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New methods for an old debate: Utilizing reader response to investigate the relationship between collaboration and quality in academic journal articles

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ABSTRACT

There has been a longstanding debate about the merits of collaborative research, with most studies focusing on the citation advantage of such research. However, citation studies provide only one lens on the issues. New methods of inquiry are necessary to incorporate other audiences of scholarly literature. Reader response surveys were used to evaluate the quality of collaborative versus single-authored research. Graduate students in three sections of the same library and information science course during the 2010 academic year used surveys to rate each week's assigned readings according to overall quality, usefulness for class discussion, and enjoyability. Students voted whether to keep each article in the reading list for the following semester. Data were analyzed to compare results for single-author versus multi-author works. Multi-author works were favored over single-author. These findings provide another layer of empirical support for the benefits of collaborative research and inform both scientometricians and educators.

1. Introduction

The increase in scholarly collaboration is a marked trend in the sciences and social sciences, including library and information science (Cronin, Shaw, & La Barre, 2003; Ding, Foo, & Chowdhury, 1998; Lipetz, 1999; Liu, 2003; Sonnenwald, 2007). Collaboration, as measured through patterns of co-authorship, has been investigated by many scholars (Cronin, 2001; Glanzel, 2002; Hart, 2007; Lipetz, 1999) and does not appear to be decreasing. In the more than 40 years since Price and Beaver (1966) and Zuckerman (1967) published the first studies suggesting a positive correlation between academic collaboration and the productivity and quality of research, there have been no shortage of studies examining this issue through various lenses.

Previous studies have largely relied on unobtrusive measures of analysis, such as citation counts and analyses of scholarly output. The majority of these studies are conducted at the peer level; they investigate the quality of research as shown through citations, reviews, or authorship patterns between peers. The results have been mixed, with researchers supporting or rejecting the correlation between collaboration and quality, or presenting inconclusive results. Despite the mixed success of previous efforts–or perhaps because of them–this question continues to merit strong and persistent inquiry, particularly as collaboration rates increase, supported in large part by institutional and funding initiatives. Therefore, new methods of inquiry are required to gain a more holistic understanding of the effects of increased collaboration on the quality and impact of scholarship.

2. Problem statement

Citation counts are frequently used as a proxy for the quality of a piece of published research. Citation counts, it is argued, are evidence of the impact of an article on scholarship: The article has been read and has influenced another article. This metric captures the impact on just a single audience type, however, the peer scholar. What is not captured is the impact of the article on other groups. For a professional field, this could include student and practitioners who read and use scholarship, but may not contribute to it. Therefore, reader response surveys can provide feedback on many aspects of scholarship that unobtrusive quality metrics may not address. Student responses were used to provide a new lens for examining the relationship between collaboratively authored works and quality.

As early as 1980, Presser called the growth in collaboration "clearly documented" (Presser, 1980, p. 95). But we still have ambiguous results regarding the impact of this change in authorship patterns on the quality of research published. A new metric for examining this question is provided, from a viewpoint that is unique in employing obtrusive metrics and elicits responses from those who are not peers in the academic community. This provides the added advantage of minimizing the social, cognitive, and geographic connections between scholars that can cause biases in many bibliometric studies. Self-citation, and citation of colleagues and friends within an extended social network can and often do affect the number of citations a work receives. Similarly, the personal and professional connections

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of journal editors may influence article acceptance. Thus, neither of those metrics are completely objective assessments of an article's quality. By relying on qualitative measurements supplied by a non-peer group–graduate students in an master's in library science program–an attempt is made to create a less-biased metric than currently in use. As the students are assumed to have little to no relationship with any of the authors being assessed, their reactions may be more a reflection on the text itself, with little influence exerted by the name or affiliation of the author or authors.

