Academic Libraries & Institutional Learning Analytics: One Path to Integration

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Introduction

For years, higher education institutions have been called upon to demonstrate that their students are learning and achieving success in the form of outcomes attainment, retention to completion or graduation, and post-graduation career placement and earnings. Likewise, academic libraries have recognized the importance of demonstrating their contribution to learning and success markers. Since the 2010 publication of ACRL's *Value of Academic Libraries* report, many librarians have embraced the use of assessment and research to explore links between student library interactions and student learning and success measures (Ackermann, 2015; Association of College and Research Libraries, 2010; Association of College and Research Libraries, 2015; Association of College and Research Libraries, 2016; Catalano & Phillips, 2016; Jantti & Cox, 2013; Jantti and Heath, 2016; Murray, Ireland, & Hackathorn, 2016; Soria, Fransen, & Nackerud, 2013; Soria, Fransen, & Nackerud, 2014; Soria, Fransen, & Nackerud, 2017; Stone & Ramsden, 2013). In general, the research linking libraries with student learning and success has pursued a correlation approach in which librarians use correlation methodologies to explore connections between library services and resources and the needs, goals, and outcomes of their institutions.

In an effort to investigate the linkages between libraries and institutional goals, typical correlation research questions follow a three-step formula found in Figure 1 (Oakleaf et al., 2017; Oakleaf, 2017). Essentially, librarians select 1) library service or resource engagement or use data and 2) data that serves as a surrogate for student learning or success; then they hypothesize a link between these two elements using a verb expressing a potential relationship.

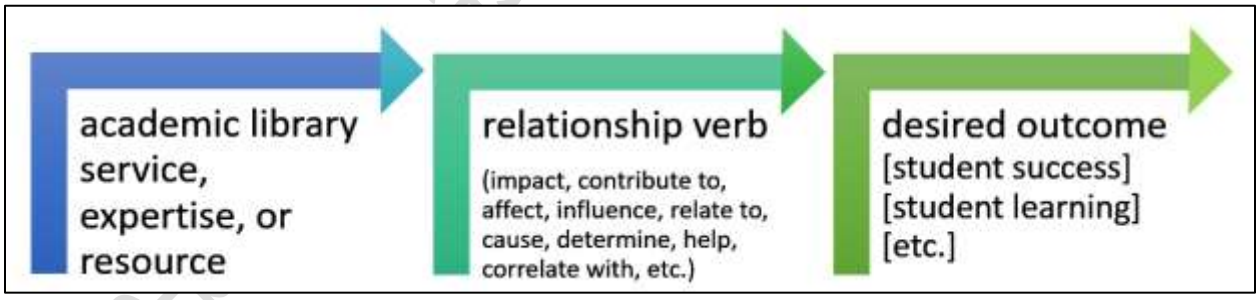

Figure 1. Correlation Research Question Formula

Example research questions that follow this format are found in Figure 2 (Oakleaf & Kyrillidou, 2016; Oakleaf, 2017).

Academic Library Service, Expertise, or Resource	Relationship Verb	Desired Outcome
Are students who attend reference consultations	more likely to	earn higher course grades?

To what extent does information literacy instruction	impact	achievement of learning outcomes sought by employers?
Is increased use of library resources	correlated with	student employment at 6 months post-graduation?

Figure 2. Example Correlation Research Questions

In recent years, this research stream has successfully produced results that connect students' library engagement with grade attainment, completion of courses, persistence through programs, and timely graduation. While this research represents a significant step forward in the quest to link libraries with student learning and success, the limitations of this approach are beginning to surface. Key among these limitations is a pattern of difficulties evolving from the limited data available to conduct this research.

