



Web-based Citation Management Tools: Comparing the Accuracy of Their Electronic Journal Citations



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ARTICLE INFO

Article history:

Received 12 August 2014

Accepted 12 September 2014

Available online 29 October 2014

Keywords:

Bibliographic management

Citation generators

EBSCO Discovery Service

RefWorks

EndNote Basic

Zotero

ABSTRACT

Many students struggle when citing sources in their research papers and have turned to web-based citation tools in increasing numbers. In order to test the accuracy of the citations generated by these products, a sample of student-selected electronic journal articles was collected and MLA and APA citations for these articles were created using EBSCO Discovery Service's Cite tool, EndNote Basic, RefWorks, and Zotero. Although EndNote Basic, RefWorks and Zotero's APA citation error rates were significantly lower than that of EBSCO Discovery Service, none of the programs was capable of generating an error-free MLA electronic journal citation.

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INTRODUCTION

Works cited. Bibliography. Reference list. No matter the words used to describe them, these lists of research sources can inspire alternating feelings of confusion and frustration in students. According to a Project Information Literacy report, 41 percent of undergraduates surveyed expressed difficulty in knowing how to cite sources (Head & Eisenberg, 2010). In another survey, 13 percent of students indicated that citations were the most challenging aspect of research (Miller, 2013).

Many students, knowing the importance of citing their sources accurately, turn to bibliographic management tools for assistance. According to a 2012 EDUCAUSE study, the number of students using web-based citation/bibliography tools is five times greater than it was in 2010, with 80 percent of undergraduates surveyed indicating that they used these types of tools (Dahlstrom, 2012). The rising trend of web-based citation tool use among undergraduates continued in 2013 (Dahlstrom et al., 2013).

It has become clear, both from student admission and personal observation, that students at our online public university are also frequent users of web-based citation tools. Based on reference questions asked, as well as students' work in the library instruction exercises, many students appear to be relying on the citation feature available in EBSCO Discovery Service (EDS). While these generated citations follow the basic format for APA or MLA citations, they may be missing information, include incorrect information, or have formatting errors.

When the Library was undergoing its annual review of library resources and databases, librarians decided to review RefWorks, the library's current bibliographic management product, to see if the library should continue to support it, or if a free option, like Zotero or EndNote Basic, would better meet the needs of our students.

While these products were being assessed based on a number of factors, like ease of use and quality of support documentation, it seemed an opportune time to evaluate the accuracy of the citations these products generated, especially compared to those generated by EDS. As many students already use EDS for citations with mixed results, it was worth investigating whether one of the other three products could consistently produce more accurate citations and should therefore be recommended more heavily to our students. This study therefore examined APA and MLA bibliographies created using the citations generated by RefWorks, EndNote Basic, Zotero, and EDS to determine the frequency and type of errors each program's citations contained. These errors were studied to determine if any one citation product was able to consistently generate more accurate citations than those created by the other products.

LITERATURE REVIEW

Several articles have been written about bibliographic management products. Some have compared their features (Gilmour & Cobus-Kuo, 2011; Hensley, 2011; Ovadia, 2011), others have investigated their use among students (Emanuel, 2013; Salem & Fehrmann, 2013), or how faculty perceive them (Martin, 2009). However, relatively few publications have examined the actual accuracy of the citations generated from these products. Brahmi and Gall (2006) compared EndNote and Reference

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Manager's citations to the instructions provided for references by top medical journals. It was discovered that both programs had difficulties formatting the author, article title, journal title and punctuation according to the journals' standards (Brahmi & Gall, 2006).

Kessler and Van Ullen (2005) examined the accuracy of citations generated by NoodleBib, EasyBib and EndNote. The three products differed in the types of errors they generated, as well as in their handling of print and electronic sources, with NoodleBib having the lowest error rate.

BACKGROUND

Every year, the library reviews its current resources and services to make sure they are meeting the needs of students and faculty. During this year's review, it was suggested that perhaps RefWorks, the library's current bibliographic management tool, could be replaced with a free alternative that would still meet the research and citation needs of students and faculty. RefWorks, a subscription bibliographic management product, allows users to import references directly from library databases. These references can then be organized and shared, or added to bibliographies.

The free alternatives to RefWorks that were considered were Zotero and EndNote Basic. Zotero, a project of the Roy Rosenzweig Center for History and New Media at George Mason University, is a free reference manager that permits collecting, organizing, citing, and collaborating on documents (Roy Rosenzweig Center for History and New Media, 2014). Zotero supports thousands of citation styles, and functions within the Internet browser to capture reference information.

EndNote Basic is the free reference manager from Thomson Reuters (Thomson Reuters, 2014). EndNote Basic allows researchers to import references directly from library databases. Researchers can then organize and create bibliographies from these references, in the twenty most popular citation styles.

Zotero, EndNote Basic, and RefWorks were compared using a number of factors, including ease of use and installation, user support, and citation accuracy. This article will focus on the accuracy of the citations generated from the three citation managers, in comparison with the citations generated through the citing feature of EDS, which is commonly used by our students.