This new metric expands our understanding of the relationship between collaboration and quality, factors of interest to those who study science, philosophy, history, and the sociology of science. It also gives educators new tools to evaluate the work that they assign for course readings. Despite four decades of research on this question, there is still no consensus. It is hoped that by proposing an alternative viewpoint for evaluation of collaborative research, and suggesting triangulation between obtrusive and unobtrusive metrics, the discussion might be furthered, and a better understanding might be gained of the impact of collaborative knowledge dissemination on the quality of science.

3. Literature review

Studies have examined three primary aspects of research in light of collaboration: quality of research, productivity, and funding. The first of these aspects is considered here, since previous findings on this matter have been widely divergent, and established collaboration evaluation metrics have failed to produce consensus.

To illustrate the difference in opinion, this literature review is divided into three sections: 1) supportive studies: those supporting the theory that collaboration produces higher quality research; 2) mixed results: those with ambiguous findings regarding the relationship between collaboration and quality; and 3) non-supportive studies, those rejecting a positive, direct relationship between collaboration and quality. It should be noted that the term "collaboration" refers specifically to the academic article produced by collaboration, where there is more than one author on a byline of an academic paper. Conceptualizations of collaboration or collaboration as a process, rather than a product, are not addressed.

3.1. Supportive studies

One of the early studies to fuel this area of research was Zuckerman's (1967) examination of the publications of Nobel-Prize winning researchers. Her analysis demonstrated that Nobel Prize winners were more likely to collaborate than their nonwinning counterparts. Oromaner was the next to test the idea, conducting the first citation study of single- versus multi-author works, focusing on prominent sociological journals; he found that single-author works were "somewhat less likely to have an impact than are multi-author articles (54% vs. 62%)" (Oromaner, 1975, p. 152). Following this study, Beaver and Rosen (1979) conducted a simple analysis of prestigious science journals and found that a disproportionate amount of articles published in top journals were co-authored. Whether that proportion was a function of a higher quality of co-authored publications, however, or a side effect of the increase in academic collaboration was not established. Presser's study attempted to address this problem by examining editorial responses (accept, revise and resubmit, reject) for single- versus co-authored manuscripts. He found that multi-author works had higher acceptance rates and more positive reviews, concluding that "authors who work with others are more likely to write higher quality papers, regardless of discipline" (Presser, 1980, p. 97.)

Lawani (1986) examined studies singled out for praise by the editorial board of *Yearbook of Cancer*, and found high correlation between multi-authored works and quality. Hernon, Smith, and Croxen (1993) conducted a study similar to Presser's, focusing on *College & Research Libraries* and found that co-authored manuscript submissions were more likely to be accepted than those with a single author. Hart surveyed the curriculum vitae of respondents for publications and found that "collaboration increases with the increasing quality of the type of journal" (Hart, 2000, p. 98) with single-author articles comprising 86% of non-refereed journal articles and 52% of core library and information science (LIS) literature. His survey responses also indicated a strong feeling among respondents that collaboration fostered the exchange and introduction of new ideas and areas of expertise, positively affecting the research process. Perhaps the most emphatic support for this theory comes from Glanzel, who examined citations for single- and multi-author works in mathematics, biomedical research, and chemistry. This study concluded, "the theory that multi-authored papers are more likely to be cited, and attract more citations, than single-authored papers was strongly supported and proved to be universal" (Glanzel, 2002, p. 472).

Franceschet and Costantini, (2010, p. 14) examined 18,500 scholarly products according to citation and peer review and found that "in most cases" collaboratively authored pieces measured higher in impact and in peer review. This effect was greater if the affiliations of the authors of a collaboratively authored piece were heterogeneous. Most recently, Hsu and Huang conducted a large-scale citation analysis of more than 90,000 journal articles published in seven science journals and found a roughly 57% likelihood that a co- or multi-authored journal article would receive more citations than a single-author work (Hsu & Huang, 2011, p. 323). Using citations as indicators, these works support the assertion of the higher quality of collaborative works.