The Problem: Data Unavailability, Inaccessibility, & Imprecision

Research correlating libraries with student learning and success requires library data, such as student use of reference or instruction services, circulation data, digital downloads, or library space usage. It also requires data that serves as a surrogate for student learning and success, such as student course grades, retention rates, graduation numbers, or initial workplace earnings. Unfortunately, these pools of data can be problematic in three main ways: data can be 1) too imprecise, 2) completely unavailable, or 3) inaccessible due to institutional silos (Oakleaf et al., 2017). Sometimes, researchers find that data available to them is too imprecise and lacks the finer levels of granularity required for useful analysis; one example is the use of GPA as a surrogate for learning attainment (Oakleaf et al., 2017). Other times, the data necessary for research is unavailable because it has not been recorded or maintained by libraries or their institutions, either by choice (to protect privacy, in accordance with policies, or because the data was deemed unimportant), by accident, or by circumstance (prior to the advent of recent technological advancements, many data points were not easily recorded). Oftentimes, researchers discover that the required data is inaccessible due to data "siloing." That is, the data may be owned by the institution (and not shared with the library), buried in vendor-owned data systems, or stored in formats that are not easily translatable, preventing the research from being conducted at all (Oakleaf, 2017). These data problems represent a significant challenge to researchers seeking to take the correlation of libraries with student learning and success to the logical next step (Oakleaf et al., 2017).

The Challenge: Data Availability, Accessibility, & Detail

To advance research investigating the academic library's contribution to institutional student learning and success outcomes, librarians can expand and improve the data included in their research efforts. The data required for future library impact investigations needs to be granular, accessible, and translatable across library and institutional systems. To gain this data, librarians can seek access to more detailed data about student library interactions, student learning outcomes, and student success indicators currently found in a variety of data silos, including library vendor systems, learning management systems, student engagement information systems, learner relationship management systems, student advising systems, co-curricular/extracurricular involvement systems, and any existing

institutional data warehouses. In short, librarians can prepare to engage in the broader Next Generation Digital Learning Environment (NGDLE) initiative generally and participate in institutional and cross-institutional "learning analytics" specifically (Oakleaf et al., 2017; Oakleaf, 2016; Oakleaf, 2017).

The Evolving Learning Landscape: The NGDLE and Learning Analytics

The NGDLE seeks to replace the current LMS-focused digital learning environment. Higher education experts predict that in the near future, higher education learning environments will shift from an over-dependence on the LMS to a new vision of learning environment architecture, one made up of a variety of pedagogical applications, tools, and services, all connected by means of open standards ("7 Things You Should Know About NGDLE," 2015; Oakleaf, Walter, & Brown, 2017). By leveraging interoperability standards, all applications associated with an institution's teaching and learning mission can contribute learning data to a central repository. The institutional data repository can then serve as a resource for learning analytics initiatives.

Learning analytics is the "measurement, collection, analysis, and reporting of data about learners and their contexts, for the purposes of understanding and optimizing learning and the environments in which it occurs" (Conole, Gasevic, Long & Siemens, 2011). Essentially, learning analytics employs data to improve learning contexts and help learners succeed. To accomplish these goals, learning analytics systems input data from a variety of sources and output descriptive information about student populations and cohorts; this information is employed to discover behaviors, characteristics, or other attributes that appear to lead to student difficulties or successes. Learning analytics systems attempt to predict, based on known attributes, which students are "at risk" so that educators can intervene quickly. Interventions emanating from learning analytics systems include notifications to students, advisors, or faculty; requirements for students to meet with support services, changes to institutional processes or policies; or other actions intended to support improved student outcomes (Alhadad et al., 2015).

Learning analytics systems come in a variety of forms and draw from a wide range of data sources. Many are "home grown" by individual higher education institutions, and even more are offered by vendors either as single offerings or suites of learning analytics "solutions." The learning analytics landscape is growing and fast changing; it is difficult to obtain a census of all the options. In general, learning analytics tools tend to be clustered into or across the following system categories: enrollment management, relationship management, business intelligence/reporting, learning management system activity/achievement monitoring, integrated planning and advising, early-alert warning, and degree mapping. Typically, the data used by learning analytics systems comes from student information systems, learning management systems, clickers, publishers, video-streaming and web-conference tools, surveys, and co-curricular and extracurricular involvement systems (Alhadad et al., 2015).

