

Information Literacy's Influence on Undergraduates' Learning and Development: Results from a Large Multi-institutional Study

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This paper investigated the reliability and validity of the National Survey of Student Engagement's Experiences with Information Literacy module, an assessment instrument developed in collaboration with a group of instructional librarians. After identifying three information literacy related constructs in the module, it assessed the relationship between the constructs and students' engagement in Higher-Order Learning and Reflective and Integrative Learning activities and students' perceived gains. The results from these analyses indicated that information literacy activities are positively and significantly correlated with student engagement and students' perceived gains.

Today undergraduates face a conundrum. They can access more information on their cell phone at a moment's notice than previous generations could access at in a multi-story university library. Yet, the increasing inclusion of terms like "alternative facts" and "fake news" in the popular discourse highlights how much of the information digested by students is of questionable quality.¹ This reality makes knowing how to properly search for, use, and evaluate information a critical skill for the 21st century.

Information literacy has been widely recognized as a key college learning outcome for decades.² However, assessing information literacy skills has been difficult for librarians as the common methods frequently focus on small samples at or within a single institution, testing knowledge of specific skills, are time intensive (rubrics), and/or use instruments that have not been psychometrically validated.³ Due to these concerns, instructional librarians approached the National Survey of Student Engagement (NSSE) to collaborate with NSSE researchers on expanding the information literacy content in NSSE.⁴ The collaboration resulted in the creation of the Experiences with Information Literacy module, which institutions can elect to append to the core NSSE instrument. In contrast to other information literacy assessments, the module mainly focuses on student engagement in activities associated with information literacy skill development and the extent to which instructors emphasize the proper use of information, which makes its results actionable. Additionally, most bachelor's-granting colleges and universities periodically administer NSSE to their students⁵ and 181 institutions have chosen to administer the module to their students over the past three years.⁶ Therefore, the module is relatively efficient to administer and its' data are already available to a wide variety of institutions.

This study has two main purposes. First, it seeks to establish the reliability and validity of the NSSE Experiences with Information Literacy module. Second, through its investigation of the predictive validity of the mod-

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ule's constructs, it examines how engagement in information literacy activities contributes to students' learning and development. To accomplish these objectives, the study utilizes data from nearly 45,000 seniors attending 128 colleges and universities. The results have the potential to highlight the usability of the module and provide further evidence on the importance of information literacy in promoting student learning outcomes.

Student Engagement Theory

Both the study and the creation of the NSSE Experiences with Information Literacy module were informed and guided by student engagement theory. The theory combines empirical research and several well-known concepts in the higher education literature.⁷ Student engagement utilizes Pace's quality of effort concept, which postulates that student learning is a product of students' quality and quantity of effort, and Astin's student involvement theory, which theorizes that student retention is related to involvement in academic and co-curricular activities.⁸ In addition to focusing on students' activities, it emphasizes the role of the institution to promote student learning and development in and outside of the classroom. Chickering and Gamson demonstrated a variety of effective educational practices that promote student learning.⁹ Additionally, Kuh and colleagues exhibited how institutions can structure their institutions to promote student learning outside of the classroom.¹⁰ When applying the theory to information literacy, institutions are viewed as having the responsibility to emphasize and instruct students on the proper and effective uses of information and providing ample or adequate information resources for students. Furthermore, students are expected to exhort time and effort to properly search, evaluate, and use information sources.

Research Questions

1. What information literacy constructs exist within the NSSE's Experience with Information Literacy module?
2. Do the constructs adequately fit the observed data?
3. Are the constructs reliably measured?
4. After controlling for other factors, how do the constructs correlate to students' engagement in higher-order learning and reflective and integrative learning skills?
5. After controlling for other factors, how do the constructs relate to students' perceived gains?

