International Journal for the Scholarship of Teaching and Learning

Volume 6 | Number 2 Article 9

7-2012

Criteria for Evaluating Journals in the Scholarship of Teaching and Learning in Agriculture, Natural Resources, and the Life Sciences

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Keywords

Scholarship assessment, Evaluation of journals, Agriculture, Natural resources, Life sciences, Scholarship of teaching and learning

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Abstract

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Introduction

The purpose of this paper is to identify existing criteria that may be considered in evaluating the journals in the scholarship of teaching and learning (SoTL). Interest in SoTL emerged in the late twentieth century because of an increasing focus on accountability and a desire to increase the prominence of teaching and learning in higher education institutions. It is usually considered to be a subset of individual disciplines (Potter, 2008). Since it is not practiced by all faculties, those who conduct research in this area may encounter questions related to the assessment of this work, particularly for promotion and tenure decisions. The limitations of the existing criteria may point to the need for new criteria to be created for emerging multidisciplinary areas. The paper provides data related to these criteria for a set of journals in the areas of agriculture, natural resources, and life sciences and discusses the

https://doi.org/10.20429/ijsotl.2012.060209

implications.

Literature Review

The Scholarship of Teaching and Learning

During the past twenty years, a strong interest in the public policy arena in institutional cost-effectiveness and assessment of learning led to increased scrutiny of faculty priorities (Edgerton, 2005; Shulman, 2004). The prevailing paradigm considered research as the most important of the three primary roles of faculty: teaching, research, and service (Becker & Andrews, 2004; Braxton, Luckey, & Helland, 2002; Finnegan & Gamson, 1996; Glassick, Huber, Maeroff, & Teaching, 1997; Hutchings, Huber, & Ciccone, 2011; O'Meara, 2005). The seminal report of the Carnegie Foundation for the Advancement of Teaching, *Scholarship Reconsidered* (Boyer, 1990), changed that model and defined the role of faculty as engaging in four forms of scholarship: discovery, integration, application, and teaching. Some of the reasons that faculty engage in SoTL are that:

- It is an obligation of a professional scholar/educator
- It is a means of continuous improvement of teaching
- It addresses the needs of the public for assessment and accountability (Shulman, 2000).

Definitions of SoTL either focus on the scholarly practice of teaching or on research on teaching (Bowden, 2007; Braxton, et al., 2002; Potter, 2008). Theall considers that SoTL is an "extension of the three other types of scholarship into the realm of teaching and the legitimizing of research on teaching" (Theall, 2003, p. 415) . There is some consensus that communication with the scholarly community is a defining characteristic of SoTL (Bowden; Braxton, et al.; Hutchings, et al., 2011). Lee S. Shulman explained that *scholarly teaching* becomes the *scholarship of teaching* when the work of a member of the faculty becomes "public, peer-reviewed and critiqued, and exchanged with other members of our professional communities so they, in turn, can build on our work" (Shulman, 2000, p. 50).

Academic promotion and tenure decisions take into consideration the significance of a candidate's publications. Writing about education in a particular discipline and writing about research in that discipline co-existed, but they usually did not have equal weight. This may, in part, be the result of unfamiliarity with teaching-focused journals in a discipline. For instance, in the sciences, scientific research and its publishing venues must be reputable for tenure success, but research about teaching in the sciences may not be required or even well understood. SoTL is an example of an interdisciplinary area that evolved from established disciplines (Hagstrom, 2001). So while this research has always been important in the discipline of Education, the SoTL movement raised the profile of research about teaching in the subject disciplines. It underscored the scholarly rigor needed to be accepted as significant by the academy in a broader swath of disciplines.

Assessment of the Scholarship of Teaching and Learning

Once SoTL was identified as an aspect of faculty work that is as important as discovery, there was a need for a common understanding among academics of how to assess this "new" mode of scholarship. A subsequent Carnegie Foundation report began this discussion

(Glassick, et al., 1997). However, this remains an ambiguous area (Bowden, 2007). Hutchings, Huber, and Ciccone (2011, p. 120) recently stated that "much remains to be done to craft guidelines for evaluation, documentation, and peer review that adequately recognize the scholarship of teaching and learning." Academic departments typically lack standards for evaluating (O'Meara, 2005).

One criterion in the evaluation of faculty work is their scholarly contributions and the impact of their publications. However, this has not always been the case. A glance at the history of higher education in the United States shows a significant change in faculty responsibilities, and therefore faculty evaluation during the past 150 years. Early American colleges and universities, following the model of English universities, were committed to teaching, not research (Eliot, 1901). A change in focus began during the industrial change in nineteenth century at the time of the passage the Morrill Act and the establishment of land-grant ("Morrill Act of 1890. The Agricultural College Act of 1890. An act to apply a portion of the proceeds of the public lands to the more complete endowment and support of the colleges for the benefit of agriculture and mechanic arts...", 1890; "Morrill Act. An act denating public lands to the several states and territories which may provide colleges for the benefit of agriculture and the mechanic arts," 1862). Universities included the goal of service to expand and communicate knowledge for general societal improvement, especially in the fields of business, agriculture and technology.