Currently, library data is generally omitted from learning analytics efforts; however, the development of more detailed, insightful, and useful research correlating academic libraries and institutional goals like student learning and success may require the integration of library data into learning analytics systems in the near future. Moving from existing library correlation research—or "library analytics"—to participation in broader institutional learning analytics efforts would represent a sea change in the effort to demonstrate the library's existing impact on student learning and success outcomes. Beyond the implications of such a move on existing correlation research streams, the inclusion of library data in institutional learning analytics initiatives offers a new hope: that librarians will discover new

connections—and perhaps uncover missed connections—that can inform, enable, and empower librarians to make decisions and take actions to reinvigorate or even revolutionize the ways in which libraries can support and generate student learning and success. The potential benefits of linking libraries and institutional learning data are numerous, yet so too are the challenges of such an approach. One significant challenge is the need to develop and deploy library-specific interoperability standards to serve as a crosswalk between library and institutional data.

The Crosswalk: Interoperability Standards

To prepare for integration into institutional learning analytics initiatives, libraries can develop and adopt library-specific interoperability standards that will enable the collection, storage, and transport of data about learning across institutional and library data systems (Oakleaf et al., 2017; Oakleaf 2017). A growing number of learning technologies have adopted interoperability standards. One such standard, IMS Global's Caliper Analytics®, provides an information model, shared vocabulary, and a common data interchange format for describing, collecting, and exchanging learning activity data between systems. Caliper standardizes the process of describing learning activities and tracking learner engagement across the learning technology ecosystem. In other words, Caliper defines a structured data stream that enables data residing in disparate systems to be more easily exchanged, accumulated, and queried. A Caliper event centers on an actor, action, and object as depicted in Figure 3.

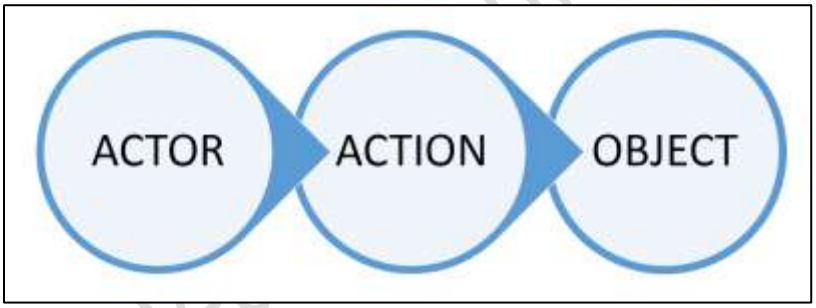

Figure 3. Caliper Structure

In academic libraries, the actors in this formulation could be students, faculty, and other library users. Actions might include *participating* in a library experience, such as an instructional event, reference transaction, or exhibit; *attending* a library space, such as the general library facility or a more specific location—a learning commons, study room, lab, or makerspace; *checking out* a book, reserve item, interlibrary loan, or technological resource; or *accessing* library materials, including articles, ebooks, computers, printers, or copiers (Oakleaf et al., 2017). (See Figure 4 for additional examples.)

