

An Analysis of Student Performance at the Intersection of Diversity and Information Literacy

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Conclusion – Students are more diverse in a single classroom setting than presumed prior to research; therefore, our instructional practices should be diverse and inclusive, as well. More preparation work and fact finding should be conducted by library faculty and instructors to facilitate the learning of the students, and not just the act of teaching. Librarians could ask for more information about the course demographics and respond accordingly. Librarians should also be properly trained in instructional practices to be better equipped to meet the expectations and challenges of teaching a diverse class.

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Research Article

An Analysis of Student Performance at the Intersection of Diversity and Information Literacy

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Abstract

Objective – When teaching Information Literacy (IL) concepts, instructors often have no knowledge about the background or previous IL exposure of the students they are teaching. This study aims to create a holistic picture of the students at a large Midwestern United States university in a first year introductory course on the design process for solving engineering problems.

Methods – Institutional data and course level data were traced and linked to individual students in an introduction to design thinking first year course. This course is at a major high research activity institution in the Midwestern United States. From a total course size of 650, institutional and course level data of 127 students were selected randomly and analyzed. Some data points are self-reported and some data points are performance-based.

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Introduction

In higher education, library faculty and instructors rarely know about the backgrounds of the students we teach. We are often encouraged to teach to a variety of types of students, not completely understanding what that means or looks like in the context of our individual classes. Furthermore, librarians may be at a disadvantage, not knowing the information literacy (IL) skills of the students that we teach. We may be invited to speak on a topic, with little to no knowledge about what they are preparing for and how much they may already know. Information literacy instruction sometimes occurs as if in a vacuum, with little knowledge about the background and IL exposure of the students taught. This same lack of knowledge often applies when we design our own courses. We often teach what we want them to know, but not what they are prepared to understand.

Not only are past IL experiences ignored, so are students' concurrent research and IL experiences. We know that preparedness gained in high school can have an impact on performance in college, including research practices (McCarron & Inkelas, 2006). Preparedness can sometimes be related to the rigor and resources of their high schools (Roderick, Coca, & Nagaoka, 2011) but also to family finances (Bettinger, 2004; Castleman & Long, 2016) or not having exposure to those who have attended college before, i.e., first-generation college students (Bui, 2002; Pike & Kuh, 2005; Stroud, 2017). There have been many studies on the intersection of gender and grade performance, especially in STEM disciplines (Hubbard, 2005; Severiens & ten Dam, 2012). Furthermore, information literacy and library usage are positively correlated with student matriculation (Soria, Fransen, & Nackerud, 2013).

In the LIS literature, the relationship between student success and information literacy has been well documented. In 2014, Soria, Fransen, and Nackerud conducted a series of regression analyses of over 5000 students and found that students who had used the library resources and services at least once in the first year had a higher GPA than those who did not. Though several data points were collected, they did not specifically report about the performance differences of students along ethnicities, income, and other “pre-college” data. There was an opportunity to explore the library use and exposure along with a variety of data points, which this study will do.

The LIS profession is continuously challenged to think beyond race and ethnicity to include other diversity measures. Specifically, we were challenged to expand our definition of diversity to include “underrepresented, disadvantaged, and underserved in terms of information” (Jaeger, Subramaniam, Jones, & Bertot, 2011, p. 11). Based on their definitions, diversity expands to include any people who may not have the best access to information, whether it is because of language barriers, access to technology, or statistical status as a minority. According to Fabbi’s (2015) research on the use of the iSkills assessment of information and computer testing, she found that there are four predictive variables to a high school student’s success: student’s best language, race, cumulative GPA score and honors/non-honors curricular paths. This was supported by Huerta and Watt’s (2015) work that also said that GPA and AP courses in high school predicted college success. After high school, more research is needed to explore those predictive variables over time. Conversely, Lanning and Mallek (2017) found that students’ high school performance and demographics had no influence on their information literacy performance. They collected demographic and high school information, along with admission test scores. Only their current GPA and ACT were relevant in their post-test regression analysis of IL performance.