Methods

Data

To answer the aforementioned research questions, I utilized data from the 2014 and 2015 administrations of the National Survey of Student Engagement (NSSE). NSSE examines students' engagement in educationally beneficial activities, their perceptions of the campus environment, self-assessments of how their college experience has improved their learning and development, and students' background characteristics. I choose to use data from the 2014 and 2015 NSSE administrations as they were the first two administrations that included the Experiences with Information Literacy module. The module is set of additional questions that institutions can elect to append to the core NSSE instrument that focuses on how often students use and evaluate information, the extent to which instructors emphasized the proper use of information, an item asking how much students' college experience has influenced their ability to use information effectively. The module was developed through a collaboration between NSSE staff and a group of instructional librarians.¹¹ The designers of the module utilized their academic training, experience teaching information literacy skills, and consulted existing information literacy standards and rubrics when creating the module.¹² In keeping with student engagement theory, the

module was not designed test a specific student's information literacy capabilities. Rather, it seeks to investigate how often students use information literacy skills and how institutions promote the proper use of information through their curriculum, as students' time and effort in educationally beneficial activities is presumed to promote student learning and development. The module was pilot-tested in 2013 and subsequently refined and officially added to NSSE in 2014.

In the 2014 and 2015 NSSE administrations, 44,700 senior students responded to the Experiences with Information Literacy module. These students attended 128 U.S. bachelor's-granting institutions. The response rate for the sample was 27%. Previous research indicates that NSSE data produces accurate and reliable group means at this response rate.¹³ Table 1 contains the characteristics of the sample. About two-thirds of the respondents were White. Six out of ten students were female. Three in four students were 25 years old or younger. Over half of the sample had a parent who earned a bachelor's degree or higher. The most common major was business; however, the sample was well dispersed among a variety of academic disciplines. A plurality of the respondents attended a research university. Two-thirds of the sample attended a public institution.

Race/Ethnicity	%	Physical sci., math, & computer sci.	5
Asian/Pacific Islander	8	Social sciences	14
Black/African American	7	Business	17
Hispanic/Latin@	11	Communications	5
White	65	Education	7
International	4	Engineering	7
Other race/ethnicity	5	Health professions	15
Sex	%	Social service professions	4
Female	62	All other	6
Male	38	Undecided, undeclared	<1
Parental Education	%	Basic 2010 Carnegie Classification (aggregated)	
Less than high school	6	Research universities	43
High school	19	Master's colleges and universities	41
Some college	11	Baccalaureate colleges—Arts & Sciences	6
Associate's	10	Baccalaureate colleges—Diverse Fields	6
Bachelor's	28	Other/not classified	5
Master's	19	Control	%
Doctoral or professional	8	Public	64
Major Field	%	Private	36
Arts & humanities	10		
Biological sciences	9		

The primary data utilized were 13 of the 14 items on the Experiences with Information Literacy module. The lone item not included in the analyses was the final item asking about how students' college experiences influenced their ability to use information literacy effectively. A list of the items used from the module and their distributions are displayed in Table 2. I also used data on two of the NSSE Engagement Indicators: Higher-Order

TABLE 2
Distribution of the Experiences with Information Literacy module items

Variable name	Item	Response option	%
<i>During the current school year, about how often have you done the following?</i>			
INLO1A	Completed an assignment that used an information source (book, article, Web site, etc.) other than required course readings	Never	2
		Sometimes	12
		Often	27
		Very often	59
INLO1B	Worked on a paper or project that had multiple smaller assignments such as an outline, annotated bibliography, rough draft, etc.	Never	7
		Sometimes	26
		Often	32
		Very often	35
INLO1C	Received feedback from an instructor that improved your use of information resources (source selection, proper citation, etc.)	Never	8
		Sometimes	28
		Often	33
		Very often	32
INLO1D	Completed an assignment that used the library's electronic collection of articles, books, and journals (JSTOR, EBSCO, LexisNexis, ProQuest, etc.)	Never	12
		Sometimes	24
		Often	27
		Very often	37
INLO1E	Decided not to use an information source in a course assignment due to its questionable quality	Never	27
		Sometimes	37
		Often	21
		Very often	15
INLO1F	Changed the focus of a paper or project based on information you found while researching the topic	Never	17
		Sometimes	45
		Often	24
		Very often	14
INLO1G	Looked for a reference that was cited in something you read	Never	12
		Sometimes	34
		Often	30
		Very often	24
INLO1H	Identified how a book, article, or creative work has contributed to a field of study	Never	16
		Sometimes	35
		Often	28
		Very often	21
<i>During the current school year, how much have your instructors emphasized the following?</i>			
INLO2A	Not plagiarizing another author's work	Very little	3
		Some	8
		Quite a bit	19
		Very much	69