Another shift began in the twentieth century, inspired by the German university tradition of discovery of knowledge. After World War II, research as the model for faculty work became the major focus. Universities rewarded research by promoting faculty, granting tenure, and increasing salaries. During the post-World War II era, especially the 1960's, the major concern of universities was to recruit and retain faculty members. By the 1980's, the emphasis on research was universal; John Centra reported in his 1977 survey of over 450 department heads that large research universities emphasized research, although teaching was a close second in importance (Centra, 1977). The 1987-88 National Survey of Postsecondary Faculty Teaching, Learning and Assessment reported "even schools traditionally structured for teaching—liberal arts and comprehensive institutions—now followed the research model" (Fairweather, 1993, p. 11). Promotion and tenure reviewers began to critically evaluate faculty member's performance. The quantity and quality of a faculty member's publications became critical (Centra, 1977).

The debate of the relative importance of teaching vs. research continued. One of the major proponents of bringing the focus back to teaching was Ernest Boyer (Boyer, 1990), past President of The Carnegie Foundation for the Advancement of Teaching. He advocated for expanding the definition of scholarship to include the *application* of knowledge. He believed that faculty members should share their knowledge through teaching. As mentioned earlier, he outlined four separate, but overlapping functions: the scholarship of discovery, the scholarship of integration, the scholarship of application and the scholarship of teaching. The need to evaluate the scholarship and publications of a faculty member necessitates a fair methodology. Evaluation of the journals in which they publish is part of this.

This leads to the question that is the focus of this article. How can a faculty member or academic unit in an emerging field, such as SoTL, determine the quality, impact, or prestige of the journals in the field? This may seem like a straightforward determination, but there are actually a number of nuanced factors to take into consideration to place a journal into context.

Criteria for Journal Quality Criteria

Common methods for ascertaining the quality of a journal are:

- Peer review
- Acceptance rate
- Longevity
- Open access availability
- Inclusion in indexing/abstracting services
- Citation analysis, such as ISI journal impact factor, *h*-factor, and Eigenfactor™ Score
- Expert opinion or inclusion on a "core list" of journals compiled by experts

Peer review. One widely accepted indicator of journal quality is peer review (Long, 2010). Peer review means that the article has been reviewed by other scholars in the field prior to publication. Usually this process is anonymous, or "double-blind;" neither the author nor the reviewer is known. Commonly an editor will ask two or three other experts to review the article and comment on its acceptability. However, since all research journals use some form of this method, it cannot be the sole method of evaluating the relative quality of a journal.

Acceptance Rate. The acceptance rate is the percentage of articles submitted to a journal that are accepted for publication. In 2009 Haensly, Hodges and Davenport (2009) studied acceptance rates in relation to journal quality in the field of economics and finance. They found a relationship between lower acceptance rates and higher citation counts, impact factors, and survey-based rankings. This suggests that acceptance rates may be an indicator of journal quality. (Haensly, et al., 2009) Fields that have less consensus about theories and methods have lower journal acceptance rates than fields that have high consensus (Hargens, 1988). However, there are also caveats about considering this factor. It is important to understand the context of a journal's publishing pattern and know about its editorial policies. Journals that are older or supported by associations in the field may receive more manuscripts and therefore have lower acceptance rates. In some cases editors may work more closely with authors to revise articles and therefore have higher acceptance rates. Journals that have a narrower subject focus have more consensus on theories and methods and therefore have higher acceptance rates.

Longevity. A journal's longevity (length of time it had been published) is a *de facto* indicator of value. Interest in SoTL may have spawned new journals that do not have the advantage of longevity that influences the reputation and prestige of journals.

Open access availability. Open access (OA) journals are those freely available on the Web. They have varying business models, including subsidies through author charges or sponsorship by institutions. Journals that are not open access usually regain their costs through subscriptions. Only those who have personal subscriptions, access to libraries with subscriptions, or choose to pay per article can access the articles. As early as 2005 there was some evidence that OA journals should be weighted more in journal ranking lists than non-open access journals (Ladwig & Sommese, 2005). Eysenbach (2006) did one of the first longitudinal studies of OA and non-OA articles. During the first four to sixteen months after publication, he concluded that "open access articles are cited earlier and are, on average, cited more often than non-OA articles" (Eysenbach, p. 0696). Davis, et al. examined eleven scientific journals and found that OA articles "may reach more readers than subscription access publishing" (Davis, Lewenstein, Simon, Booth, & Connolly, p. 343).

However, they did not find evidence of increased citations during the first year. In a study of four disciplines by Norris, et al. (2008), there was a clear citation advantage for OA articles, however this advantage varied by discipline. There is some evidence that OA journals should be weighted more in journal ranking lists than non-open access journals (Ladwig & Sommese, 2005). In a recent meta-analysis of OA citation studies by Swan, 27 of 31 studies showed a greater rate of citation for open access articles (Swan, 2010). Of even greater interest to this study, this analysis examined the higher citation rate by broad disciplinary area. Agricultural studies showed an increase of 200-600% in citations with OA, greater than any of the other nine areas.

Inclusion in indexing/abstracting services. Inclusion in major indexing/abstracting services such as BIOSIS, Agricola, or Web of Science involves a selection process that can be stringent (Paynter, Jackson, & Mullen, 2010). Editorial boards identify the major journals to be indexed. One limitation of this method is that a journal must be in existence for several years to be considered.

Citation Analysis. After peer review, the most widely accepted indicator of journal quality is the ISI journal impact factor, an outgrowth of citation indexing. Through citation indexes, a researcher can find new publications on a topic by identifying articles that cited known articles from the past. Citation indexing has a long history dating back to its use in legal research in the 19th century. Modern use of citations to identify key articles originated with Eugene Garfield (2006). He published the first edition of *Science Citation Index®*, (SCI) in 1961. The purpose of SCI was to identify newer articles, i.e., as an indexing tool.

