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[ARTICLE]

MEASURING THE IMPACT OF LIBRARY INSTRUCTION ON FRESHMAN SUCCESS AND PERSISTENCE

A Quantitative Analysis

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ABSTRACT

This study examines the relationship between formal library instruction and undergraduate student performance and persistence in higher education. Researchers analyzed two years of academic and demographic data collected from first-time freshmen at Middle Tennessee State University in an attempt to quantify the effect of librarian-led one-shot classroom instruction on students' grade point averages and their likelihood of returning to school for the sophomore year.

INTRODUCTION

Instruction librarians at academic libraries teach classes of students how to articulate research questions, formulate search terms, select and navigate appropriate search tools, and evaluate results in support of academic projects. Though some colleges and universities offer stand-alone, for-credit library classes, most often library instruction sessions are taught in support of other academic departments' courses with librarians serving the role of guest lecturer. As a result, librarians in the latter scenario usually do not grade students' work and, therefore, cannot personally attest to the effectiveness of their teaching as evidenced in the students' writing and research projects. Instead, librarians use formal and informal assessment tools—pre-tests and post-tests, student "satisfaction" surveys, classroom assessment techniques, and anecdotal feedback from teaching faculty—to measure the effectiveness of their teaching and their students' learning (Oakleaf, 2008).

But are instruction librarians making a difference in student success and retention with one-shot instruction lessons? Are students able to apply these new skills to help them succeed and persist in their class work? Do students who receive this library instruction outperform their peers who do not?

This study used two years of student data and library instruction records from Middle Tennessee State University (MTSU) and its James E. Walker Library to test two hypotheses: 1) Formalized librarian-led library instruction is correlated with first-to-second-year retention rates, and 2) formalized librarian-led library instruction is correlated with grade point averages among first-year students. The null hypothesis, therefore, would be that library instruction does not affect retention and grade point average (GPA). For the purposes of this study, library instruction is defined as a face-to-face class session (either 55 minutes or 1 hour 25 minutes) taught by an American Library Association (ALA)-accredited librarian in support of a for-credit, non-library course. These courses included first-year orientation seminars, English composition and public speaking classes, and others. At MTSU—a large comprehensive university with a broad array of baccalaureate, masters, and Ph.D. programs serving more than 26,000 students—there is no requirement for any class to come to the library for instruction, so all of the classes in this study received library instruction at the request of the classroom instructor.

To test the two hypotheses, the authors analyzed student records combined with locally collected library instructional records to determine if first-year students who had received a formal library instruction session from a librarian were more likely to return to school as sophomores the following year and to earn higher first-year GPAs. By introducing demographic student data such as high school GPA, family income, ACT scores, etc. into the analysis, this study built on earlier attempts that tracked student output measures and introduced an improved methodology for measuring the correlation between academic library instruction and student success and retention.

LITERATURE REVIEW

The literature on undergraduate persistence and retention is as vast as it is inconclusive. Despite being the subject of intense study and scrutiny in the field of higher education,

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no one has found the perfect formula for undergraduate retention. Vincent Tinto, arguably one of the most influential researchers in this field, postulates a model of student retention that focuses on the student's overall academic and social integration (Tinto, 1993). Using this model, some librarians have argued for libraries to strengthen their relationships with first-year programs at their institutions (Gardner & Hardesty, 2004). Alexander Astin is known for his input-environment-outcome (I-E-O) model of student retention. In this model, Astin considered input factors that students bring with them to the university (demographic, social, and academic), the environment in which they operate (relationships, facilities, support networks, etc.), and the outputs of those undergraduate experiences (students' knowledge, satisfaction, post-college careers and income, etc.). While Astin's model aimed for a holistic view of the college experience, he is ultimately silent about the role of libraries and library instruction (Astin, 1993).