TABLE 2 (CONTINUED)
Distribution of the Experiences with Information Literacy module items

Variable name	Item	Response option	%
INLO2B	Appropriately citing the sources used in a paper or project	Very little	3
		Some	10
		Quite a bit	22
		Very much	64
INLO2C	Using scholarly or peer-reviewed sources in your course assignments	Very little	6
		Some	13
		Quite a bit	24
		Very much	58
INLO2D	Questioning the quality of information sources	Very little	11
		Some	21
		Quite a bit	26
		Very much	43
INLO2E	Using practices (terminology, methods, writing style, etc.) of a specific major or field of study	Very little	7
		Some	17
		Quite a bit	26
		Very much	50

Notes: Percentages are weighted. Percentages may not sum to 100% due to rounding.

Learning and Reflective & Integrative Learning. The Engagement Indicators are summary measures of various dimensions of student engagement. Information on the reliability and validity of the Engagement Indicators is available from NSSE's Psychometric Portfolio.¹⁴ In addition to the Engagement Indicators, I used NSSE's perceived gains scale, which is a composite of 10 items inquiring about how students' college experience influenced their learning and development. The reliability of the perceived gains scales was .90. A list of the items contained in the two Engagement Indicators and perceived gains scale is displayed in Appendix A. To efficiently estimate effect sizes, I standardized the Engagement Indicators and perceived gains scale to have a mean of 0 and standard deviation of 1. I also utilized data on a variety of student characteristics to control for differences in students' background and academic characteristics. The control variables were sex, race/ethnicity, time spent working, major field, grades, educational aspirations, parental education, age, and enrollment level. The EI and control variables were captured on the core NSSE instrument or provided by institutions.

Analyses

The initial analyses conducted an exploratory factor analysis (EFA) to identify information-literacy constructs in the Experiences with Information Literacy module. Half of the sample was randomly selected for use in the EFA (to preserve data for use in subsequent analyses). Due to the ordinal nature of the module variables, the EFA utilized polychoric correlations as they do not assume that the variables are continuous¹⁵ and was estimated using a full information maximum likelihood estimator to account for missing data. I identified the appropriate number of factors through an examination of scree plot of the extracted factors eigenvalues¹⁶ and practical experiences based on the development of the module. The factor loadings were rotated using an oblimin rotation with a Kaiser normalization.

After identifying an initial set of latent constructs in the module, I conducted a confirmatory factor analysis (CFA) to verify the factor structure of the underlying data. CFAs differ from EFAs as the factor structure is hypothesized by the researcher, rather than derived from the data. The CFA was performed using the half of the sample not used in the EFA. Like the EFA, the analysis utilized polychoric correlations, as the module variables were ordinal,¹⁷ and a full information maximum likelihood estimator. The initial structure of the CFA model was based upon the EFA results, although the latent constructs were allowed to correlate. The model was subsequently refined based upon the model fit information and modification indices. I sought to refine the model so that the model fit information met generally accepted standards for CFAs. These criteria were a root mean square error of approximation (RMSEA) of .06 or lower, comparative fit index (CFI) of .95 or higher, Tucker-Lewis Index (TLI) of .95 or higher.¹⁸

TABLE 3
Exploratory factor analysis constructs and loadings

Variable	Item	Information Use	Information Evaluation	Instructors' Emphasis
INLO1A	Completed an assignment that used an information source other than required course readings	.646		
INLO1B	Worked on a paper or project that had multiple smaller assignments	.797		
INLO1C	Received feedback from an instructor that improved your use of information resources	.587		
INLO1D	Completed an assignment that used the library's electronic collection of articles, books, and journals	.423		
INLO1E	Decided not to use an information source in a course assignment due to its questionable quality		.666	
INLO1F	Changed the focus of a paper or project based on information you found while researching the topic		.721	
INLO1G	Looked for a reference that was cited in something you read		.658	
INLO1H	Identified how a book, article, or creative work has contributed to a field of study		.605	
INLO2A	Not plagiarizing another author's work			.834
INLO2B	Appropriately citing the sources used in a paper or project			.891
INLO2C	Using scholarly or peer-reviewed sources in your course assignments			.821
INLO2D	Questioning the quality of information sources			.843
INLO2E	Using practices of a specific major or field of study			.699

Notes: Item labels shortened. Factor loadings were rotated using an oblimin rotation with a Kaiser normalization. Loadings with an absolute value less than .30 are suppressed.

