

The Impact of Academic Library Resources on First-Year Students' Learning Outcomes

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Colleges and universities are under increasing pressure to demonstrate their contributions to students' learning and development.¹ In fact, over a decade ago, all of the regional accrediting agencies in the United States agreed to emphasize college students' learning as central to the accrediting process.² Under these increasingly pervasive expectations to demonstrate students' learning, fully 85% of Association of American Colleges & Universities (AAC&U) members reported that they have a common set of learning outcomes for all undergraduates.³ Additionally, nearly 90% of Association of American Universities (AAU) member institutions reported using quantitative data to collect information on student learning outcomes, with 70% reporting that they had one employee or office specifically charged with developing, coordinating, or implementing assessments of student learning.⁴

Amid the increasing calls for accountability to demonstrate students' learning, colleges and universities are currently confronting competing demands for fewer resources;⁵ consequently, it is even more vital that programs and services demonstrate their contributions to student outcomes. Academic libraries are no exception and, over the last decade, researchers have expanded their efforts to better understand how libraries contribute to students' success, including students' retention⁶ and academic achievement.⁷ One critical area of students' learning and development often explored by library

researchers includes students' development of information literacy,⁸ with close to 70% of library strategic plans listing information literacy as a paramount focus.⁹ Also the *Ithaka S+R US Faculty Survey 2015* indicated "an increase in the share of faculty members who believe that their undergraduate students have poor research skills and a substantial increase in the perceived importance of the role of the library in helping undergraduate students develop research, critical analysis, and information literacy skills."¹⁰

Libraries, in turn, have a long history of teaching and assessing information literacy and of focusing on student learning. Efforts like the Association of College & Research Libraries (ACRL) Information Literacy Immersion Assessment Workshop, the ACRL's *Information Literacy Competency Standards for Higher Education*, and now the ACRL *Framework for Information Literacy for Higher Education*¹¹ attest to the connections between libraries and student learning. As a result, the library community is much more likely to create student learning outcomes and use a variety of formative and summative student learning assessments.¹² However, at a substantial number of institutions, the majority of instruction programs are built on a "one-shot model and tend to capture limited amounts of information, e.g., only one librarian's class, one group of students, or one assessment method."¹³

Some libraries offer credit-bearing courses and have built deeper, richer student learning assessments.¹⁴ However, librarians often continue to find themselves in an awkward position in supporting student learning of critical thinking, analytical thinking, written communication skills, and reading comprehension. These higher-order skills take time and practice to develop, and time and practice are inherently not part of a one-shot session. Thus, there remains a significant gap with regard to the libraries' role in students' development of other critical learning outcomes common across colleges and universities. The absence of data related to these outcomes is concerning given Oakleaf's recommendation that

academic librarians collect “systematic, coherent, and connected evidence to establish the role of libraries in student learning”¹⁵ and the clear imperatives created by internal and external stakeholders for colleges and universities to demonstrate their contribution to students’ development.

Our study works to apply large-scale data collection, including course-integrated instruction, workshops, and one-shots, but also the multitude of experiences students have with the libraries, which support their learning—from using a database or e-book to chatting with a librarian.

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and how they contribute to undergraduate student learning outcomes as outlined by campus strategic plans and accreditation bodies. We are following Oakleaf’s construct, that “because libraries exist within educational institutions, it might be argued that nearly all library resources and services contribute, directly or indirectly, to learning.”¹⁶

The purpose of this study is therefore to explore the impact of library resources on first-year college students’ development of learning outcomes. We utilized quasi-experimental procedures (propensity score matching techniques) to construct control (non-library users) and treatment (library users) groups similar to those found in randomized experiments. We took these steps to reduce the potential bias found within students’ self-selection to use specific library resources. In this study, we explored the average treatment effect to examine differences in learning between students who used academic library resources (the “treatment” group) and those who did not use academic library resources (the “control” group).

Conceptual Framework

We used Astin's input-environment-output model as our conceptual framework given its relevance to the research design.¹⁷ The "inputs" within this model include students' pre-college characteristics, experiences, and demographics. The environment includes experiences during higher education and the outputs include students' self-reported development of critical thinking and analytical skills, written communication skills, and reading comprehension skills. Inputs can have an effect on both environmental experiences and outcomes, which is why we entered these variables in our statistical models. In order to test the potential impact of environmental experiences, it is important to consider the direct effects of input variables on outcomes while also examining the potential effects those input variables have on the environmental variables. In the case of students' use of academic libraries, for instance, self-selection bias may contribute to systematic differences between students who use library resources and those who do not use the same library resources.