3.2. Mixed results

Early citation studies were often ambiguous, however, with wide variation reported from discipline to discipline. Lindsey examined 1300 articles from seven science and social science disciplines over a six-year period and reported an "inconsistent pattern" of citation counts where "single-authored works dominated the literature of economics, while multi-authored articles were prominently cited in biochemistry" (p. 151). In addition, by running a chi-square analysis of the data, Lindsey found that Oromaner's (1975) study was not statistically significant (Lindsey, 1980, p. 162). Smart and Bayer (1986) conducted a citation study for three disciplines over a 10-year period and found higher mean citation counts for co-authored articles. Statistical tests found significance only for management literature, however, not clinical psychology or educational measurement. Schubert (2002) examined all articles from the first 50 volumes of *Scientometrics* and found a relatively equal split of citation counts between single- and multi-author works in the top 26 cited articles. Leimu and Koricheva's citation analysis was limited to some 800 ecology articles published in a single journal. They found that collaboration had a "rather minor effect on the impact of the resulting publications, as measured by their citation rates" (Leimu and Koricheva, 2005, p. 438). Higher initial citation rates were tempered when the authors took into account the tendency of multi-author papers to be heavily self-cited by the various authors in future studies. Many of these studies suggested a disciplinary factor in the studies which should be addressed.

3.3. Non-supportive studies

Several studies have found evidence to counter the idea of a positive, direct correlation between co-authorship and article quality. Bayer's (1982) four-year analysis of articles published in the *Journal of Marriage and the Family* found no difference in citation rates between single- and multi-author papers. Bridgstock's (1991) citation analysis of four Australian science journals likewise found no significant correlation. Perhaps most damning to the idea of heaver citation rates for multi-author articles is Avkiran's subtly-titled study *Scientific*

Collaboration Does Not Lead to Better Quality Research, which examined the citations of 2792 articles in 14 finance journals over a five-year period (Avkiran, 1997). He wrote that his results were "quite unambiguous in lending support to the hypothesis that there is no significant difference between the mean number of citations from multiple-author and single- author papers" (p. 178). Furthermore, he concluded with a call to academic appointments and funding allocations to "place less, rather than more emphasis on presence of collaborative research" (p. 182). Finally, Hart examined 542 journal articles from the *Journal of Academic Librarianship* and *College & Research Libraries* over eight years and found no evidence that "co-authorship leads to a higher quality article as measured through rates of citation…for articles from one of the journals (JAL), single authored articles were cited to a slightly higher degree than were co-authored articles" (Hart, 2007, p. 194). He concluded that there was "no compelling evidence that co-authored articles are of higher quality as measured by rates of citation" (p. 194).

3.4. Other correlations

Other positive correlations associated with collaboration have been studied, most notably author productivity (Fox, 1983; Harande, 2001; Pao, 1982; Price & Beaver, 1966). Other studies, such as Persson, Glanzel, and Danell (2004), however, argue that the increase is really in efficiency, not in personal productivity. Lee and Bozeman's (2005) fractional count study supported this idea. By examining the curriculum vitae of 443 academics and dividing the number of publication credits by the number of authors in each credit, the authors found little relationship. There has also been a positive correlation established between collaboration and funding allocation (Hart, Carstens, LaCroix, & May, 1990; Heffner, 1981; Pao, 1992; Price, 1981). And, as Bahr and Zemon (2000, p. 491) write, collaboration can be its own reward, a mechanism aimed at "alleviating the professional isolation" of many academics. Other researchers note benefits such as fostering teamwork or making efficient use of "scarce research funds" (Avkiran, 1997, p. 1981).

There is also little doubt that collaboration establishes networks and professional relationships, and aids in the sharing of knowledge and ideas. In addition, collaborative articles are likely to be read through multiple times by different individuals (the authors and those in the author's "editing network") and, as any writer can attest, another set of eyes is rarely a bad thing. Cronin et al. (2003, p. 856) put it rather well: "Collaboration is not a function of professional rank or status…teamwork pays off, whatever your place in the pecking order". However, these benefits are difficult to quantify. A writer is unlikely to record how many times an idea was shared, or retroactively keep track of all the professional advantages enjoyed through a relationship developed in the co-authoring of a paper. And, for every point there is a counter point: Avkiran (2003, p. 856)wonders, acerbically, if "a resume that is dominated by collaborative research publications can raise the question whether that person is capable of implementing the full research process without assistance".