Elsewhere, academic libraries are well-represented in the conversation about undergraduate persistence and retention, though Pierard and Graves (2007) found "a paucity of data demonstrating connections between student use and knowledge of how to use libraries and their academic success and persistence, either during or after the first year." Elizabeth Mezick found a positive correlation between libraries' expenditures and staffing levels and persistence and retention (Mezick, 2007). While this finding is encouraging, the study did not take into account other mitigating factors like students' academic and socio-economic characteristics that they bring to their respective schools. Emmons and Wilkinson also found a statistically significant correlation between library staffing and graduation rates at schools belonging to the Association of Research Libraries (ARL). The authors speculated that their findings were correlated with other factors related to the elite status of ARL institutions, e.g., low faculty-student ratios, academic support, institutional spending per student, etc. (Emmons & Wilkinson, 2011).

In his book, *Library Assessment in Higher Education*, Joseph Matthews summarized a subset of the academic library retention literature that focuses on library instruction using a variety of statistical techniques. He identified seven studies that measured students' library skills through "knowledge tests" and found no support for library instruction's influence on retention and GPAs; he also identified six other such studies, however, that *did* find a positive correlation (Matthews, 2007). These conflicting studies illustrate the lack of consensus about the effects of library instruction on students' academic performance as well as a lack of consensus about how to measure such an effect.

A study by Wong and Cmor (2011) found a correlation between repeated library workshop attendance and graduation GPA among 8,701 students at Hong Kong Baptist University, but only after a minimum of three or four library workshops. Much like the other library studies previously mentioned, Wong and Cmor do not control for other measurable input variables like the students' academic and demographic characteristics.

METHODS

The researchers linked to several sources of data collected by MTSU and the James E. Walker Library and compiled them into a new data set for analysis. A spreadsheet of locally collected records of library

instruction classes enabled the researchers to identify specific course sections that had received library instruction during the fall 2008 and spring 2009 semesters. Course section numbers from the library instruction files were traced to the first-generation, first-year students' fall 2008 course registrations. This process identified students enrolled in courses that provided formalized library instruction.

The university retains all student demographic and academic information in a local data warehouse, the Blue Info Data Warehouse (BIDW). The BIDW copies specific information from the Student Information Unit and the Finance Unit from the university's Enterprise Resource Planning system (Banner) daily into a database tailored for MTSU's data requirements. The researchers collected information such as grades, age, courses taken, and declared major and exported the data from BIDW into a *Microsoft Access* database using structured query language (SQL). Each student and every variable associated with that individual constituted one observation. Prior to analysis, all personally identifying information such as student names were redacted. After excluding minors, 3,330 observations were available for analysis.

Compiling a data set was a labor-intensive endeavor. While the researchers were able to obtain raw data from the BIDW, they often required processing in order to make them useable for this study. For example, calculating a student's first-year GPA required running multiple queries to average GPAs from multiple semesters and exclude transfer credits from other institutions. Furthermore, some data, like the library instruction variable, had to be entered manually. Such nuances of data collection and processing at other institutions will be highly individualized, depending on how data are collected, stored, and reported.

The resulting data set included demographic variables (age, gender, race, zip code, and household income), variables that represented academic preparedness (high school GPA, ACT test scores, and academic major), as well as college courses and grades received. The resulting data presented a statistically rich snapshot of the student population and improved upon earlier studies that relied simply on single output measures (like GPA).

DATA ANALYSIS

The researchers analyzed the new data set using *STATA* software. The hypotheses were tested by applying Ordinary Least Squares (OLS), Probit, and Tobit regression models. The result of an OLS model is an estimate of the linear relationship between two variables. Regression models are excellent tools for hypothesis testing because they allow researchers to control for other observable variables, i.e., estimating the relationship between student performance and library instruction while controlling for demographic characteristics and prior academic performance. A Probit model is a variation of OLS that is used when the dependent variable is binary, e. g., the answer to a yes or no question. In this study, a Probit model attempted to establish a correlation between library instruction and retention, the latter being a binary variable. Tobit models are used when the dependent variable is continuous but limited to a specific range. In this study, a Tobit model tested for a correlation between library instruction and GPA because GPA is limited. It must be between 0 and 4. Greene (1997) provided an excellent description of these models and the statistical theory behind them.