The use of citation data to determine journal rankings or "impact" was a direct outgrowth of Garfield's citation indexes. Although Garfield first mentioned journal "impact factor" in 1955 (Garfield, 2006). It was not until 1975 that he and Sher re-sorted the author index of *SCI* by journal name to create the first ranking of journals by citations. This led to the publication of *Journal Citation Reports* (*JCR*). Many studies used the ISI journal impact factor to identify core collections of journals for specific disciplines (Blessinger & Frasier, 2007; Blessinger & Hrycaj, 2010; deVries, Kelly, & Storm, 2010; Weissinger, 2010).

The impact factor has been criticized extensively in the literature, especially when used as an evaluation measure for promotion and tenure. Questions centered on its validity, its variation among disciplines (Leydesdorff, 2008; Van Nierop, 2009), and a low correlation with expert opinion surveys (Serenko & Dohan, 2011). It includes self-citations, and a single, highly cited article can strongly influence it (McGarty, 2000). Many articles that are very influential are published in journals with lower ISI journal impact factors. Journal Citation Reports is selective in indexing journals, especially in the social sciences and the humanities; of the 12,000 journals indexed only approximately 2,500 are in the social sciences (Social Sciences Citation Index). Altmann and Gorman (1998) concluded that impact factor is not reliable as a measure of a journal's importance since impact factors vary each year.

Criticism of the ISI journal impact factor led to the proposal of other metrics. The two most common are the Eigenfactor™ Score (hereafter referred to as "Eigenfactor") and the *h*-index. Each has advantages and disadvantages; each attempts to solve problems of other metrics.

The journal impact factor is based on calculating the average number of times the articles in a journal have been cited by newer articles. It can be further refined by limiting the range of years during which the citations are counted or the years during which the articles were published, by eliminating self-citations, and other variations. ISI's definition of the journal impact factor limits the calculation by dividing the number of citations in the census year by the number of articles published in the previous two years. An ISI journal impact factor of 1.0 means that, *on average*, the articles published one or two year ago have been cited one time (ISI's Journal Citation Reports help page).

The Eigenfactor ranks the influence of a journal rather than an article. It calculates the number of times that articles published in a journal during a census period provide citations to papers published during an earlier period. Journals generating higher impact to the field have larger Eigenfactor scores. The Eigenfactor approach is thought to be more robust than the impact factor by considering the significance of those citations.

A third metric is the *h*-index and was developed by physicist Jorge Hirsch (2005). He suggested that "a scientist has index *h* if *h* of his/her N_p papers have at least h citations each, and the other (N_p − h) papers have no more than *h* citations each" (Hirsch, p. 16569). The calculation can be applied to journals as well as to authors.

Citations per article are reported in every record in the *Web of Science*, *Google Scholar* and *Scopus.* The ISI journal Impact Factor, the Eigenfactor and the *h*-index can be retrieved through online database searches, although not all through the same database. These calculations will vary depending upon the set of journals used in the calculation. For example the *h*-index can be calculated based on journals indexed in the *Web of Science* or those indexed in *Google Scholar*.

The Eigenfactor is reported in *Journal Citation Reports (JCR)* and also at the Eigenfactor website and is based on the journals indexed in the *Web of Science*.

The *h*-index is available from the *Web of Science* and from Harzing's *Publish or Perish*. Each of these sources used a different set of data to calculate the *h*-index. To obtain the *h*-index as calculated in the *Web of Science*, search for a journal name in the *Web of Science* in either *Science Citation Index* or *Social Science Citation Index* and then click on the "Create a report" icon. In these databases the "*h*-index factor is based on the depth of your product subscription and your selected timespan. If your subscription depth is 10 years, then the *h*-index value is based on this depth even though a particular author may have published articles more than 10 years ago."(Web of Science Help). Harzing's *Publish or Perish* program uses the citations per article in *Google Scholar* to calculate the *h*-index. To get the *h*-index from Harzing's *Publish or Perish* download the software from their website (Publish or Perish). Then use the "journal impact" tab and enter a journal name. The calculations are compiled and appear in the results window.

To summarize this, the journal ISI impact factor and the Eigenfactor based upon the data in the *Web of Science* database, can be obtained from *Journal Citation Reports*. The *h*-index, based upon *Web of Science* data, can be obtained from the *Web of Science*. The citations per paper average, which is comparable to the ISI journal impact factor, and the *h*-index based upon the statistics in *Google Scholar* can be calculated using Harzing's *Publish or Perish* program.

Expert opinion and core lists of journals. Many academic departments in universities develop ranked lists of journals by polling their own faculty (Paynter, et al., 2010).

Scholarly associations may compile core lists of journals by surveying their members' opinions on journals. In some fields there are few such compilations while in other fields, there are many such lists. Surveying experts in a field is a method used for compiling core lists of journals (Blake, 1996; Bray & Major, 2011; Goodyear et al., 2009; Kohl & Davis, 1985; Lamp, 2009; Nisonger & Davis, 2005; Smith & Middleton, 2009; Stankus, Clavin, & Joslin, 1999).

This concept has limitations for an area of discipline-focused SoTL journals, which are only loosely affiliated given subject matter. Because of the multi-disciplinary focus of these journals, as well as the broad potential audience (e.g., instructors in any of the life sciences), a core list has not been compiled and may be impossible to create.