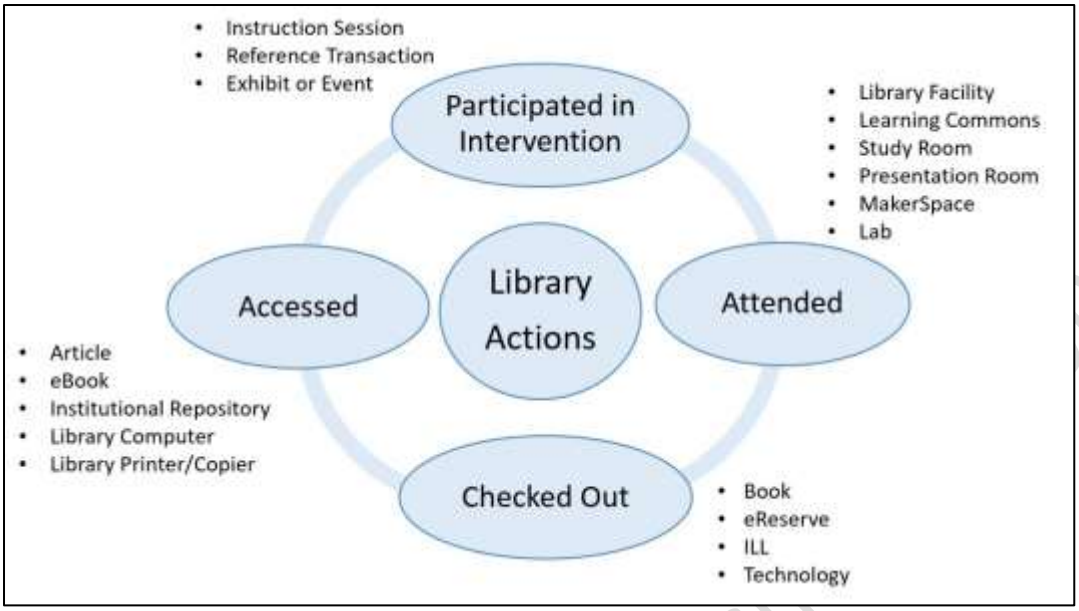

Figure 4. Library "Actions"

Caliper segments its model into profiles, each of which describes a learning activity or a supporting activity that helps facilitate learning. A Caliper profile is a logical container comprising one or more defined events that together help describe a set of interactions. Beginning with an actor and action, a Caliper library profile can be fleshed out with objects and additional relevant attributes, as shown in Figures 5-8.