Library instruction and cultural competence is an emerging area of interest for researchers. Understanding diversity is quite different than being culturally competent and adept when working with people who are different than you, especially in an instructional setting. Lori S. Mestre’s research (2009) has been looking at cultural competence in K-12 and college environments. In 2009, she published a work that found a significant gap in the cultural competence training of librarians before professional positions (Mestre, 2009). She found that such training would help librarians modify their instruction to be more culturally non-offensive (Mestre, 2009). In 2010, in the book *Librarians Serving Diverse Populations* (Mestre, 2010) she expanded on her earlier research to suggest how librarians could be trained in intercultural competence, as well as in strategies for library administration and library school curriculum development to effect positive change for professionals and pre-professionals. Some of the efforts include strategic assessment and ongoing training on incorporating multiculturally sensitive stories in the lesson planning (Mestre, 2010, pp. 100-101).

In 1991, Marilyn Loden and Judy Rosener published pioneering work on the dimensions of diversity (Loden & Rosener, 1991). In their book, they introduced the diversity wheel, with primary and secondary levels of diversity of individuals and institutions. The first level of diversity represents the internal dimensions of diversity, characteristics that influence self-identity. The six dimensions on the first level are age, gender, sexual orientation, physical ability, ethnicity, and race. The second level of diversity represents external characteristics that influence social identity. The 10 dimensions on the second level are: marital/family status, parental status, geographic location, income, personal habits, recreational habits, first language, work experience, educational background, and work experience. The original dimensions were expanded in 2010 to include income, class, and spiritual beliefs. These dimensions and characteristics of diversity can influence how

people value themselves and those around them. Because of the value placed on these dimensions, individually and collectively, the dimensions of diversity can positively or negatively influence interpersonal interactions in the classroom (Milem, Chang, & Antonio, 2005). Understanding these dimensions and where students appear within the social construct of the classroom is within the realm of responsibility for teaching faculty who are interested in effectively teaching to all walks of students (Milem et al., 2005). For this study, we will relate these dimensions of diversity with student performance on assignments to understand more about their performance along those dimensions. The dimensions are many of the data points collected by the university or self-reported by students at admission. We will collate those variables to create a holistic picture of the students in the course studied.

Background of the Course

According to the Association of American Colleges and Universities (AACU) Information Literacy VALUE Rubric, information literacy is “the ability to know when there is a need for information, to be able to identify, locate, evaluate, and effectively and responsibly use and share that information for the problem at hand” (Association of American College and Universities, 2019). In the classroom setting it may be manifest as written assignments, projects, or other learning objects that require research and producing an assignment or experience. According to criterion 3 of the AACU rubric, the student should be able to evaluate information and its sources critically. Additionally, in criterion 5, students should access and use information ethically and legally. The course studied, TECH 120, is a first-year gateway course which introduces students to design thinking for solving problems. The steps of the design thinking include utilizing available information at each step, including defining the problem, brainstorming solutions, and developing and testing a prototype. The AACU IL standards, not the current or previous ACRL

IL standards, are the approved definitions used to create the “information literacy” core curriculum designation by University Administration at the institution where the study was held. The learning objectives for this course, and others that are considered core curriculum IL designated courses at the institution, are created using the AACU IL standards.

TECH 120, Technology and the Individual, an introduction to technology design, typically enrolls approximately 650 students each year, most of whom go on to pursue majors in science, technology, engineering and mathematics (STEM) disciplines. It is the gateway course to the College of Technology and is a required course for all of the majors in that College. Most of the students are first-year students. TECH 120 also fulfills the information literacy course category of the general education core curriculum requirements that all students must complete before graduating. A librarian has been an integral part of the course design and has contributed information literacy-related content through the entire length of the semester-long course, including assistance with rubric design and assignments.

Student assignments are produced along the design thinking continuum of designing prototypes, including three IL-specific assignments that were analyzed as a part of this study. The first assignment is a bibliography created by the students on pedestrian safety at crosswalks, after watching a librarian-created video on keyword selection and the basic use of the databases Google Scholar, Engineering Village, and Academic Search Premier. The second assignment is a repeat of the first assignment, after a librarian in-class visit to review the databases and answer questions about their experiences. At the end of the semester, as a final project and the third assignment of this study, students produce academic-style poster presentations about a technological problem and solution within their College. A bibliography section is included in

the rubric for this assignment and is also a part of the optional templates provided. The self-selected problems vary from mechanical/facilities problems to student time-management problems.

Aims

This study aims first to create a holistic picture of the lives of the students in a single technology course; capturing demographic data, high school rank, Pell Grant eligibility, college transcript, and other institutional data and assessments. We want to investigate which demographics and common categories of diversity, i.e., underrepresented minorities (URMs), first-generation and legacy students (relatives, usually children, of a graduate of a school), and family financial contribution, correlate to their IL performance in a first-year course. We also investigate how students perform who have taken IL courses before or concurrently.