Combining expert opinion and citation analysis methods. It is not uncommon to use multiple methods to compile a core list. The impact factor can supplement the results of an expert opinion survey (ABS Launches Academic Journal Quality Guide Version 4; Towns & Kraft, 2012; Ugaz, Boyd, Croft, Carrigan, & Anderson, 2010; Youngen, 2011). The Australian government took on an ambitious project to assess scholarly journals. This was part of the program, Excellence in Research for Australia, initiated by the Australian Research Council. The initial list included nearly 20,000 journals allocated among 181 fields (Lamp, 2009). The peer reviewed journals in education were evaluated by three criteria: esteem percentage, a prestige evaluation developed from responses of over 800 scholars to a survey; the ISI journal impact factor; and whether the journal had an international editorial board.

Methodology

The methodology for this study consisted of these stages:

- The identification of relevant journals
- The identification of evaluative criteria for the journals
- Data-gathering about the relevant journals

Identification of Relevant Journals

The authors began the process of identifying journals for this study by compiling a master list of all SoTL journals included on a list from POD: Professional and Organizational Development Network in Higher Education (http://www.podnetwork.org/resources/periodicals.htm), the Committee on Institutional Cooperation (CIC), and *Ulrichsweb*™, a standard resource for information about journals. Compilers of the former two lists did not post their selection criteria for inclusion on the lists. *Ulrichsweb*™ strives to be a comprehensive resource on journals. POD supports centers or departments in colleges or universities whose focus is faculty development. These centers are resources that faculty instructors can use to develop teaching approaches. Many of these centers post lists of journals related to SoTL on their web sites. The other lists used for compiling the master list of journals were from land-grant institutions that were peer institutions of Purdue University. These were members of the Committee on Institutional Cooperation (http://www.cic.net/Home.aspx) (CIC), a consortium of twelve research universities at the time the list was compiled that included:

- University of Chicago
- University of Illinois*

- Indiana University
- University of Iowa
- University of Michigan
- Michigan State University*
- University of Minnesota*
- Northwestern University
- Ohio State University*
- Pennsylvania State University*
- Purdue University*
- University of Wisconsin-Madison*

The listed institutions with an asterisk following their names are CIC members that are land-grant institutions (http://www.csrees.usda.gov/qlinks/partners/state_partners.html). Land grant institutions are public institutions that also conduct research and respond to the needs of their home states in areas such as agriculture (Toutkoushian, 2001). Most of the universities posted a list of SoTL journals on their web sites.

The journal titles included on all of these lists and indications of which institutions listed them were recorded in a Microsoft Excel spreadsheet. Since the total number of titles was large, the authors decided to limit the subject areas of the journals included for this paper to agriculture, natural resources, and the life sciences (excluding medicine). The authors determined each journal’s focus by using the “aims and scope” (or similarly titled) area on the journal’s website to ensure that articles included and audience addressed met the criteria for selection. The authors did not include titles in non-English languages or that focused solely on K-12 education. The resulting list contained 36 journals. These are listed with their ISSN’s in Appendix A. The ISSN is the standardized international code which allows the identification of any serial publication, including electronic serials, independently of its country of publication, of its language or alphabet, of its frequency, medium, etc.

Evaluative Criteria for the Journals
The commonly accepted criteria for evaluating journal quality and impact discussed above were applied to the journals selected for this study:

- Peer-review
- Acceptance rate
- Longevity
- Open access availability
- Citation analysis (including ISI journal impact factor, Eigenfactor, and *h*-index based on Google Scholar data)
- Inclusion in indexing/abstracting services

There were no published lists developed by soliciting the opinion of experts in the scholarship of teaching and learning in agriculture, natural resources, or the life sciences about which journals are the best in the field. Similarly, there were no published lists of core journals for those fields.

Table 1 lists the sources for the data collected. The primary, or original, sources for the data are in boldface. The URL’s for the resources listed in the table do not provide access to the source if a subscription is required. Those affiliated with institutions that subscribe to the resources generally may gain access through their institutional library web site.

*Acceptance rate***.** The authors requested this information from journal editors by email and sent a second email to non-respondents.

Longevity. The starting date for each journal was initially obtained from *Ulrichsweb*™ and verified against the journal's website. In several instances, the website reflected more current information, such as a name change for a journal.

Open access availability. The open access availability of each journal was determined from the publisher's web site and from *Ulrichsweb*™.

Inclusion in indexing/abstracting services. Greider (2002) listed the most critical indexes for the agricultural sciences. Since several of these were out of scope for this research (e.g., indexing government documents, grants, or dissertations), only four remained: Agricola, CAB Abstracts, BIOSIS/Biological Abstracts, and Web of Science. ERIC is the primary index in the field of Education (Weiner, 2009).

These were the sources used to determine the current inclusion of the selected journals in primary indexing and abstracting sources for agriculture, education, natural resources, and the life sciences:

- BIOSIS *Journal Search Subject Categories* (BIOSIS PREVIEWS - SUBJECT CATEGORIES)
- CAB Abstracts *Serials Cited* (CAB Abstracts Serials cited)
- Web of Science *Master Journal List* (Master Journal List)
- *Journals Indexed in ERIC* (Journals Indexed in ERIC)

Indexing information was not available for Agricola because the National Agricultural Library is reengineering its production. The number of journals that will be indexed will increase greatly and its current status would not be an accurate or useful snapshot.