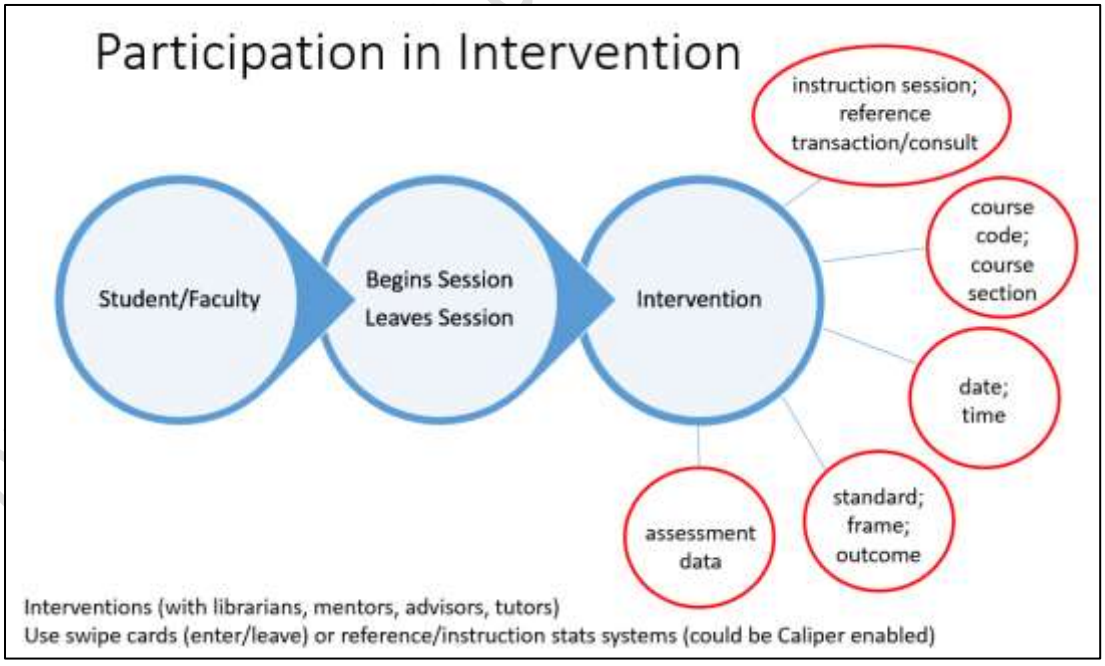

Figure 5. Participates in Intervention

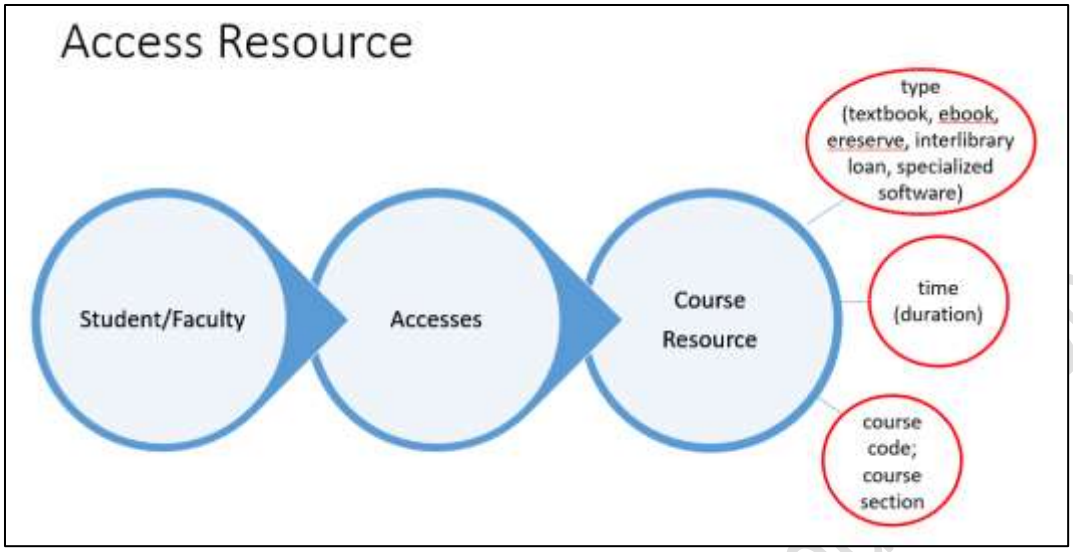

Figure 6. Access Resource

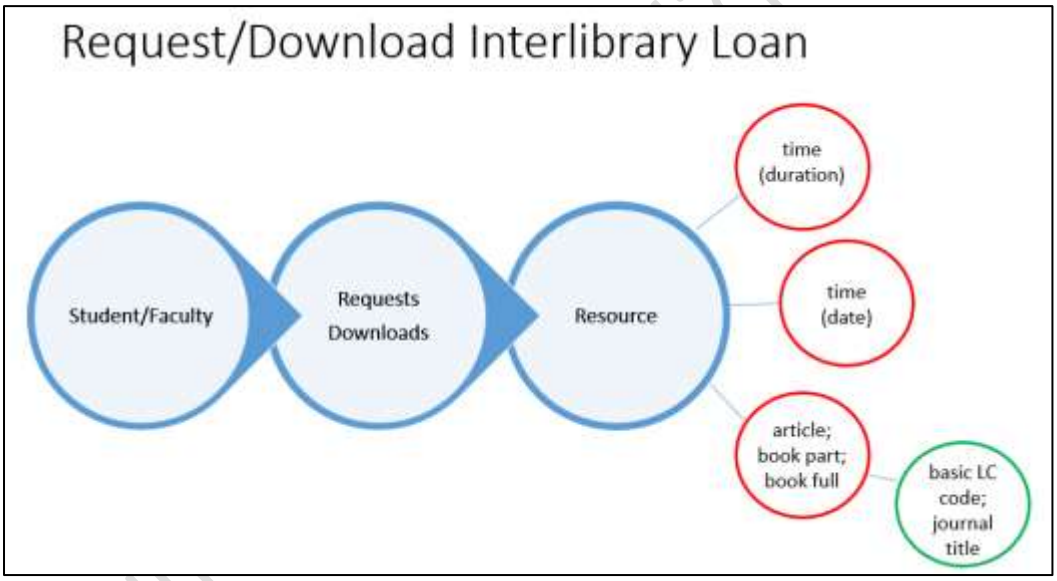

Figure 7. Request Interlibrary Loan

Once one begins brainstorming Caliper profiles, countless options emerge (see Figure 8). In order to be parsimonious and focused, librarians should limit initial development of profiles to those that will answer important questions and deliver information that librarians and other higher education professionals need—rather than just want—to know. When developing potential Caliper profiles, librarians should also consider what information is not desirable, or perhaps ethical, to include. For example, librarians may determine that inclusion of a resource's type is important to know, but that information that could be used to identify the resource (i.e., title, author, call number) is not.