Methods

Two separate IRB approvals were granted for this study. The first IRB protocol enabled the ethical use of the student assignments for citation analysis. The second IRB protocol granted consent to engage in data agreements with Financial Aid, the Registrar, and Admissions for the ethical use of the institutional data of the students studied in the first IRB. The institutional data was paired with the citation scores of the assignments completed by the students.

Variables

There are 11 non-IL independent variables in this project, along with 3 IL dependent variables. The variables are defined in Table 1.

Citation Analysis Process

A 127-student sample population was randomly selected from a total 650-student course, across

17 sections. Each of the students was assigned a number, and numbers were selected using an online randomizer, www.randomizer.org. Student assignments were collected and analyzed using a customized three-point scale rubric based on the CRAAP test (Meriam Library, 2010) on the elements of currency, relevance, authority, accuracy, and purpose of the citations rendered. The author created a 3-point scale to measure the merit of each criterion, from low (1) to high (3). Three separate assignments were collected: 1) a bibliography after watching an online IL video, 2) a bibliography created after a librarian-facilitated face-to-face session, and 3) an end-of-course project bibliography. However, for this study, we evaluated the difference in IL performance from assignment 1 and assignment 3. That is, we evaluated the difference between an assignment early in the semester with an assignment at the end of the semester. Those IL results were then paired with institutional data about each student. Four librarians, in two teams of two, normed the citation scores of the students' assignments to establish inter-rater reliability. The librarians randomly selected 10 assignments, measured them individually, and then discussed them to normalize the scores given. Librarians met three times to discuss the scores due to the number of assignments and to ensure consistency over time. The librarians were from different disciplines or departments, in order to minimize the subjective bias inherent with being familiar or unfamiliar with the disciplines that the students cited.

Institutional Data Collection

Data sources include the campus learning management system, the campus Office of Institutional Research, Assessment and Effectiveness, and the Financial Aid office. Some data points, such as the first-generation status, are self-reported, and other data points are performance based. Data were retrieved via IBM Cognos Analytics, which is web modeling and analysis software.

Table 1

Project Variable Definitions

High School Name & Location	secondary institution listed on the student's transcripts, geographic location
Course Grade Data Final grade letter & value	the final grade submitted to the registrar's office, and its weight
Major	selected course of undergraduate study
Gender	commonly referred to as "sex", self-identified biological and physiological characteristics that denote male and female, as defined by the World Health Organization
Ethnicity	identified as having the physical characteristics of a particular ethnic or cultural group; one of 6 options: 2+ Races, Asian, Black/African American, Hispanic/Latinx, International, White; includes non-domestically/foreign born
Underrepresented Minority (URM) status	university assigned; denotation of the student as an underrepresented racial minority, such as Latinx, African American/Black, or Asian American. Does not include non-domestically/foreign born
Semester GPA	cumulative grade point average with all coursework in the semester studied
Overall GPA	cumulative grade point average with all coursework in entire college career
First generation status	whether a student's parents have not attended or graduated from a higher education institution
Legacy status	whether a student's parents or other immediate family members have attended the institution where the study was held
Birthdate	the date when a student was born
Pell Grant eligibility	whether a student's financial contribution or family's contribution makes them eligible for need-based federal financial aid, i.e. how much of the cost of education can be provided by the student and/or the parents.
Assignment one	an annotated bibliography collected and analyzed using the rubric in the Appendix, before librarian-led instruction
Assignment three	a bibliography collected and analyzed using the rubric in the Appendix at the end of the course
Average (Avg) IL Difference	average difference in the citation scores between assignment 1 and assignment 3
Concurrent IL Status	whether student is enrolled in another IL designated core curriculum course during the same semester such as Freshmen English

All identifiable data were anonymized by a campus data analyst prior to being shared with the other authors. Project metadata was kept via a shared Google document.

Data were stored using Excel spreadsheets. Data analysis was conducted using Minitab, Excel, and Tableau. We used descriptive and inferential statistics to determine how different demographics and preparedness affect performance. Minitab was used to calculate Pearson correlations to determine whether or not there were any associations between variables. Next, Excel was used to test for significance. One-sided t-tests and ANOVA t-tests were conducted to determine p values. Cohen’s D was used to determine effect size. A t-test’s statistical significance indicates whether or not the difference between groups’ means most likely reflects a real difference in the population from which the groups were sampled. Finally, Tableau was used to create data visualizations to get a view of the demographic breakdowns.