Four decades of research has failed to bring to a conclusion. There is no reason to believe that continuing to examine the correlation between collaboration using only established metrics will yield anything but more disagreement. New metrics, used in tandem with existing methods, are required.

4. Methodology

Data were gathered from students in three sections of the same graduate course in the School of Library and Information Science (SLIS) at Indiana University during the spring and fall semesters of 2010. Each week, students in these classes were assigned a number of journal articles to read, and after class were encouraged to complete voluntary, anonymous questionnaires about the readings. All of the articles were made available to the students electronically via the university's online collaboration and learning environment. The surveys asked students to rank the articles on a scale of 1 (worst score) to 10 (best score) in three categories: overall quality, usefulness for discussion, and enjoyability. The respondents were encouraged to interpret these terms idiosyncratically. No explicit definitions were provided, meaning that variability exists to the same extent as subjective opinion. Additionally, students were asked to indicate whether or not the article should be kept on the following semester's reading list.

There were a total of 51 students enrolled in these courses with 772 questionnaires returned. To prevent skewing, the data were preprocessed, with articles receiving fewer than five student responses excluded. As a result, three single-author articles and three multi-author articles were removed from the data set. The remaining 758 questionnaires provided ratings for 42 articles, of which 23 were multi-author papers and 19 single-author papers, with 398 ratings for multi-author papers and 360 for single-author works. The articles are described in Table 1.

Table 1
Number of responses for single-author vs. multi-author articles.

TYPE	Single-author	Multi-author	Total
N	19	23	42
Mean	18.9	17.3	18
Median	19	13	16
Sum	360	398	758
Minimum	5	5	5
Maximum	37	42	42
Range	32	37	37
Std. deviation	11.0	10.5	10.6
Variance	121.9	86.3	102.2

4.1. Limitations

As a post-hoc study, the data collection portion did not have a hypothesis as a directing force. Rather than being a metric for assessing single- versus multi-author papers, the questionnaires were developed to improve future sections of the course by obtaining student feedback regarding the assigned reading list. The articles were not chosen because they were published in the most prestigious journals, or were the most cited. They were chosen because they fit in well with that week's discussion topics. It was only in an evaluation of these scores that the opportunity to conduct this study presented itself. Thus, the number of articles in each group is different. Also, and again due to the post-hoc nature of the study, the articles were not selected with publication dates in mind. Date of publication does affect citation, with very recently published articles unlikely to receive many citations. While none of the articles surveyed were published in 2010, 11 were published in 2009. The average publication date for single and multi-author articles is very close: June 2005 for single-author articles and March 2005 for multi-author articles. The distribution of articles by year, as well as ISI and Google Scholar citation counts, is shown in Table 2.

Table 2
Number of articles and citations by year.

Year	Number	Citations
1986	1	175
1989	2	148
1995	1	16
1998	1	3
2000	2	9.7
2004	2	8.14
2005	2	18.26
2006	8	10.6 (avg.)
2007	6	9.2 (avg.)
2008	7	5 (avg.)
2009	11	4.4 (avg.)