ACTOR	ACTION	OBJECT

Student/Faculty	Attends	Intervention (virtual/digital/text reference transaction/consult)
Student/Faculty	Enters/Leaves	Space (library building, study carrel, learning commons, study room, presentation room, special collections, lab)
Student/Faculty	Checks out	Resource (book, ereserve, technology, interlibrary loan)
Student/Faculty	Accesses	Resource (ebook, ereserve, interlibrary loan, specialized software?)
Student/Faculty	Uploads (to Institutional Repository)	Resource (paper, poster?)
Student/Faculty	Logs In/Out (from library computer)	Library Computer Session
Student/Faculty	Retrieve? Save? Download?	Resource
Student/Faculty	Prints (from library computer)	Resource (article, paper, poster)

Figure 8. Brainstorming Library-Focused Caliper Profiles

The Output: Data Stores & Dashboards

Once Caliper profiles are created to facilitate the collection, transfer, storage, and querying of library data, a number of storage and viewing tools could be developed to enable librarians and others understand, investigate, demonstrate, communicate, and grow library impact on student learning and success. Leveraging an interoperability standard like Caliper, library data from multiple systems could populate a unified library data store. The same data could be included in an institutional Learning Record Store (LRS) or data warehouse, an Integrated Planning and Advising System (IPAS), or another learning analytics system. Learning data could be rendered dashboard accessible or protected from a variety of user groups—librarians, institutional research professionals, educational researchers, advisors, faculty, and/or students—based on permissions set by policies governed by the library or its overarching institution as shown in Figure 9 (Oakleaf et al., 2017).