I assessed the reliability of the constructs identified by calculating Cronbach's α coefficient for each of the constructs. Finally, I investigated the predictive validity of the constructs by examining their correlation with NSSE's Higher-Order Learning and Reflective & Integrative Learning Engagement Indicators and the perceived gains scale, holding constant other characteristics. In these analyses, I standardized the constructs to have a mean of 0 and standard deviation of 1. To estimate the predictive validity of the constructs, I estimated two regression models for each of the three outcome measures. The first model contained the control variables previously described and school-level fixed effects to account for the institution attended. The second model added the information literacy constructs. This two-step approach allowed me to investigate how the inclusion of the information literacy constructs improved the predication of these outcomes.

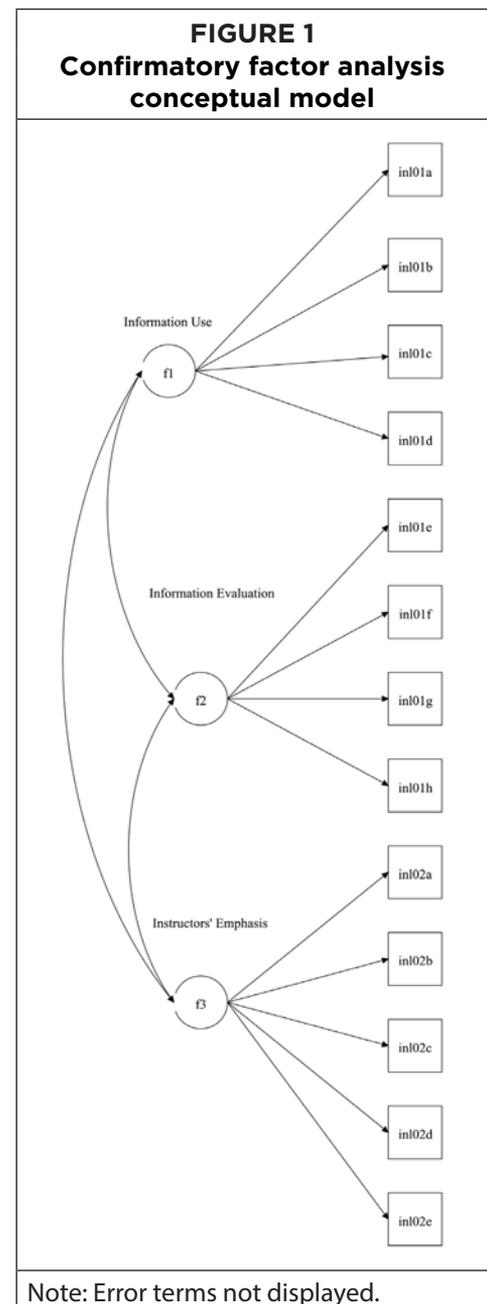
Results

Exploratory factor analysis

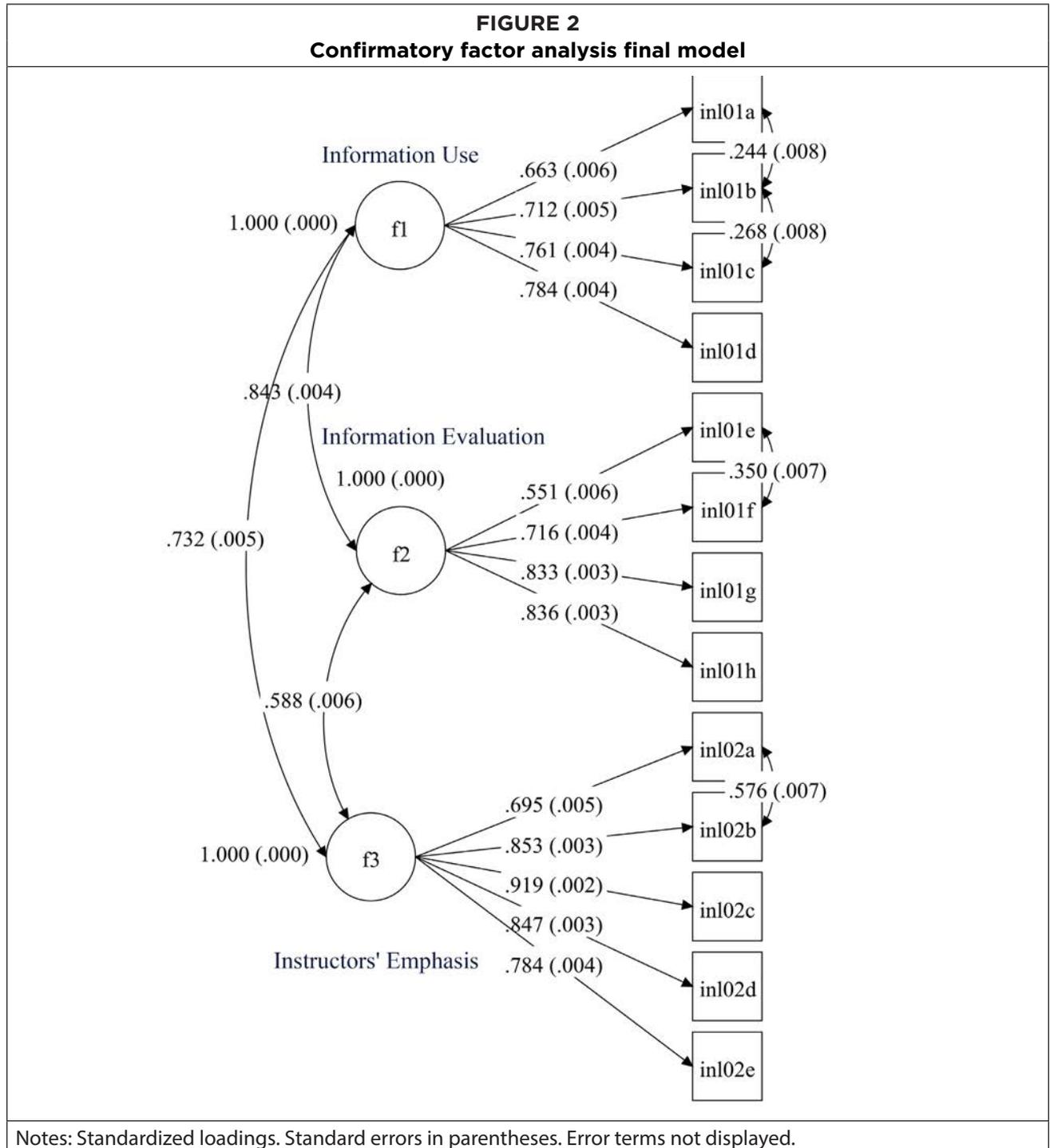
I began the analyses by estimating an EFA using a random half of the sample. An analysis of the scree plot indicated that three factors should be extracted from the data. The rotated loadings for the three factors are available in Table 3. After analyzing the results, I titled the constructs: information use, information evaluation, and instructors' emphasis. The first four items in the module loaded onto the information use construct. These items inquired about how often students used various information sources in their coursework or received feedback from an instructor on their information use. The second construct, information evaluation, contained the four remaining items in the first question set. These items focused on how students evaluated and utilized information sources to conduct a richer literature review or revise their topic of study. The five items in the second question all loaded onto the third construct: instructors' emphasis. These items all inquired about specific activities instructors can emphasize to improve students' use of information. None of the items had substantial cross loadings onto another construct. The correlations between the factors ranged from .37 to .53.