Citation analysis. ISI impact factor and the Eigenfactor were identified through *Journal Citation Reports 2010*. The *h*-index was obtained from a search of *Google Schola*r on Nov 8, 2011 using the *Publish or Perish* (PoP) software program. The search was limited to the 2008-2011 publication years.

Table 1. Sources for Data on Evaluation Metrics for Journals in the Scholarship of Teaching and Learning in Agriculture, Natural Resources, and the Life Sciences.

Criterion	Sources
Peer Review	**Journal's web page** *Ulrichsweb*™ (http://ulrichsweb.serialssolutions.com/)
Acceptance Rate	**Contact journal editor; Journal's web page**
Longevity	**Journal's web page**
Open Access Availability	**Publisher's web site;** *Ulrichsweb*™ (http://ulrichsweb.serialssolutions.com/); Directory of Open Access Journals (http://www.doaj.org/)
Impact Factor	***Journal Citation Reports*** (in Web of Science) (http://thomsonreuters.com/products_services/science/science_products/a

	-z/journal_citation_reports/) Journal's web page
Google Scholar data	***Google Scholar Citations*** (http://scholar.google.com/citations?view_op=new_profile&hl=en) *Publish or Perish* database (http://www.harzing.com/pop.htm)
Scopus	http://www.scopus.com/home.url
Eigenfactor^{TM} Score	http://www.eigenfactor.org; Journal's web page
h-Index	***Journal Citation Reports*** (in Web of Knowledge) (http://thomsonreuters.com/products_services/science/science_products/a-z/journal_citation_reports/) Journal's web page *Publish or Perish* database (http://www.harzing.com/pop.htm) **Scopus** (http://www.scopus.com/home.url)
Inclusion in Indexing/Abstracting Services	***Biological Abstracts Journal List*** (http://science.thomsonreuters.com/cgi-bin/jrnlst/jlresults.cgi?PC=BA) ***CAB Abstracts Serials Cited*** (http://www.cabi.org/default.aspx?page=1016&site=170&pid=125&xslttab=2&newtitlesonly=0&letter=*) ***Journals Indexed in ERIC*** (http://www.eric.ed.gov/ERICWebPortal/journalList/journalList.jsp) ***Science Citation Index Expanded Journal List*** (http://science.thomsonreuters.com/cgi-bin/jrnlst/jloptions.cgi?PC=D)
Expert opinion or inclusion on a "core list" of journals	**Literature search** **Scholarly associations**

Results

Table 2 displays the acceptance rate, when available, journal start date (longevity), and open access availability for the journals in this study.

Acceptance Rate

The journal editors reported this information in a variety of ways, including an average acceptance rate for one or more years or a range of averages. Eight journal editors did not respond. Two declined to provide an acceptance rate.

The acceptance rates varied from 7% to 80%. The mean response rate was 41% and the median response rate was 44%. This was calculated by substituting 29% for the *Electronic Journal of Science Education*, whose acceptance rate was <30%; 24% for *Science Educator*, whose acceptance rate was <25%; 11% for the *Journal of Science Teacher Education*, the average of its rate that ranged from 7-15%; and 67.5% for the *NACTA Journal*, the average of its rate that ranged from 63-72%.

Longevity

All but three (n=33, 92%) of the journals existed for at least ten years. The newer journals began publication in 2002 or 2003.

Open Access Availability

Most (n=26, 72%) of the journals were not available through open access. Eight (22%) were completely OA and two (6%) became OA after an embargo period of six months (*Bioscene: Journal of College Biology Teaching*) and one year (*Journal of Agricultural Education*).

Table 2. Characteristics of Selected Agriculture, Natural Resources, Life Sciences Journals Publishing SoTL.

Journal Title	Acceptance Rate	Longevity	Open Access
Advances in Physiology Education	70%^	1989-	N
American Biology Teacher	35%	1938-	N
Applied Engineering in Agriculture	76%	1985-	N
Biochemistry & Molecular Biology Education	60%	1972-	N
Bioscene: Journal of College Biology Teaching	30%	1975-	Y*
BioScience	45%	1951-	N
Bioscience Education	no response	2003-	Y
CBE Life Sciences Education	52%	2002-	Y
Electronic Journal of Science Education	<30%	1996-	Y
Environmental Education Research	^^	1995-	N
Instructional Science	43%^^^	1971-	N
International Journal of Science Education	no response	1979-	N
Journal of Agricultural Education	36%	1960-	Y**
Journal of Agricultural Education & Extension	20%	1994-	N
Journal of Biological Education	^^^^	1966-	N
Journal of College Science Teaching	35%	1971-	N
Journal of Environmental Education	15%	1969-	N
Journal of International Agricultural & Extension Education	10%^^^^^	1994-	N
Journal of Microbiology & Biology Education	no response	2000-	N
Journal of Natural Resources & Life Sciences Education	60%	1972-	N
Journal of Research in Science Teaching	no response	1963-	N
Journal of Science Education & Technology	57%	1992-	N
Journal of Science Teacher Education	7-15%	1989-	N
Journal of sTEm Teacher Education	60%	1994-	Y
Journal of Technology Education	44%	1989-	Y
Journal of Technology Studies	46%	1974-	Y
Journal of Undergraduate Neuroscience Education	no response	2002-	Y
Journal of Women and Minorities in Science and Engineering	no response	1994-	N
NACTA (North American Colleges and Teachers of Agriculture) Journal	63-72%	1957-	Y
Research in Science & Technological Education	45%	1983-	N
Research in Science Education	25%	1971-	N

School Science & Mathematics	no response	1901-	N
Science Education	14.9%	1916-	N
Science Educator	<25%	1992-	N
Science Teacher Education	80%	1991-	N
Studies in Science Education	no response	1974-	N

* After 6 month embargo.
** After 12 month embargo
^ In 2010; 58% in 2009; 53% in 2008.
^^ Editor indicated that acceptance rate can give a misleading impression of quality and so would not provide it.
^^^ In 2010; 27% in 2009.
^^^^ Editor declined to provide because final decisions on publication of submitted papers relate entirely to the quality of the article (rather than any pre-determined acceptance quota).
^^^^^ In 2009; 20% in 2008; 18% in 2007.