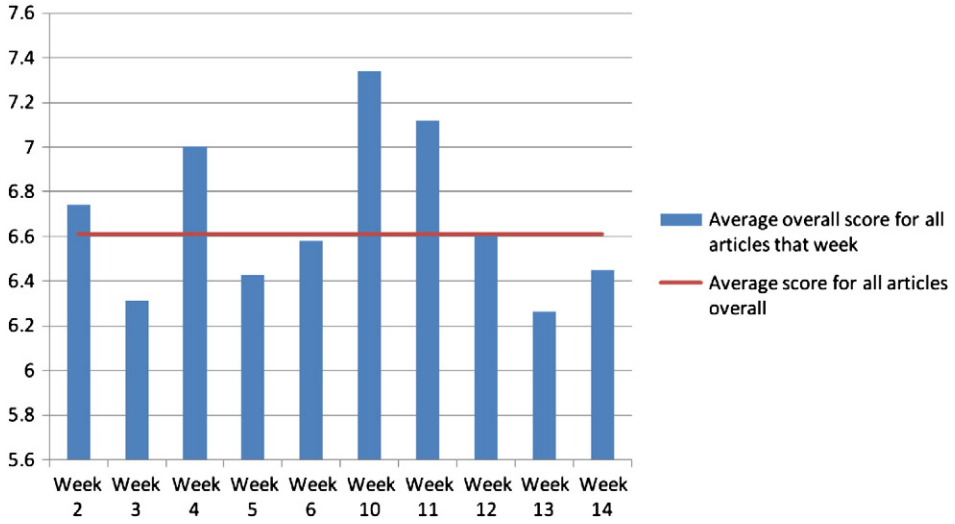

Fig. 1. Average overall scores by week compared with average overall scores for the entire semester.

Since response to the surveys was optional, certain factors (such as end-of-semester stress and looming deadlines) decreased the number of responses later in the semester. This did not appear to correspond to either a decrease or increase in average ratings (Fig. 1). Out of a possible 2142 possible surveys, 772 were returned producing a response rate of just over 36%. While there is a numerical gap between possible responses and actual responses, the response percentage does not preclude sound analysis. As Visser, Krosnick, Marquette, and Curtin (1996) pointed out, response rates nearer 20% may yield more accurate results than surveys with response rates of 60% or higher. Similarly, Keeter, Kennedy, Dimock, Best, and Craighill (2006) found no statistical difference between data gleaned from surveys with response rates of 25% and those with response rates of 50% or higher. In any case, the size response pool, similar number of single- and multi-author articles, and similar number of responses for each type of article made it possible to conduct the present study.

4.2. Analysis

For this study, the following null hypotheses were established:

HO1. There will be no significant difference between the quality ratings for single-author and multi-author articles.

HO2. There will be no significant difference between the usefulness ratings for single-author and multi-author articles.

HO3. There will be no significant difference between the enjoyability ratings for single-author and multi-author articles.

Articles were placed into one of two categories: single authorship or multiple authorship. The data were analyzed descriptively to examine differences in ratings by category, and for each component of the questionnaire. Lastly, the number of citations for each article was analyzed using ISI and Google Scholar to determine if this method produced similar results as existing quality metrics.

5. Results

The number of responses received varied by article, though the two overall subsets were roughly equivalent with single-author papers having a higher number of average responses (18.9) than multi-author papers (17.3). However, there were more total responses for multi-author papers: 398 versus 360. In terms of the number of responses, multi-author articles yielded a larger range than single-author articles, but a smaller median value. In addition, the number of responses to multi-author articles produced a smaller variance than single-author articles (Table 1).

5.1. Mean ratings of single- and multi-author articles

The results show that multi-author papers scored better than single-author in every category except usefulness (Fig. 2). In addition,

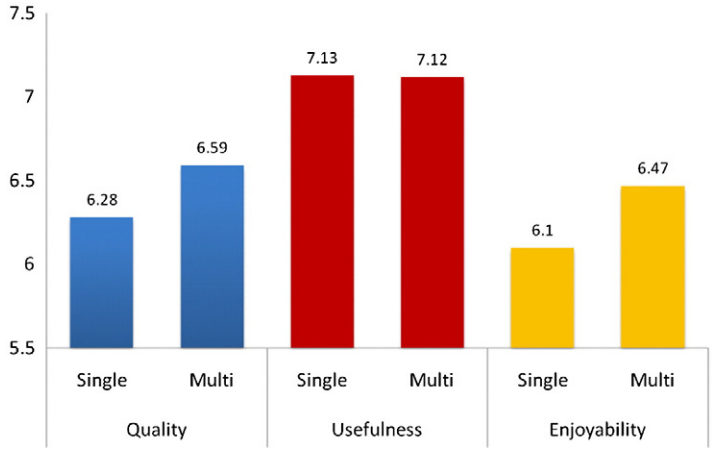

Fig. 2. Average ratings of single- and multi- author paper on quality, usefulness and enjoyability.