Results

After compiling the data, we found the overall demographics of the class. Students from outside of the College of Technology comprised 9% of those enrolled, which means that 91% were College of Technology majors. The class consisted of 81% that were self-identified as male, 69% white, and 13% underrepresented minorities. A total of 76% of the students were freshmen.

Concurrent Enrollment in an IL Course

A total of 62% of TECH 120 students were not concurrently enrolled in another information literacy core curriculum course. However, 32.28% (41) students were also enrolled in ENGL 106, the cornerstone English course required by all freshmen. Another 5.51% (7) were enrolled in

STAT 301, which also fulfilled the IL requirements as required by the university.

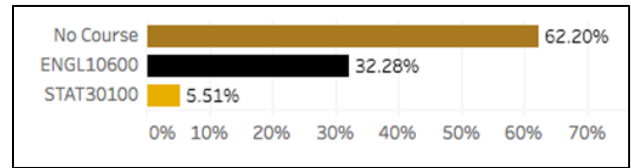


Figure 1
Percentage of students in concurrent IL course.

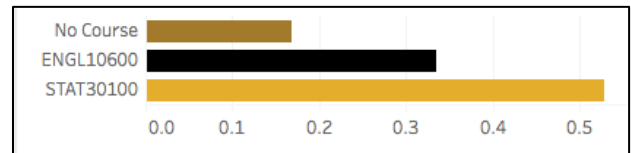


Figure 2
Citation score difference of students in concurrent IL course.

Prior Enrollment in an IL Course

Most students, 83.46%, had not completed an IL categorized core curriculum course prior to enrollment in this course. However, one student who scored considerably worse on both assignments had taken STAT 301 previously and had the largest difference between assignments.

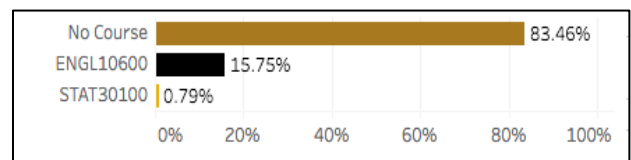


Figure 3
Percentage of students who previously enrolled in IL course.

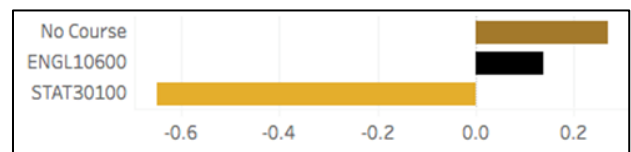


Figure 4
Citation score difference of students who previously enrolled in IL course.

Ethnicity

In terms of ethnicity, 68.50% (87) of the students identified as white and 8.66% (11) of the students identified as Asian or Asian American. In terms of nationality, 7.87% (10) students were identified as International students or non-domestically born. Nearly 10% of the students were identified as an underrepresented minority, with 4.72% (6) Black/African American, 5.51% (7) Latinx, and 5 (3.94%) that identified themselves as multiracial.

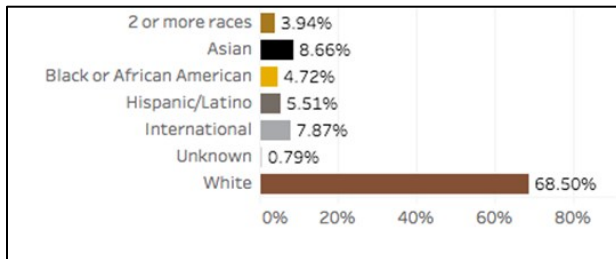


Figure 5
Ethnic backgrounds of the students.

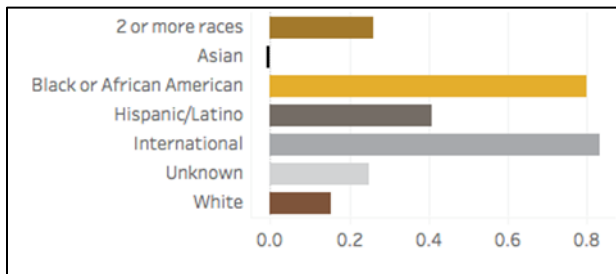


Figure 6
Citation score difference by ethnic background.