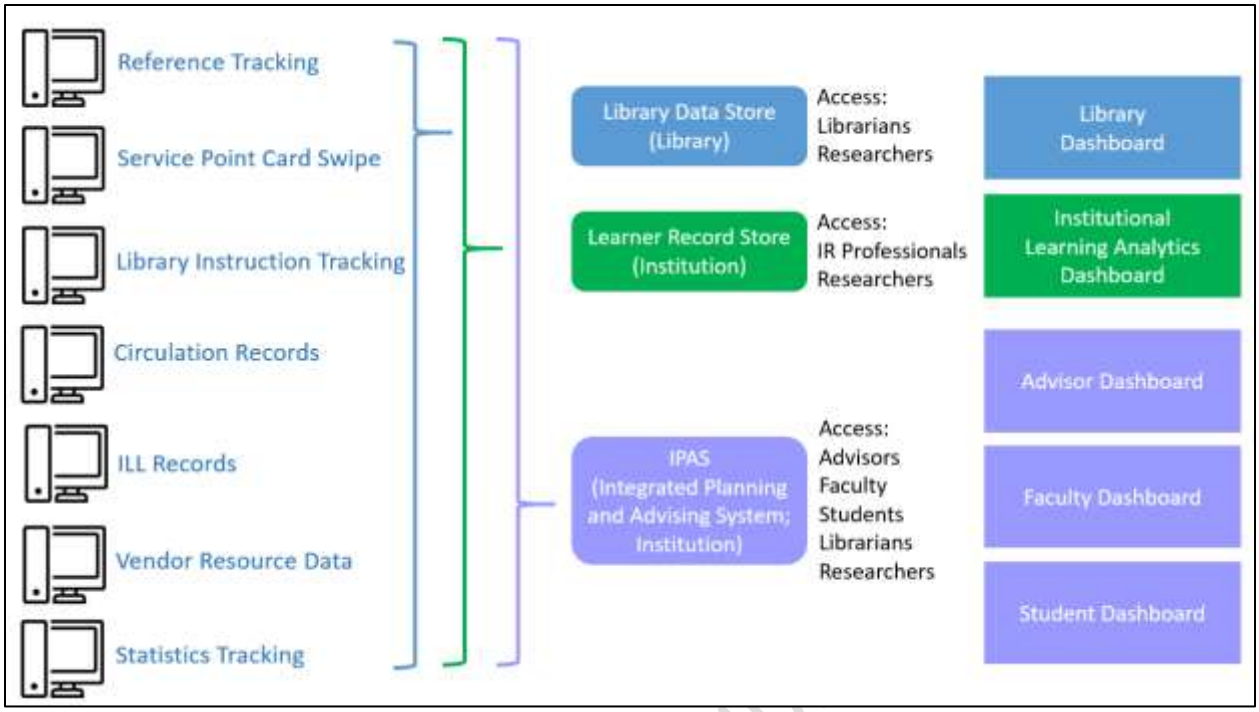

Figure 9. Library Data Stores

A dashboard resulting from these record stores could take on a variety of formats, depending on the types of questions, problems, priorities, and needs of a particular library and institution. One might imagine several options as starting points. For example, librarians may wish to create dashboards that track the degree or relative rank of student library resource use or other library participation as well as average course grades and semester-to-semester retention, as in Figure 10, an idea inspired by Brightspace (https://www.d2l.com/products/student-success-system/). Librarians might also want to create a view of student library interactions based on Caliper-enabled library actions or possible success indicators along with the number of students who engage in each action, their average GPA, credits earned, a calculated retention risk score, an academic integration, score and velocity to completion score, as shown in Figure 11, which was inspired by the PAR Framework (http://www.parframework.org/). A third possible view might display a "library score" as a dial representing a summary of student library interactions. As one moves the dial, displays of student GPA, earned credits, retention risks, and velocity to degree for different groups of students might display. Figure 12 depicts this idea, using the PAR Framework dashboard as inspiration (http://www.parframework.org/improving-first-year-experiences/). Should librarians wish to drill down to a course level view of student library interactions, a dashboard could reveal an individual student's participation in possible library-related success indicators in comparison to an "average" student in the same course (see Figure 13). Alternatively, librarians might find a dashboard showing activity counts of student participation in grouped library interactions paired with grade percentages helpful, as in Figure 14, a concept inspired by Brightspace (https://www.d2l.com/products/student-success-system/). Any of these dashboard displays might also be customized for additional stakeholder groups, including student, faculty, or advisor access.

Library Interactions in Curriculum

Code	Title	Co-Req	Pre-Req	Major	Ave Grade	Retained to Following Semester	Library Resource Use	Library Participation
ENG 101	First-Year Writing	n/a	ENG 100	Gen Ed Core	87%	54%	★★★★★	★★★★★
MTH 101	Intro to Mathematical Reasoning	MTH 102	n/a	Gen Ed Core	82%	48%	★★★★★	★★★★★
IST 101	Careers in Information Studies	n/a	n/a	Info Mgmt	93%	85%	★★★★★	★★★★★
SPN 101	Spanish I	SPN 102	n/a	Spanish	85%	82%	★★★★★	★★★★★
ART 351	Art History I	ART 352	ART 251	Art	94%	94%	★★★★★	★★★★★
BUS 251	Global Enterprise	n/a	BUS 101	Finance	76%	89%	★★★★★	★★★★★

Figure 10. Library Interactions in the Curriculum

Library Interactions in Student Population

Library Success Indicators	N Students	Ave GPA	Ave Earned Credits	Ave Retention Risk	Academic Integration Score	Ave Velocity Score
Participates Instruction Session	1025	3.2	36	1.4	2.4	45
Participates Reference Transaction	783	3.5	23	2.1	5.3	57
Participates Event or Exhibit	326	2.8	46	0.3	3.9	23
Attends Library Space	2130	2.9	34	1.8	2.9	37
Checks Out Resource	1467	3.4	23	0.9	1.7	61
Uses (Retrieves, Saves, Downloads) Resource	1823	3.4	43	0.8	6.4	78