Table 3
Average rating of each paper.

Variable	Article	Mean	S.D	Variance
Quality	Single	6.3	1.12	1.27
	Multi	6.61	.99	.99
	Total	6.45	1.06	1.12
Usefulness	Single	7.13	.85	.72
	Multi	7.12	.76	.58
	Total	7.12	.79	.630
Enjoyability	Single	6.10	1.55	2.39
	Multi	6.47	1.06	1.12
	Total	6.27	1.29	1.66
Keep	Single	0.788		
	Multi	0.848		
	Total	0.819		

single-author papers had a higher standard deviation and variance in all categories, indicating comparatively greater quality consistency for multi-author papers, with the average quality score for all papers equal to 6.45 on the 0–10 Likert scale. Multi-author papers were rated slightly higher than single-author papers (6.61 and 6.3). The overall average usefulness (for discussion rating) was 7.12, with single-author papers receiving an insignificantly higher score than multi-author papers (7.13 and 7.12). In enjoyability, the difference between the two was more apparent—with multi-author journal articles rated at 6.47, and single-author journal articles at 6.1. The largest difference between the two sets was in the ratio of yes-to-no votes for keeping the article in the following year's reading list. Multi-author papers received a .848 yes-to-no ratio, while single-author works received a ratio of .788. These ratings are included in Table 3.

Correlations between ratings in quality, usefulness, and enjoyability were addressed to examine if any potential differences among these elements. The Spearman correlation for the three ratings indicated that all significantly correlated at the 0.01 level (see Table 4). This may indicate that issues of quality, usefulness, and enjoyability are all closely related in reader response.

5.2. Individual ratings of single- and multi-author articles

Each of the three hypotheses was analyzed using the Mann–Whitney test, which relies on the assumption of equal distribution of groups and is appropriate for use on ordinal variables.

The results in Table 5 show that although the single- and multi-author papers showed no significant difference regarding their distributions of usefulness, statistically significant differences exist in the areas of quality and enjoyability.[1] The results reveal a significant difference at the .05 level between the quality ratings for single-author and multi-author articles. As a result, null hypothesis $H_{O1:}$ "There will be no significant difference between the quality ratings for single-author and multi-author articles" is rejected and it is concluded that there is a significant difference between the quality ratings for single-author and multi-author articles.

There was no significant difference between the two groups as rated in usefulness for class discussion. The ratings for usefulness between the single-authored and multi-authored papers were not significantly different and $H_{O2:}$ "There will be no significant difference between the mean usefulness ratings for single-author and multi-author articles" is accepted.

In regards to enjoyability, the ratings for single-authored and multi-authored articles were shown to be significantly different at the .05 level. Therefore hypothesis H_{O3}: "There will be no significant difference between the enjoyability ratings for single-author and multi-author articles" is rejected, and it is concluded that there is a significant difference between the enjoyability ratings for single-author and multi-author articles.

Table 4
Spearman's *rho* of quality, usefulness, and enjoyability.