First Generation Status

First-generation college students made up 20% (26) of the sample. There were 101 students (79.53%) who reported that at least one parent or both parents had attended a higher education institution. Interestingly, the difference in IL performance was greater with non-first generation students than first-generation students. That is, students who were exposed to family members who had a college education had a greater performance gap than those who did not have a family member who had attended college.

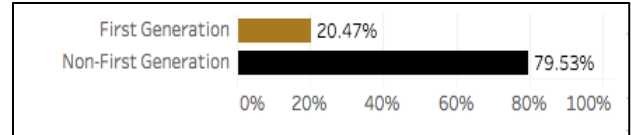


Figure 7
First generation status of students.

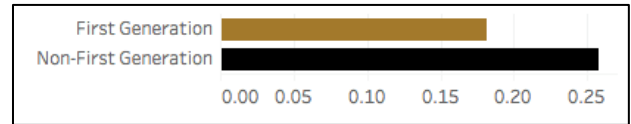


Figure 8
Citation score difference based on first generation status.

Gender Status

Only 24 students (18%) were female, while the remaining 81% were male. The difference in IL performance was greater among male students than female students.

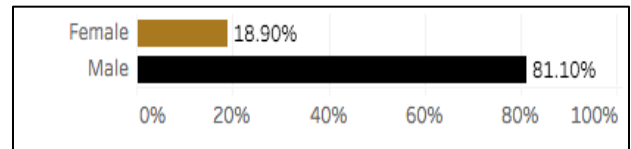


Figure 9
Gender of the students.

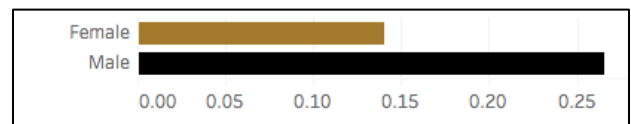


Figure 10
Citation score difference by gender.

Legacy Status

A total of 63.78% (81) of the students were not the immediate family members of university alumni. The remaining students had a parent, sibling, or another relative that attended the university. Most students with relatives who attended the university had a positive IL performance difference from assignment 1 to assignment 3. However, students whose parents attended the university had a negative IL performance difference, which means that they

actually did worse on the final assignment than the first assignment.

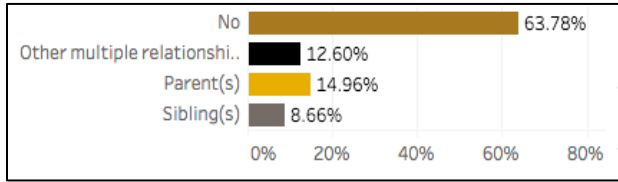


Figure 11
Legacy status of the students.

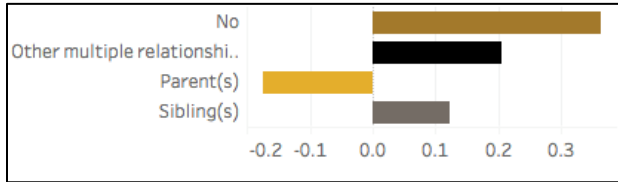


Figure 12
Citation score difference by legacy status.

Pell Grant Eligibility

Although 89 students were not eligible for the Pell Grant, 30% (38) of students were eligible for the grant. Those who were eligible for a Pell Grant had a greater IL difference, denoting a larger improvement from assignment 1 to assignment 3.

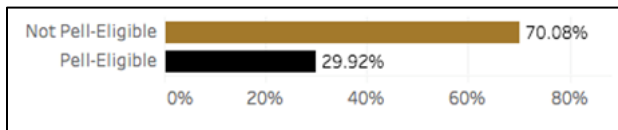


Figure 13
Pell Grant eligibility by student.

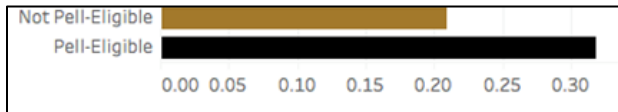


Figure 14
Citation score difference by Pell Grant eligibility status.

Underrepresented Minority Status

A significant majority of students, 87% (111), were not underrepresented minorities. A count

of 16 students identified as URM; 13% of students were identified as Black/African American, Asian American, or Latinx. Based on the ethnicity data, multi-racial students may also be grouped with underrepresented minorities. This is unclear, but the data supports this as a possibility. Students who were URM had a larger IL difference from assignment 1 to assignment 3 than those who were non-URM.