To reduce self-selection biases, educational researchers use quasi-experimental designs in their analyses. In most experimental studies, researchers randomly assign participants to a control group or a treatment group to better test the effects of the treatment; however, such randomization is not often possible in educational settings. It would be unethical, for instance, to prohibit the use of academic library resources to students who may be randomly assigned to a control condition. Quasi-experimental techniques can simulate the characteristics of experimental designs by matching groups of students based upon demographic variables or other observable characteristics, with the only differences between these students the type of "treatment" received (e.g., using academic libraries).¹⁸ The resultant effects of such steps can help researchers to better estimate the effects of "treatments" on outcomes with a greater degree of accuracy. Therefore, in the present study, we utilized

propensity score matching techniques to estimate the effects of first-year students' use of academic libraries on their development of three learning outcomes: critical thinking and analytical skills, written communication skills, and reading comprehension skills.

Methodology

Sample

We drew the sample used in this study from the 2014 entering class of first-year undergraduates at the University of Minnesota ($n = 5,368$). During spring 2015, all students at the university were invited to take the Student Experience in the Research University (SERU) survey, a multi-institutional, comprehensive census in which students are asked to report upon their experiences in higher education, including their satisfaction, involvement, and development. Of the 472 first-year students at the University of Minnesota who responded to the SERU survey and were paired after matching techniques, there were more females ($n = 346$, 73.3%) than males ($n = 126$, 26.7%). Additionally, 1.9% were international students ($n = 9$), 4.7% Hispanic ($n = 22$), 1.5% American Indian or Native American ($n = 7$), 13.1% Asian ($n = 63$), 3.2% Black ($n = 15$), 0.4% Hawaiian ($n = 2$), 74.8% White ($n = 353$), and 0.2% ($n = 1$) did not specify race/ethnicity.

Measures

Covariate measures. The independent variables utilized for propensity score matching analyses were intentionally selected because of their known relationships to students' use of academic library resources. The covariate measures included students' race/ethnicity,¹⁹ sex,²⁰ on- or off-campus residency,²¹ first-generation status,²² participation in an honors program,²³ college of enrollment,²⁴ socioeconomic status as measured by Pell Grant,²⁵ and incoming ACT/SAT scores.²⁶ All indicators were derived from institutional records. When ACT scores were missing, we converted SAT scores to ACT

scores according to ACT concordance tables. Students' college of enrollment was dummy-coded with the liberal arts college (which admits the greatest proportion of first-year students) serving as a common referent.

Environmental measures: Students' use of academic libraries.

The environmental or “treatment” variables included students' use of academic libraries at least once during the academic year based upon at least one use in five primary areas: checking out books (including interlibrary loans and electronic books), using electronic resources (including academic journals accessed, websites used, and databases searched), logging into library computer workstations, engaging in library instruction sessions (introduction courses, workshops, or course-integrated instruction), and reference services used (e.g., meeting with a peer research consultant or chatting with a reference librarian). The sample of 472 was equally matched such that half of the students had used a library resource at least once and half had never used a library resource.

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We extracted collection loans—primarily book checkouts and renewals—from the university's Ex Libris Aleph catalog transaction records²⁷ and no distinctions were made between initial checkout and renewal. E-book views, database logins, and electronic journal logins used a “click-through” script to capture usage of these resources. Computer workstation use at the libraries required that users log in through a shared computer management software service called Cybrarian.²⁸ Login data included Internet ID and date of transaction, which we extracted from the Cybrarian database. We gathered reference transactions that occurred via live Internet chat from QuestionPoint²⁹ and we parsed the data into a list of Internet IDs. Library services staff train undergraduates (a.k.a. peer research consultants) to help students narrow down

their research topic, choose keywords, evaluate articles and websites, and learn other key research skills. We gathered Internet IDs for students who met with a peer research consultant.

Outcomes measures: Students' learning outcomes. The dependent variables of interest in this study included first-year students' self-reported development of three learning outcomes: critical thinking and analytical skills, written communication skills, and reading comprehension skills. In the SERU survey, students were asked to indicate their skill levels when they started at the university and their current skill levels on a scale from 1 (very poor) to 6 (excellent). We subtracted students' skills when they started at the university from their current skills to develop variables measuring students' growth or regression in those areas.