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TABLE 1 — VARIABLE DESCRIPTION AND DESCRIPTIVE STATISTICS

Variable	Description	Observations	Mean	Std. Dev.
Library	=1 if student was registered for a class that attended a library instruction session	3330	0.52	0.50
Retained	=1 if student enrolled in fall of 2009	3330	0.73	0.45
FGPA	First year grade point average	3330	2.59	0.98
Female	=1 if student is female	3330	0.02	0.50
Hispanic	=1 if student is Hispanic	3330	0.02	0.15
African American	=1 if student is African American	3330	0.18	0.39
Other Minority	=1 if student is another minority	3330	0.04	0.20
Income	Household Income in Thousands	3169	79.00	75.58
Undeclared	=1 if student is undeclared	3330	0.17	0.37
ACT	ACT composite score	3178	22.50	3.52
Spring	=1 if student enrolled in the spring of 2009	3330	0.91	0.29
HSGPA	High school grade point average	3330	3.26	0.51

Table 1 contains a description of the variables used in estimation as well as descriptive statistics. These variables allowed the researchers to test the stated hypotheses while controlling for demographic, socioeconomic, and academic factors—a weakness of earlier retention studies. "Retained" is a binary variable set to 1 if the student returned in the fall of 2009. The mean was 0.73, implying a 73% retention rate. It is important to note that this was not MTSU's official retention rate, which is calculated differently. The library variable is also a binary variable set to 1 if the student was enrolled in a class that attended a library session. The mean was 0.52, implying that 52% of the 3,330 first-year students in the data set were enrolled in a class that attended a library session. According to this preliminary analysis, approximately 1,700 first-year students were enrolled in classes that attended library instruction in that academic year. "ACT," "HSGPA," and "FGPA" represent the students' ACT composite scores, high school GPAs, and first-year GPAs, respectively. The average ACT score was 22.50, the average high school GPA was 3.26, and the average first-year GPA was 2.59. The "Female," "Hispanic," "African American," and "Other Minority" variables were dummy variables set to 1 if the student was a member of one of these groups. The 2008 first-year class was 52% female. Eighteen percent were African Americans, and 6% were Hispanic or other minorities. The average annual household income was $79,000. This study also included a fall-to-spring retention rate labeled "Spring." Approximately 91% of the students in the sample returned in the spring of 2009.

The Impact of Library Instruction on Student Retention

The researchers used a Probit model to test the hypothesis that attending a library instruction session has an impact on first-year retention. The null hypothesis, therefore, is that library instruction has no impact on student retention. Parameter estimates and marginal effects are presented in Table 2. In addition to the variable of interest, library instruction, the authors included academic and socio-economic variables to serve together as a control function, thus allowing for an unbiased estimate of the impact of library instruction.

The analysis showed that a student's first-year GPA has a positive and statistically significant impact on student retention. Items accompanied by asterisks in Table 2 show a statistically significant correlation. A 1-point increase in GPA corresponds to a 26.7% increase in the probability the student will return for his or her sophomore year. An African American male is 11.6% more likely to be retained than a Caucasian male, a difference that is statistically significant. Undeclared students are 11.4% less likely to be retained, a difference that is also statistically significant. The researchers expected to find that students who did not return for the spring semester (their second semester) were far less likely to return as sophomores the following fall (for a third semester). To control for this, the study also included a variable for "spring" enrollment. Unsurprisingly, students who are enrolled for the spring semester are statistically more likely to return for a second year. The remaining estimated coefficients were not statistically significant. Thus this study failed to reject the null hypothesis that

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TABLE 2 — PROBIT RESULTS, INDEPENDENT VARIABLE = RETAINED		
	Estimated Coefficients	**Marginal Effects**
Library	0.0795	0.0241
	(0.0598)	(0.0181)
FGPA	0.886***	0.267***
	(0.0363)	(0.0117)
Female	-0.0923	-0.0278
	(0.0596)	(0.0179)
Hispanic	0.174	0.0491
	(0.205)	(0.0538)
African American	0.428***	0.116***
	(0.0790)	(0.0190)
Other Minority	0.398***	0.103***
	(0.163)	(0.0350)
Income	0.000324	9.77e-05
	(0.000395)	(0.000119)
Undeclared	-0.350***	-0.114***
	(0.0759)	(0.0264)
Spring	1.710***	0.607***
	(0.126)	(0.0359)
Constant	-3.188***	
	(0.163)	
Observations	3169	
Pseudo R^2	0.37	
χ^2	1358***	

Standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

library instruction has no impact on retention. A number of factors could be driving this result. For example, it is difficult to isolate the impact of any single variable because the variables commonly used to predict retention are collinear. Academic performance variables such as first-year GPA are strongly correlated with socioeconomic variables. This collinearity will inflate standard errors increasing the odds of a false negative.