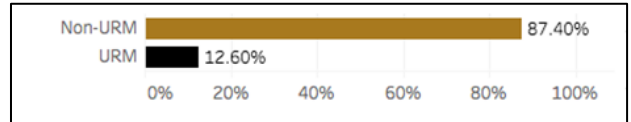


Figure 15
Underrepresented Minority status.

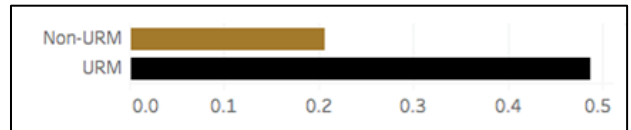


Figure 16
Citation score difference by Underrepresented Minority status.

Information Literacy

Overall with all variables controlled, the average citation score for all students was 2.289 on the first IL assignment, on a scale of 1 to 3, with 30 students scoring below 2. The overall average citation score on the second assignment was 2.532, with 3 students (8.66%) scoring below 2. This suggests growth in overall IL performance for the entire sample of 127 students from assignment 1 to assignment 3.

Table 2
Average Citation Score, cumulatively

	Assignment #1	Assignment #3
Average IL Score	2.289940031	2.532168551

Table 3

T-Tests Scores Comparing URM Status, Gender, and Pell Grant Eligibility Status with IL Performance

	URM (Y=1)	Gender (M=1)	Pell-eligible (Y=1)
IL 1	-0.093	-0.072	-0.062
IL 3	0.05	-0.017	0.004
Change in IL	0.12	0.063	0.064
TECH 120 Grade	-0.209*	-0.087	-0.109
F14 Term GPA	-0.127	-0.142	-0.1

*Statistically significant at $p < .05$

Table 4

T-Test Scores Comparing First-Generation Status, Legacy Status, and High School Rank

	First Generation (Y=1)	Legacy (Y=1)	HS Rank (n=79)
IL 1	0.04	0.135	0.093
IL 3	0	-0.165	-0.072
Change in IL	-0.04	-0.224*	-0.138
TECH 120 Grade	-0.254**	-0.06	-0.029
F14 Term GPA	-0.185*	-0.087	-0.011

*Statistically significant at $p < .05$ **Statistically significant at $p < .01$

Discussion

Diversity

Diversity within higher education can be defined along many variables; including, but not limited to, gender, ethnicity, URM status, and economic contributions. Research has shown that gender (Moss-Racusin, Dovidio, Brescoll, Graham, & Handelsman, 2012)) does influence the performance of females in STEM. There are inherent and explicit biases in the classroom that can dictate the success of a diverse group of students (Greenwald & Krieger, 2006; Gregory, Skiba, & Noguera, 2010; Hill, Corbett, & St Rose, 2010; Jacoby-Senghor, Sinclair, & Shelton, 2016; Staats, 2015). According to the findings, there was a significantly negative correlation between the IL performance of URM students and their course grade, suggesting the grades of URM students decreased in relation to minority status. There were no other significant correlations found between those variables identified as pertaining

to diversity, gender, and Pell grant eligibility. Our findings are supported by the literature that URM students can perform more poorly academically in certain settings. However, our study found no significant differences along gender lines nor economic status.

Exposure

An important interest in the study was to find the influences of pre-college and concurrent college experiences on the performance of IL related assignments. One of those influences is exposure to formal IL instruction in other courses. We ran Pearson's correlations to determine the relationship between exposure to concurrent and prior courses. There was a significantly negative correlation between the performances on assignment 1 and being concurrently enrolled in another IL course. That is, students who were in two IL designated courses simultaneously performed poorer on assignment 1 than those enrolled in the single

course. Different IL topics, techniques, and course elements could be the reason for the difference in performance. Librarian involvement could also be a contributing factor, as IL is a significant portion of the learning outcomes for the course and the librarian was significantly involved with the course design of the studied course. It is unknown whether a librarian was involved with the design of other courses.

Preparedness

College readiness can be an accurate measure of performance capability at the college level. College readiness is often denoted with the academic rigor of the courses offered and taken in high school (Roderick et al., 2011). However, college readiness can also be attributed to exposure through social networks like family and fellow students (Bui, 2002). We found that there was a significant negative correlation between the IL performance of first-generation students and their GPA during the term of the study. That finding suggests that first-generation students perform less than their counterparts both in IL performance and overall for the course and the term studied. This is consistent with existing literature regarding the performance of first-generation students, justifying the need for support interventions. Interestingly, legacy students had a negative average change in IL score, meaning that their IL scores decreased over the course of the semester. High school was not a significant correlation, though considered as a preparedness factor. Only those students who attended high schools in the same state of the study were included.