Inclusion in Indexing/Abstracting Services

Table 3 shows the inclusion of the selected journals in primary indexing sources for agriculture, education, natural resources, and the life sciences. ERIC included the most journals (n=28, 78%). CAB Abstracts included 6 (17%); Web of Science included 5 (14%); and BIOSIS included 2 (6%) of the journals. Five (14%) of the journals were not included in any of these indexing sources.

Table 3. Primary Indexing Sources for Selected Agriculture, Natural Resources, and Life Sciences Journals Publishing SoTL.

Journal	BIOSIS	CAB	ERIC	Web of Sci.
Advances in Physiology Education	N	N	Y	Y
American Biology Teacher	N	N	Y	Y
Applied Engineering in Agriculture	N	Y	N	Y
Biochemistry & Molecular Biology Education	N	N	Y	N
Bioscene: Journal of College Biology Teaching	N	N	Y	N
Bioscience	N	Y	Y	Y
Bioscience Education	N	N	Y	N
CBE Life Sciences Education	N	N	Y	Y
Electronic Journal of Science Education	N	N	N	N
Environmental Education Research	N	N	Y	N
Instructional Science	N	N	Y	N
International Journal of Science Education	N	N	Y	N

Journal of Agricultural Education	N	N	Y	N
Journal of Agricultural Education & Extension	N	Y	Y	N
Journal of Biological Education	Y	N	Y	N
Journal of College Science Teaching	N	N	Y	N
Journal of Environmental Education	N	N	Y	N
Journal of International Agricultural & Extension Education	N	Y	N	N
Journal of Microbiology & Biology Education	N	N	N	N
Journal of Natural Resources & Life Sciences Education	Y	Y	Y	N
Journal of Research in Science Teaching	N	N	Y	N
Journal of Science Education & Technology	N	N	Y	N
Journal of Science Teacher Education	N	N	Y	N
Journal of sTEm Teacher Education	N	N	Y	N
Journal of Technology Education	N	N	Y	N
Journal of Technology Studies	N	N	Y	N
Journal of Undergraduate Neuroscience Education	N	N	N	N
Journal of Women and Minorities in Science and Engineering	N	N	N	N
NACTA Journal (North American Colleges and Teachers of Agriculture)	N	Y	N	N
Research in Science & Technological Education	N	N	Y	N
Research in Science Education	N	N	Y	N
School Science & Mathematics	N	N	Y	N
Science Education	N	N	Y	N
Science Educator	N	N	Y	N
Science Teacher Education	N	N	N	N
Studies in Science Education	N	N	Y	N

Citation Analysis
Table 4 shows the data related to citation analysis for the journals. Most of the journals (n=22, 61%) did not have an ISI journal impact factor. Fourteen (39%) journals had an ISI journal impact factor, which ranged from .09 to 5.51. The mean ISI journal impact factor was 1.34 and the median was 0.96.

Most of the journals (n=25, 69%) did not have an Eigenfactor. The range of the eleven (31%) journals that had an Eigenfactor was from 0.000399 to 0.021091. The mean score was 0.003710 and the median was 0.001550.

All journals had an *h*-index from *Publish or Perish*. The indices ranged from 1 to 29. The mean index was 9 and the median was 7.

The number of articles published from 2008-2011 ranged from 8 to more than 1,000. The *Journal of Technology Education* and the *Journal of Undergraduate Neuroscience Education* published 8. *Bioscience* and *Science Education* published the most articles (more than 1,000). The mean number of articles published (substituting 1,000 articles for the journals that actually published more than 1,000) was 218; the median was 214.

Table 4. Citation Data for Selected Agriculture, Natural Resources, and Life Sciences Journals Publishing SoTL.

Journal Title	**2010 ISI Impact Factor**	**2011 Eigen-factor Score**	**2008-2011 PoP *h*-index**	**2008-2011 PoP # of articles**
Advances in Physiology Education	1.382	0.00155	10	225
American Biology Teacher	0.09	0.00048	7	587
Applied Engineering in Agriculture	0.507	0.00246	7	183
Biochemistry & Molecular Biology Education	0.619	0.00066	6	387
Bioscene: Journal of College Biology Teaching	N/A	N/A	2	21
BioScience	5.51	0.02109	29*	1,000
Bioscience Education	N/A	N/A	4	56
CBE Life Sciences Education	N/A	N/A	1	26
Electronic Journal of Science Education	N/A	N/A	5	53
Environmental Education Research	0.679	N/A	15	197
Instructional Science	1.473	0.00138	14	165
International Journal of Science Education	1.063	0.00338	19	518
Journal of Agricultural Education	N/A	N/A	8	432
Journal of Agricultural Education & Extension	N/A	N/A	7	238
Journal of Biological Education	0.367	0.0004	6	134
Journal of College Science Teaching	N/A	N/A	8	168
Journal of Environmental Education	0.316	N/A	11	253
Journal of International Agricultural & Extension Education	N/A	N/A	4	25
Journal of Microbiology & Biology Education	N/A	N/A	6	129
Journal of Natural Resources & Life Sciences Education	N/A	N/A	3	116
Journal of Research in Science Teaching	2.728	0.00424	23	264
Journal of Science Education & Technology	N/A	N/A	15	298
Journal of Science Teacher Education	N/A	N/A	10	214
Journal of sTEm Teacher Education	N/A	N/A	4	19
Journal of Technology Education	N/A	N/A	3	8
Journal of Technology Studies	N/A	N/A	2	18