Authorship	Quality vs. usefulness	Quality vs. enjoyability	Usefulness vs. enjoyability
Single-author	.356**	.600**	.542**
Multi-author	.402**	517**	.575**
Overall	.376**	.560**	.559**

**Correlation is significant at the 0.01 level (2-tailed).

5.3. Comparison to citation counts

The final question was whether this method of analysis is redundant, given the various metrics currently employed in the single- versus multi-author debate. In order to test this, the citation counts of the 42 articles were collected from both ISI and Google Scholar. These two metrics are fundamentally similar, in that both are forms of personal response. The students would respond to perceived high quality, usefulness, or enjoyability by awarding that article with a high rating and a vote to keep it in the reading list. Since scholars largely respond to the same manner through citations, the use of citation analysis is widely accepted as a measure of research impact and quality. Thus, if the articles selected for praise in student evaluations were also found to be highly cited, it would render the new method superfluous, as it would be returning the same results as an already established metric.

It should be noted that in order to get a more comprehensive citation for each article, there are three citation counts for each article: the citation from Google Scholar, the citation from ISI, and the sum of these two. Tables 6 and 7 display the correlations between the mean quality rating, ISI citation counts, Google Scholar citation counts, and the total citation counts for single-author articles and multi-author articles.

As a whole, multi-author papers showed higher citation counts than did single-author papers. However, no significant correlation was found to indicate that the articles with the highest quality ratings were also the ones most cited. In addition, the 18 articles published in 2008 and 2009 are still likely to be collecting citations, and as such these numbers may change. Therefore, this analysis demonstrates that, when there is no significant difference in terms of citations received, the student response surveys provide an additional layer of analysis for determining differences between single- and multi-author papers,

6. Discussion and future research

Statistically significant differences were found between these articles in terms of quality and enjoyability. The results showed a higher variance and standard deviation for single-author papers in all

Table 5
Mann–Whitneytest.

Test statistics[a]			
	Quality	Usefulness	Enjoyability
Mann–Whitney U	64772.500	66779.000	61002.000
Wilcoxon W	129752.500	139550.000	122427.000
Z	−2.326	−.031	−2.010
Asymp. Sig. (2-tailed)	.020*	.975	.044*

[a] Grouping variable: paper type.
* Significant at the 0.05 level (2-tailed).

[1] According to the statistical theorem, as the sample size approaches 20, it is reasonable and convenient to treat the data as a normal distribution when interpreting Mann–Whitney test result. Therefore, if the Z score is between 1.96 and 1.96 under the .05 level (2-tailed), and between −1.645 and 1.645 under the .05 level (1-tailed), these two distributions are not significantly different.

Table 6
Descriptive data regarding ISI and Google Scholar citation counts of single- and multi-authored papers. (Type 1 = single author; Type 2 = > 1 author).

	Article type	*N*	Mean	Std. deviation	Std. error mean
ISI	1	10	5.60	12.877	4.072
	2	17	6.47	17.292	4.194
Google Scholar	1	15	11.00	26.595	6.867
	2	23	12.26	20.702	4.317

categories, which may suggest that there is a greater degree of agreement in rating multi- rather than single-author articles. The overall ratings for collaborative papers were, in other words, much more consistent. This may demonstrate value in using this technique to assess scholarship, particularly when that scholarship has use to multiple audiences.

The results of this study may provide evidence to support the observation by several scholars that collaboration in scholarship has had the unintended consequence of creating a neutral and anonymous tone of voice that has come to typify much current scholarship. As Cronin (2005, p. 48) wrote, "the recognizable voice of the individual author is being replaced by the sometimes pasteurized prose of the collaboration, reinforcing the already well-established 'conventions of impersonality' in scientific writing". Presser (1980, p. 96) succinctly hypothesized that it may eventually be determined that collaboration "leads less to producing very good papers and more to avoiding bad ones". Although collaborative writing may come to lack the occasional stylistic flourishes that signify this or that author's written voice, however, it may also be more consistent in terms of quality. The metaphorical blinders that may keep a solitary researcher from seeing a fundamental flaw in a painstakingly written piece of scholarship could be less restricting when multiple eyes and voices are present.

