-STEM respondents reported that they wanted to have more electrical outlets. This finding reflects the previous findings from 2018 indicating that students, regardless of disciplines and class status, wanted more electrical outlets. In response to the 2018 survey, the University library installed additional electrical outlets in several areas of the libraries (Citation withheld for blinding). However, the responses in two other areas were different. STEM respondents wanted to have quiet study space and drink options, whereas non-STEM respondents wanted to have additional comfortable furniture and computers. Given that the STEM programs tend to provide rigorous curriculums with a heavy course load, it is anticipated that STEM students would express a desire for more quiet study spaces. This finding provides evidence for academic

libraries that securing and expanding quiet study spaces is important to support STEM students' academic needs.

Conclusion

Academic librarians agree that efforts to understand users' needs are critical to improving library services and resources, and further demonstrating the value of the library for students' academic success. However, few studies examine the needs of undergraduate STEM students and how their library use has an impact on their GPA. The current study provides solid evidence that there are variations in students' perceptions of library resources between STEM and non-STEM respondents; even if the magnitude of difference is small, it is significant because STEM respondents' use of certain library resources (online, journals and databases) has a significant impact on their GPA compared to non-STEM respondents. The practical implication from the current study is that revisiting the previously collected survey data provides a deeper understanding of the perceptions and library use patterns of certain student groups. Due to the COVID-19 climate, many students are experiencing even more challenges in terms of accessing library resources and physical spaces. The methodology used in this study would be useful for academic libraries to have a deeper understanding of which groups are significantly affected by access to library resources and spaces during this unprecedented time. This practice will provide meaningful information for academic libraries to better understand the differences between groups based on their library use and academic disciplines, and that information can be used when securing and promoting library resources for future decision-making through ongoing assessment.

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