Confirmatory factor analysis

With the remaining portion of the sample, I conducted a CFA. Figure 1 contains the initial conceptual model between the three constructs. As shown in the conceptual model, the three constructs are presumed to be latent variables measured by the specific survey items from the module. Additionally, the three latent constructs were allowed to correlate, as information literacy activities are presumed to be interrelated. When analyzed, the initial conceptual model did not adequately fit the data according to the model fit information. The modification indices indicated that the model needed to account for residual correlations between some of the items. After allowing some of the items to correlate, adequate model fit was achieved. The RMSEA was .051,



the CFI was .989, and the TLI was .985. All three criteria met the generally accepted standards for CFAs.¹⁹ Figure 2 contains the final model and standardized factor loadings between the latent and observed variables.



Construct reliability

After confirming the construct validity of the three factors in the model, I estimated the reliability the three constructs by calculating the Cronbach's α for each composite variable. The α s for information use, information

evaluation, and instructors' emphasis were .79, .80, and .87, respectively. All three α coefficients exceed the generally accepted threshold of .70 for utilized for social science research.

Predictive validity

Finally, I assessed the predictive validity of the three constructs by estimating regression models predicting the following NSSE composite variables: Higher-Order Learning, Reflective & Integrative Learning, and perceived gains. For each outcome, I first estimated a regression model that included the aforementioned control variables and institution specific fixed effects. The second model added the three information literacy constructs.

TABLE 4
Fixed effect estimates of the relationship between information literacy constructs and selected outcomes

	Higher-Order Learning		Reflective & Integrative Learning		Perceived Gains	
	Est.	Sig.	Est.	Sig.	Est.	Sig.
Information Use	0.21	***	0.15	***	0.22	***
Information Evaluation	0.13	***	0.24	***	0.19	***
Instructors' Emphasis	0.19	***	0.12	***	0.24	***
R ² change	.16		.12		.25	
Final R ²	.20		.21		.29	

* $p < .05$, ** $p < .01$, *** $p < .001$

Notes: Models hold constant race/ethnicity, time spent working, major field, grades, transfer status, educational aspirations, parental education, age, and enrollment status. Models include institution-specific fixed effects. The information literacy constructs and outcome measures are standardized with a mean of 0 and standard deviation of 1. R² change is the amount of additional explained variance by the information literacy constructs after holding accounting for student and institutional factors.

Table 4 contains the regression coefficient estimates of the information literacy constructs when predicting the outcome measures, holding constant student and institutional characteristics. For each of the three outcome measures, the information literacy constructs each uniquely predicted a significant proportion of the variation in the Higher-Order Learning, Reflective & Integrative Learning, and perceived gains scales. Additionally, these relationships were all positive and not trivial as all of the coefficient estimates were greater than .10. Therefore, a standard deviation change in one of the information literacy constructs would be expected to result in roughly a tenth to quarter standard deviation change in Higher-Order Learning, Reflective & Integrative Learning, and perceived gains. Furthermore, as the information literacy constructs were significantly correlated, yet exert a unique influence on the outcomes, the effects of more engagement in information literacy activities appears to be additive. Finally, as demonstrated by the R² change and final R² statistics, the information literacy constructs accounted for half to three-quarters of the explained variance in the outcome measures. This finding indicates that information literacy activities play an important role in student learning and their perceived gains.

Implications

Due to the increasing need for information literacy skills in the workplace and civil society, improving students' use of information is a key liberal learning outcome during college. While many researchers have evaluated undergrad-

uates' information literacy skills, the existing evaluation instruments and techniques have substantial limitations.²⁰ Some focus on specific skills, rather than institutional efforts to improve these skills, limiting their actionability. Additionally, many information literacy assessment instruments are highly specialized or costly, limiting their use in large scale assessments. To remedy these gaps, NSSE partnered with a group of instructional librarians to create the Experiences with Information Literacy module, an add-on set of items institutions may elect to the core NSSE assessment instrument which is used by the majority of U.S. and Canadian bachelor's-granting institutions.²¹