The Impact of Library Instruction on First-Year GPA

In order to test the second hypothesis, the researchers wanted to measure the impact of library instruction on first-year students' academic performance as measured through GPA scores. The second phase of this study used an OLS model and a Tobit model in order to test the hypothesis that library instruction has an impact on grades. Table 3 shows the results. Both models are statistically significant as evidenced by the F statistic in the OLS model and the χ^2 statistic in the Tobit model. In the OLS model, the R^2 of .35 implies that the model explains 35% of the variation in GPA. For more information on how the R^2 is calculated, see Greene (1997).

The library coefficient in both models is positive and statistically significant, implying that students who receive library instruction, on average, have a higher grade point average than those who do not, thus lending support to the hypothesis that library instruction does have an impact on student performance. Using the OLS model estimate, a student enrolled in a course that received library instruction should have a GPA that is, on average, 0.09 higher than a student who was not in a course that received library instruction, holding everything else constant. It does, however, for the first time quantify a correlation between library instruction and undergraduate GPA.

Conclusion

Although the data do not provide evidence of a direct connection between library instruction and student retention, library instruction does appear to have a small measurable correlation with student performance. This is an interesting paradox as factors that impact retention should also impact performance. In addition to testing these hypotheses about student retention and performance, the authors introduced new, replicable data collection techniques and statistical models that further develop the study of the impact on undergraduate retention.

As researchers continue to study the relationship between library instruction and student success, there are several questions left to answer. Future research will attempt to get a better handle on attendance in library instruction sessions. For the purposes of this study, class enrollment was used as a proxy for presumed class attendance during the library instruction lesson. No actual attendance was taken during the library instruction classes, so there was no way to verify that each enrolled student actually attended the library instruction session with the class. Students who were prone to skip the library session of a class might also miss other classes and be less likely to succeed in the class and be retained. If this is the case, then the estimated impact of library instruction will be biased downward. This could possibly be remedied by capturing student log-in information at classroom computers or by installing a card-swipe system for class attendees.

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TABLE 3 — OLS AND TOBIT MODEL RESULTS DEPENDENT VARIABLE =FGPA

Variables	**OLS Model**	**Tobit Model**
Library	0.0873***	0.0924***
	(0.0289)	(0.0301)
ACT	0.0254***	0.0266***
	(0.00455)	(0.00476)
HSGPA	0.823***	0.856***
	(0.0317)	(0.0332)
Female	0.113***	0.115***
	(0.0292)	(0.0304)
Hispanic	-0.0499	-0.0450
	(0.0955)	(0.0996)
African American	0.0728*	0.0802**
	(0.0391)	(0.0407)
Other Minority	0.142*	0.157**
	(0.0762)	(0.0796)
Income	0.000696***	0.000774***
	(0.000191)	(0.000199)
Undeclared	-0.106***	-0.113***
	(0.0388)	(0.0405)
Spring	1.012***	1.113***
	(0.0519)	(0.0551)
Constant	-1.756***	-1.999***
	(0.130)	(0.137)
Observations	3053	3053
R^2	0.352	
F	165.0***	
χ^2		1352***

Standard errors in parentheses

***p<0.01, **p<0.05, *p<0.1

Future researchers might also analyze the effects of different instructional models. Many of the library instruction classes were *introductory* in nature. While this approach fits Tinto's social/academic integration model and integrates with the university's first-year student initiatives, it is not research-intensive like English composition classes that are also offered in the first year. It is possible that the effectiveness of library instruction varies in each of these two circumstances.

This study could also be expanded by reviewing 6-year retention rates and GPAs. Researchers could test a hypothesis that compounding multiple library instruction lessons will have more impact on students' GPAs and graduation rates, especially as they participate in higher level, research-intensive courses within their majors.

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