Figure 11. Library Interactions in Student Population

Library Interactions and Student Success

Figure 12. Library Interactions and Student Success

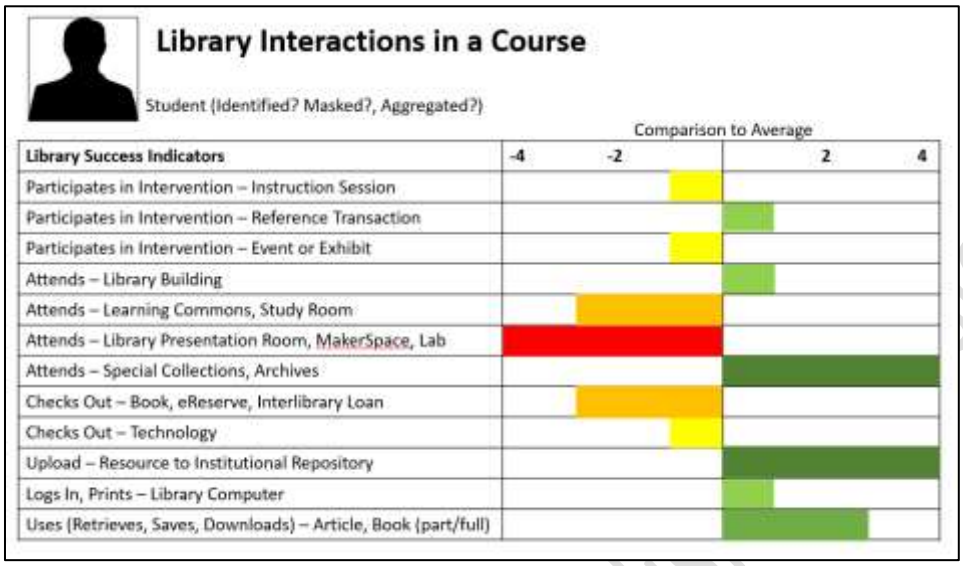

Figure 13. Library Interaction in a Course, Comparison to Average

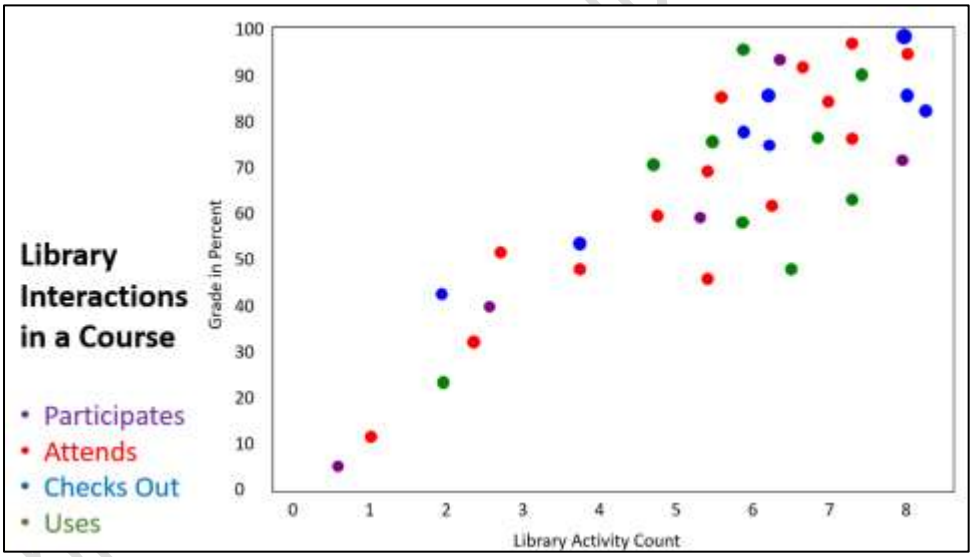

Figure 14. Library Interactions in a Course, Scatterplot

The Future?

In coming years, librarians seeking to pursue a correlation-based approach to researching the value of academic libraries and their impact on student learning and success will likely find the existing limits of data availability, accessibility, and granularity stifling. One way to combat the challenges of too little, too siloed, and too imprecise data is to investigate and employ interoperability standards to enable integration of library data into institutional learning analytics systems. In order to investigate the promise and potential pitfalls of this approach, an IMLS-funded grant project entitled Libraries Integration in Institutional Learning Analytics (LIILA) commences in July 2017. This project seeks to 1)

increase librarian awareness of and engagement in learning analytics; 2) craft a plan for integrating academic libraries into learning analytics initiatives that support student learning and success; 3) develop sustaining learning analytics partnerships and collaborations among academic librarians, educational technology lynchpins, institutional and library IT professionals, and library vendor communities; and, 4) design and develop library use cases and data profiles based on learning analytics practices and interoperability standards that can be used to integrate library data with institutional data stores. (Librarians wishing to learn more about this project may contact Megan Oakleaf at moakleaf@syr.edu.) As higher education institutions nationwide expand their use of learning analytics to answer long-standing calls for accountability and act on genuine concerns for students' ability to learn and succeed, academic librarians must consider how to advance the library's contribution to student learning and success. One path forward is the integration of academic libraries and institutional learning analytics. Given the potential benefits, it is a path that merits exploration.

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