In this study, I sought to investigate the validity and reliability of the Experiences with Information Literacy module using a large multi-institutional sample of senior students. This entailed a multi-step process where I identified constructs within the module through an EFA, confirmed that the proposed constructs adequately fit the data using a CFA, tested the reliability of the constructs by estimating Cronbach's α , and finally examined the predictive validity of the constructs by examining their relationship with previously validated NSSE constructs associated with information literacy skills. The results of the EFA indicated that there are three latent constructs within the module, a notion confirmed by the CFA. I titled the constructs information use, information evaluation, and instructors' emphasis. Information use focuses on students' basic use of information in their course assignments. Information evaluation focuses on a deeper and richer use of information by students through activities like assessing information quality, changing the focus of a paper based upon a literature review, and identifying the uniqueness of an information source. The final construct, instructors' emphasis, examined the extent to which instructors encouraged the proper use of information. The constructs were demonstrated to be reliable, as their Cronbach's α coefficients ranged from .79 to .87. Finally, I investigated the predictive validity of the three constructs by assessing their relationship to engagement in Higher-Order Learning and Reflective and Integrative Learning activities and students' perceived gains. After controlling for student characteristics and the institution attended, each of the three constructs was significantly and positively correlated to the outcome measures. Additionally, the information literacy constructs accounted for half to three-quarters of the explained variation in the outcomes, indicating that information literacy is a key component of students' learning and development.

In combination, the results of the study indicate that the Experiences with Information Literacy module is a psychometrically valid instrument that can be used to assess students' engagement with information literacy skills. The module is relatively novel in that it focuses on the process of how students develop information literacy skills, rather than a directly testing their knowledge. This allows for the users of the module data to identify specific areas of improvement. For example, an institution's module results may reveal that instructors placed less emphasis on questioning the quality of information sources. In response, instructional librarians may work with faculty members to emphasize information quality in their lessons, grading, and syllabi. NSSE also provides institutions with the raw data to compare students by their characteristics. Such a subgroup analysis may indicate that instructors in a particular discipline placed less emphasis on the use of scholarly sources and instructional librarians may work with faculty in that discipline to increase the emphasis on this topic.

Conclusion

The study's results demonstrate that the NSSE Experiences with Information Literacy module is an assessment tool meeting generally accepted standards for validity in social science research. They go on to highlight the significant and positive relationship between seniors' engagement in information literacy activities and both Higher-Order Learning and Reflective and Integrative Learning. Additionally, engagement in information literacy was positively correlated with students' self-assessments of their college learning gains, providing additional evidence of the importance of information literacy as a learning outcome. Finally, the study supports the use of the module by both institutions and librarians to assess and improve information literacy outcomes for students.

Appendix A.

Items comprising the Higher-Order Learning and Reflective & Integrative Learning Engagement Indicators and perceived gains scale.

Higher-Order Learning

During the current school year, how much has your coursework emphasized the following:

[Response options: Very little, Some, Quite a bit, Very much]

- Applying facts, theories, or methods to practical problems or new situations
- Analyzing an idea, experience, or line of reasoning in depth by examining its parts
- Evaluating a point of view, decision, or information source
- Forming a new idea or understanding from various pieces of information

Reflective & Integrative Learning

During the current school year, how often have you:

[Response options: Never, Sometimes, Often, Very Often]

- Combined ideas from different courses when completing assignments
- Connected your learning to societal problems or issues
- Included diverse perspectives (political, religious, racial/ethnic, gender, etc.) in course discussions or assignments
- Examined the strengths and weaknesses of your own views on a topic or issue
- Tried to better understand someone else's views by imagining how an issue looks from his or her perspective
- Learned something that changed the way you understand an issue or concept
- Connected ideas from your courses to your prior experiences and knowledge

Perceived Gains

How much has your experience at this institution contributed to your knowledge, skills, and personal development in:

[Response options: Very little, Some, Quite a bit, Very much]

- Writing clearly and effectively
- Speaking clearly and effectively
- Thinking critically and analytically
- Analyzing numerical and statistical information
- Acquiring job- or work-related knowledge and skills
- Working effectively with others
- Developing or clarifying a personal code of values and ethics
- Understanding people of other backgrounds (economic, racial/ethnic, political, religious, nationality, etc.)
- Solving complex real-world problems
- Being an informed and active citizen

Notes

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