While significant differences were found in the ratings on quality and enjoyability, those regarding usefulness for discussion were virtually identical. According to the ratings, enjoyability was strongly correlated with both quality and usefulness. There was a less significant correlation between quality and usefulness, however, as articles rated low in the quality category were often rated high in usefulness. In fact, the two categories for single-author items have the lowest correlational analysis. This reinforces an element often utilized in pedagogical design: Low-quality articles are often more useful for discussion, as they provide examples for illustrating flaws in methods, design, analysis, or composition. Often, the longest class discussions centered on perceived flaws in methodology, design, or composition, and how those flaws might be fixed.

The comparison between citation counts and the quality scores generated by reader response indicates that this method can identify significant differences between single- and multi-author papers even when one is not discernable through other means. There was no correlation between article ratings and citation counts; the aspects of an article which students determined to equate positively with quality are not, apparently those which prompted scholars to cite the same set of articles.

Critics of this method may point out here that students are not yet experts in their field of study, while scholars are assumed to be so. However, there is some disagreement as to exactly what a citation means (Case & Miller, 2011). A citation can be positive or negative, a classification which requires context drawn from the content of the article itself. The reader response method does not demand such labor. Furthermore, it could be argued that journal articles should not be directed at and read by scholars alone, a practice that risks insularity, elitism, and tunnel vision. Student reader response allows us a method of quality analysis that avoids these dangers. This is not to suggest that this method be used in isolation to assess article quality. A multitude of approaches have been employed over the years to assess the impact of collaboration on scholarship. This method provides one more, and brings a holistic understanding of the phenomenon one step closer. No method of analysis alone can definitely affix a number to the quality of a particular piece of research. When applied in layers, the value of variety of methods may be seen. For example, reader response could prove especially useful when citation analyses return no significant differences between sample groups.

Overall, reader responses did correlate positively with multi-authorship. Multi-author works were more likely to receive a "keep" vote for continued inclusion in the reading list for the following semester. The simplest choice made available to students, it was also the most severe judgment that could be placed on a piece.

Future research should be aimed at altering the parameters of the research by choosing articles tailored for this research question, and perhaps examining differences by journal prestige and citation count. This will enable future researchers to control the sampled population according to accepted academic quality metrics. Articles should also be chosen with age in mind, to ensure that citation counts are not low due to recent publication. Definitions of each aspect of an article being rated should be more explicitly explained to the responders. Steps should be taken to encourage consistent rates of survey completion, to avoid the late semester decrease experienced by researchers.

Furthermore, conducting a reader response survey using articles examined in previous metric analyses might reveal certain research products that perform well according to both metrics. Such findings could reveal new aspects of scholarship that associate positively with impact or reader reception. A broad platform is provided for a myriad of future investigations into not only collaboration in scholarship, but other aspects, as well. What do student responders associate with quality? What do they associate with enjoyability? Does format (i.e., photocopy, e-reader, PDF) affect reader response? A study comparing multi-author papers to hyper-author papers is suggested as well, to better understand the consistency effect apparently supported here.

Table 7
Correlation between quality ratings and citation counts in individual articles.

	Mean quality	ISI	Google Scholar	Maximum
Mean quality	1			
ISI	0.292289574	1		
Google Scholar	0.291918382	0.940821	1	

7. Conclusion

A novel metric for rating article quality is proposed when other metrics are inconclusive, or for use by researchers seeking a more holistic understanding. In doing so, this provides further evidence for a positive correlation between collaboration in research and quality of published scholarship. In light of other incentives and positive correlates to collaboration (e.g., funding, productivity, acceptance rates), the case for collaboration appears stronger.

In addition, this metric gives researchers the ability to investigate various aspects of articles, such as usefulness or enjoyability, which have heretofore been difficult or impossible to quantify. The latter quality is not generally highly regarded as indicative of quality in a scholarly publication. However, a convincing argument in any of the literature as to why enjoyability is irrelevant was not to be found. Having established the ease with which a reader response survey may be undertaken given the graduate classroom as a laboratory, the number of possible applications is limited only by the imagination of the researcher.

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