Conclusion

Students within a single course are more diverse than the eye can see. They have complicated upbringings and have followed different paths

to arrive in the college classroom. From this study, we investigated the diversity of the backgrounds of the students and aspects of their social network contributions, tangible and intangible. We learned that having concurrent or prior IL instruction may compromise the integrity of the IL instruction that took place in this course because students who took prior or concurrent IL courses did not perform as well as those who had not. This contradicts the study done by Soria et al. about the use of the library databases (2014). More research is needed to explore what happens when students take more than one research heavy or IL related course, especially in their first or second years. Perhaps further work can be done to understand why more IL instruction did not lead to a stronger performance in this study. Additionally, we learned that the impact of the URM and international experience on their overall performance cannot be overlooked in the IL instructional setting. International and URM students experienced lower IL performance gains. More IL related research and inclusive IL instructional practices should be explored to engage traditionally underserved students, like URM and international students. Perhaps considerations should be made for lower-income students, in regard to the use of technology and prior exposure to IL that may have been limited prior to their university arrival. That is to say, we can question whether every student has every app or cool new technology device to adequately engage with some course materials. Similar considerations may apply to first-generation students understanding the nuances of navigating the academic setting, including IL instruction and course and library materials. This study demonstrates that in some instances instructor assumptions may not be supported by data, and we instructors should make efforts to understand and teach the whole student with equity, not equality.

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Appendix

Rubric – Citation Analysis, based on CRAAP Test

Currency: The timeliness of the information

- How old is the information and is that important for your topic?
- Does it report facts from the actual time of the event or issue?
- Is it retrospective, providing some review or analysis of previous research?

Relevancy: The importance of the information for your needs

- Does the information relate to your topic or answer your question?
- Who is the intended audience?
- Is the information at an appropriate level (i.e., not too elementary)?
- Have you looked at a variety of sources before determining the appropriateness of this source?

Authority: The source of the information

- Who is the author/creator of the information? Is it a person, group of people, an organization?
- Is he/she the original author/creator?
- Is the person qualified? What are his/her credentials? What is his/her occupation?
- Is the source sponsored or endorsed by an institution or organization?
- Is there a potential for bias?

Accuracy: The reliability, truthfulness, and correctness of the content

- Is the bias of the author/creator obvious? Is the source trying to convince you of a point of view?
- Where does the information come from? Is it supported by evidence?
- Is the publication in which the item appears published, sponsored, or endorsed by a political or other special interest group?
- Does the language or tone seem unbiased or free of emotion?
- Are there typos, spelling errors, or grammatical errors?

Purpose: The reason the information exists

- What is the intended purpose of the information: inform, teach, sale?
- Is the information fact, opinion, propaganda?
- Does the point of view appear objective and impartial?
- Are there political, ideological, culture, religious, institutional leanings presented?

Considerations for Evaluators Scale – low (1) to high (3)

Currency: Timeliness

- 1- Not Acceptable: No date indicated, inappropriate, obsolete, or outdated for paper topic/assignment
- 2- Acceptable: Should be used with sources from other dates
- 3- Completely Appropriate: Most timely for paper topic/assignment

Relevancy: Importance of the information to the topic/assignment

- 1- Not At All Relevant/Partially Relevant to Topic: show to minimal understanding of the relation between the source and the paper topic/assignment; not appropriate for academic level & audience
- 2- Relevant to topic: Information relates to the topic; shows some understanding of the relation between the source and the paper topic/assignment; fairly appropriate for academic level & audience

- 3- Completely Relevant: Information relates to the topic; clear relation between the source and the paper topic/assignment; appropriate for academic level & audience

Authority/Accuracy: Source of the information

- 1- Not Accurate/No Authority: Unedited/Unverifiable; no to little accountability of the author; no author identified, potentially biased
- 2- Some Accuracy/Some Authority: Popular or unscholarly source; demonstrates some understanding of the information
- 3- Authoritative/Accurate: verifiable content, demonstrate thorough understanding of the information, scholarly source

Purpose: Reason the Information Exists (inform, sell, persuade)

- 1- No Understanding/Minimal Understanding of the purpose of the information
- 2- Adequate understanding of the purpose of the information
- 3- Expert understanding of the purpose of the source understanding difference between fact and opinion; recognizing bias or misinformation