Journal of Undergraduate Neuroscience Education	N/A	N/A	2	8
Journal of Women and Minorities in Science and Engineering	N/A	N/A	4	75
NACTA (North American Colleges and Teachers of Agriculture) Journal	N/A	N/A	2	22
Research in Science & Technological Education	N/A	N/A	6	95
Research in Science Education	0.853	0.001	14	280
School Science & Mathematics	N/A	N/A	6	176
Science Education	1.9	0.00417	26*	1,000
Science Educator	N/A	N/A	3	28
Science Teacher Education	N/A	N/A	10	208
Studies in Science Education	1.267	N/A	8	43

* Google Scholar limit of 1,000 articles reached, so *h*-index may not be accurate.

Discussion

Acceptance Rate

The acceptance rates for the journals varied greatly, from 7-80%. This could be an indicator of journal quality if the premise is that higher quality journals have lower acceptance rates. However, the editor of the *Journal of Biological Education* indicated that acceptance rates for his journal varied significantly from month to month based on the quality of submissions. This agreed with some other journal editors' comments. The editor of the *Journal of International Agricultural and Extension Education* reported acceptance rates of 18% (2007), 20% (2008), and 10% (2009), showing some variation from year to year. The policy of *Environmental Education Research* was not to publicize the acceptance rate because of concerns the editor stated that authors and reviewers could strictly, yet falsely, equate lower acceptance rate with higher quality.

The acceptance rate does not factor in other realities of publishing, such as the possibility of receiving a high volume of high quality manuscripts worthy of publishing (possible higher acceptance rate), receiving generally low quality manuscripts (possible lower acceptance rate), or editorial philosophies that provide more mentoring for authors through the preparation of manuscripts. Editors must make decisions about accepting a variety of topics for issues, and may need to reject quality papers based on subject content decisions. Scientific journals that publish articles about SoTL might have higher acceptance rates than education journals since high consensus fields tend to have higher article acceptance rates (Hargens, 1988).

Longevity

When the authors began this study, they expected to find that many SoTL journals were new publications. However, the journals identified for this study started in every decade of the 20th century, with the newest initiating publication in 2003. This is because the scope of the journals is the broader field of education, not solely the scholarship of teaching and learning. It appears that the disciplines of agriculture, natural resources, and the life sciences initiated few new journals focusing on SoTL.

Open Access Availability
Most of the journals (n=26, 72%) were not available open access. Therefore, there may be fewer citations to articles in these journals, affecting citation analysis metrics.

Inclusion in Indexing/abstracting Services
The primary indexing/abstracting database for education, ERIC, included the most journals (n=28, 76%). The science indexing/abstracting databases covered few (CAB, n=6, 17%; Web of Science, n=5, 14%; BIOSIS, n=2, 6%). Although SoTL is an interdisciplinary area that blends education with other academic disciplines, the education indexing resources cover its literature much more comprehensively for the fields covered by this paper. This may be one reason why faculty who do not publish in the scholarship of teaching and learning may be unfamiliar with its primary journals.

Five (14%) of the journals were not included in any of these indexing sources, however, it was not possible to discern whether the journals were indexed in Agricola due to database reconstruction at the time of the study. These journals may be included in that important resource. Another possible explanation is that the journals may consider selection for inclusion in these sources as less important than in the past due to the widespread use of Google Scholar for finding articles.

Citation Analysis
Most of the journals did not have an ISI journal impact factor (n=22, 61%). This is due to the lack of inclusion of many education journals in *Web of Science*. *JCR* coverage of disciplines varies, and tends towards established disciplines (e.g., Agronomy, Biology, Forestry). Cross-disciplinary areas, especially those that span the sciences and the social sciences (i.e., SoTL in the life sciences) do not fit well into the criteria for inclusion of journals.

The ISI journal impact factor ranged from .09-5.51. The mean was 1.34 and the median 0.96. The ISI journal impact factor is the number of citations in a journal in 2010 divided by the number of articles published in 2008 and 2009 (ISI's Journal Citation Reports help page). This is an indication that authors tend not to cite the articles in these journals soon after publication. But considering the volume of articles published in the scholarly literature each year, the chance of being cited would be small.

As a comparison, all education and educational research journals in *JCR* had a median impact factor of 0.649. Agriculture journals had a median impact factor of 0.410 and biology journals, 1.339.

This reflects on the limitations of the ISI journal impact factor, which relies on traditional mono-disciplinary boundaries and long-established publishing timelines. Given the rapid changes in the availability of citations, and sometimes full text, through the internet, there is a need to develop new criteria beyond the narrow confines of ISI journal impact factor.