Data Analyses

We utilized propensity score matching techniques in SPSS 23.0 using the procedures outlined by Thoemmes.³⁰ We began by using binary logistic regression to compute propensity scores for individual students. We used the binary variable of using the library (yes or no) as a dependent variable and the independent covariates listed above in the regressions to calculate the probabilities of using a library resource at least once. Next, we used 1:1 nearest neighbor matching, meaning that each student in the treatment condition is matched to a student in the untreated condition who has the most similar estimated propensity score. We matched without replacement and discarded all units that fell outside of the area of common support to avoid extrapolation to units that were so dissimilar that no comparisons could be made to other units.³¹

Next, it was important to check whether the matching procedures balanced the distribution of variables in both the treatment and control groups. We examined the standardized mean differences (the mean differences between the two groups divided by the

standard deviation of the control group) in the treatment and control groups before and after matching. We detected no large imbalances above .25 after matching in each analysis, meeting the threshold suggested by Rosenbaum and Rubin.³² Before matching procedures were implemented, the covariates within the treatment and control groups differed significantly. These results also suggest that the propensity score matching decreased bias by making the observed and treatment groups more similar with regard to their covariates.

Finally, we used ordinary least squares regression to examine the relationships between library users and non-library users' development of learning outcomes. We included the propensity scores as controls to remove the component of their correlation that is due to the assignment process.³³ We tested assumptions of multicollinearity, homoscedasticity, linearity, and independent/normal errors. We found that multicollinearity assumptions were not violated and, in testing homoscedasticity, we found random scatter and variability in scatterplots of standardized residuals against the standardized predicted values. In producing histograms of standardized residuals and normal probability plots comparing the distribution of standardized residuals to a normal distribution, we found evidence for normality. Examinations of matrix scatterplots suggested the relationships between the predictor and outcome variables were relatively linear and the residual errors were independent across models. Overall, the results of these tests suggested that the assumptions were not violated for ordinary least squares regressions in this study.³⁴

Results

The first model assessed whether first-year students who used a library resource at least once were significantly more likely to report development of critical thinking and analytical skills. The results of the first regression suggest that first-year students who used any library resource at least once had significantly higher

development of this learning outcome compared to their peers who did not use the library resource ($\beta = .290, p < .001$). These results held when we controlled for the propensity scores in the model.

The second regression model assessed whether first-year students who used a library resource at least once were significantly more likely to report development of written communication skills. The results suggest that first-year students who used any library resource at least once had significantly higher development of this learning outcome compared to their peers who did not use the library resource ($\beta = .226, p < .001$). These results held when we controlled for the propensity scores in the model.

Finally, the third regression model assessed whether first-year students who used a library resource at least once were significantly more likely to report development of reading comprehension skills. The results suggest that first-year students who used any library resource at least once had significantly higher development of this learning outcome compared to their peers who did not use the library resource ($\beta = .207, p < .001$). These results held when we controlled for the propensity scores in the model.

Discussion, Limitations, and Recommendations

The results of this study suggest that first-year students who used a library resource at least once were significantly more likely than their peers who did not use the library to report development of critical thinking and analytical skills, written communication skills, and reading comprehension skills. As researchers continue to explore the potential ways in which academic libraries contribute to students' success, this study—along with others³⁵—suggests that the attendant benefits can also include students' development of learning outcomes beyond information literacy.

There are some limitations to this study that are noteworthy; for instance, data utilized in this study were drawn from a large, public, research-extensive university, a factor that may limit generalization to other

institutional types.³⁶ Although we used propensity score matching analyses to achieve a degree of balance in the covariates, it is indeed possible that important unobserved covariates were not included in analyses that may contribute to students' use of academic library resources, their completion of the SERU survey, or their learning and development. Without inclusion of variables such as academic motivation, estimated treatment effects of library use may be biased and should be interpreted with caution.³⁷

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Additional limitations are related to the sample size: 472 students reflects only 8.5% of the entire 2014 first-year class ($n = 5,530$). The sample was also skewed significantly in terms of students' sex—in 2014, 52.5% of the first-year class was female and 47.5% was male—a trend that we have observed in our surveys on this campus. We were not able to capture additional variables related to students' use of libraries that may be important markers of their libraries experiences such as study rooms or other physical spaces in the library.³⁸ These limitations should be taken into consideration by readers and future researchers.

Recommendations for future research include studying a different type of university population, using a larger sample that is equally composed of females and males, and including students' self-ratings of their academic motivation and students' use of specific types of library spaces as covariates.

Conclusion

Given the evidence presented here, academic library resources may prove to play an important role in students' development of learning outcomes beyond information literacy. While research at our institution continues, we encourage all academic libraries to gather data on students' use of academic library resources and connect those data points with other sources of data to better understand the potential impact of academic libraries on student outcomes.

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