Most of the journals did not have an Eigenfactor (n=25, 69%). This is because they were not indexed by ISI. The score ranged from .000399-.021091. The mean was .003710 and the median .001550. This could be the expected value given the number of citations produced each year. But the sample of values was small and many values were missing (n=25, 69%). This affected the interpretation of these results.

The journals published a widely ranging number of articles during the period from 2008-2011. A possible explanation is that the journals with the fewest articles (n=8), *Journal of Technology Education* and the *Journal of Undergraduate Neuroscience Education,* covered more specific topics than the journals with the most articles, *Bioscience* and *Science Education* (n=more than 1,000).

Conclusion

This study examined commonly accepted criteria for evaluating SoTL journals in the areas of agriculture, natural resources, and the life sciences. There was great variation in the acceptance rates of journals. Most of the journals were at least 10 years old and most were not available through open access. ERIC was the primary indexing source that included the journals. Most journals did not have an ISI journal impact factor or Eigenfactor. The number of articles published in each journal varied greatly, from 8 to over 1,000. The large percentage of missing values for ISI journal impact factor and Eigenfactor™ Score affected the ability to interpret these results.

There were several limitations to this study. There was no established "core list" of journals in SoTL for agriculture, natural resources, or the life sciences. The authors compiled the list used for this study by comparing existing lists of journals on SoTL web sites of land-grant universities that were members of the Committee on Institutional Cooperation. However, these lists did not provide any indication of how the compilers selected the journals. It is possible that they were compiled from expert opinion or from existing lists of other institutions. The latter exemplifies "institutional isomorphism," in which institutions tend to imitate others those to whom they aspire due to economic and professional pressure (Dey, Milem, & Berger, 1997).

The study did not take into consideration the number of hits to or downloads of articles. This is a difficult metric to obtain, particularly for subscription journals. However, it would provide a dimension that is particularly relevant in the online environment.

It was not possible to obtain a list of journals indexed in the Agricola database because the National Agricultural Library was in the process of reengineering the database. Since Agricola is one of the primary resources for articles on agriculture, this left a gap in data for the indexing criterion.

Future studies might examine the following topics:

- A bibliometric study of the journals that publish the most on SoTL in agriculture, natural resources and the life sciences. If Bradford's law of scattering applies, then a small number of journals will publish the majority of the articles about the topic.(Bradford, 1985).

- SoTL is fundamentally about improving the quality of teaching. What role does improved teaching through research play in the evaluation process in agriculture, natural resources, and life sciences disciplines?

- How do the findings from this study about agriculture, natural resources, and life sciences SoTL journals compare with SoTL journals in other disciplines?

- Do journals about science that publish articles about SoTL have higher acceptance rates than journals about education research that publish articles about science?
- What other metrics can reflect the quality of journals in which authors in the scholarship of SoTL in agriculture, natural resources, and the life sciences?
- How can the inherent intra-disciplinary differences in a field such as SoTL in agriculture, natural resources, and the life sciences be reconciled when promotion and tenure evaluations take place?

In conclusion, this paper highlighted the criteria that are available for evaluating journal quality, or at least understanding the nature of a journal in context to similar titles. These criteria may be useful in providing a rationale for the selection of journals in which to submit articles for publication.

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Appendix

List of Journals on the Scholarship of Teaching and Learning in Agricultural, Natural Resources, and the Life Science Included in Analysis with ISSN's.

Title	ISSN (print journal)	ISSN (online journal)
Advances in Physiology Education	1043-4046	1522-1229
American Biology Teacher	0002-7685	1938-4211
Applied Engineering in Agriculture	0883-8542	none cited
Biochemistry & Molecular Biology Education	1470-8175	1539-3429
Bioscene: Journal of College Biology Teaching	1539-2422	none cited
BioScience	0006-3568	0006-3568
Bioscience Education	no print	1479-7860
CBE Life Sciences Education	no print	1931-7913
Electronic Journal of Science Education	no print	1087-3430
Environmental Education Research	1350-4622	1469-5871
Instructional Science	0020-4277	1573-1952
International Journal of Science Education	0950-0693	1464-5289
Journal of Agricultural Education	1042-0541	2162-5212
Journal of Agricultural Education & Extension	1389-224X	1750-8622
Journal of Biological Education	0021-9266	2157-6009
Journal of College Science Teaching	0047-231X	1943-4898
Journal of Environmental Education	0095-8964	1940-1892
Journal of International Agricultural & Extension Education	no print	1077-0755
Journal of Microbiology & Biology Education	1542-8818	1935-7885
Journal of Natural Resources & Life Sciences Education	1539-1582	1059-9053
Journal of Research in Science Teaching	0022-4308	1098-2736
Journal of Science Education & Technology	1059-0145	1573-1839
Journal of Science Teacher Education	1046-560X	1573-1847
Journal of sTEm Teacher Education	2158-6586	2158-6594
Journal of Technology Education	1045-1064	none cited
Journal of Technology Studies	no print	1071-6084
Journal of Undergraduate Neuroscience Education	no print	1544-2896
Journal of Women and Minorities in Science and Engineering	1072-8325	1940-431X
NACTA (North American Colleges and Teachers of Agriculture) Journal	0149-4910	none cited
Research in Science & Technological Education	0263-5143	1470-1138
Research in Science Education	0157-244X	1573-1898
School Science & Mathematics	0036-6803	1949-8594
Science Education	0036-8326	1098-237X
Science Educator	1094-3277	none cited

Science Teacher Education	0961-6152	1756-915X
Studies in Science Education	0305-7267	1940-8412