METHODOLOGY

To compare the accuracy of the citations generated by Zotero, EndNote Basic, and RefWorks, bibliographies were created in APA and MLA style. The reference sources used for these bibliographies were drawn from actual student research. When our librarians are invited into the online classroom for instruction, they upload an active learning exercise that focuses on creating a topical search statement and using it to locate an appropriate academic journal article. Once the students choose an article, they are asked to cite it using the citation style for their course, generally either APA or MLA. The student-selected citations from eight courses taught in the Spring 2014 semester were collected. The courses varied in subject area and included Writing, Asian Studies, Health Care Administration, Business and Management, Art History, Biotechnology, and Psychology. After duplicate and incomplete citations were weeded out, 47 unique journal citations remained.

The database record for each source was then located using EDS. Once each source was located in EDS, the Export tool was used to add the citation to the RefWorks and EndNote Basic web accounts created for this project. Each citation was imported to Zotero through the Chrome browser plug-in. The Cite tool in EDS was also used to create an APA and MLA citation for each source, to serve as a baseline comparison for this study. Many of our students use the citation feature within EDS when they complete the library exercise, so we wanted to compare the accuracy of the EDS-generated citations with those generated by

RefWorks, Zotero, and EndNote Basic to see if they could offer an improvement in citation accuracy.

After all citations had been added to RefWorks, Zotero, and EndNote Basic, APA and MLA bibliographies were created using each product. Each of these bibliographies, as well as the two created from the EDS citations, were compared to corrected MLA and APA citation lists that had been created using the citation formats for electronic journal articles outlined in the *MLA Handbook for Writers of Research Papers*, 7th ed. and the *Publication Manual of the American Psychological Association*, 6th ed., respectively.

Errors were categorized and recorded in an Excel spreadsheet. Errors were primarily categorized according to their location. The location of error categories referred to the specific section of the citation that was incorrect and consisted of author(s), date, article title, journal title, volume/issue number, page range, and access information (DOI or journal web address for APA; database name, method of access, and access date for MLA). If errors were present across multiple categories, all were recorded.

In addition to the primary categorization of error location, the citations were also studied for the specific type of error. The error type categories consisted of incorrect information, missing information, added information, and formatting errors. The formatting errors were further broken down into a range of categories, including capitalization, punctuation, and spacing. If a type of error occurred across multiple locations in the citation (i.e., both the article and journal titles were incorrectly capitalized), each instance of the error was counted. Additionally, if a single portion of the citation had multiple errors (i.e., authors' names spelled incorrectly and capitalized incorrectly), each type of error was counted. It was therefore possible for any given citation to have more errors when categorized by type than by location.

RESULTS

Errors were tallied and calculated for EDS, EndNote Basic, RefWorks, and Zotero, in both APA and MLA citation styles. Table 1 reveals that none of the four products was able to consistently generate error-free electronic journal citations. RefWorks, EndNote Basic, and Zotero each only generated two error-free APA citations, while EDS could not generate a single error-free APA citation. None of the four products was able to generate a single error-free MLA electronic journal citation.

Table 2 reveals the average number of errors per citation. All four tools averaged at least 1.5 errors per citation, based on the location of the error. EDS citations had the most errors across both categories, with over 2.5 errors per citation for both APA and MLA styles. RefWorks had the lowest average errors per citation for APA, with 2.0, and EndNote Basic had the lowest average errors per citation for MLA, with 1.83. RefWorks was significantly better at creating APA electronic journal citations than MLA ones, while EndNote Basic was significantly better at creating MLA electronic journal citations than APA citations. The differences between the MLA and APA error rates for Zotero and EDS were not significant.

RefWorks, EndNote Basic, and Zotero's average errors per APA citation are all significantly better than the error rate for EDS. Although RefWorks has the lowest number of average errors per citation, this average is not statistically significant when compared to the APA averages for EndNote Basic and Zotero at a 95 percent confidence interval.

For the MLA citations, EndNote Basic's error rate was significantly better than the error rate for EDS, RefWorks, and Zotero at a 95 percent confidence interval. However, as none of the products was capable of

Table 1
Number of error-free citations.

Citation style	EDS	EndNote Basic	RefWorks	Zotero
APA	0	2	2	2
MLA	0	0	0	0

Table 2
Average errors per citation.

Citation style	EDS	EndNote Basic	RefWorks	Zotero
APA	3.21	2.30	2.00	2.40
MLA	2.85	1.83	2.64	2.57

generating an error-free MLA electronic journal citation, this significance carries less weight.

Fig. 1 reveals where the errors occurred most commonly in the bibliographies for each citation product. All four products struggled with the volume/issue portion of the APA citation. EDS, EndNote Basic, and Zotero also had issues with the article title.

Fig. 2 shows where the errors occurred for the MLA citations across all four citation tools. EndNote Basic, RefWorks, and Zotero had the most difficulty with the access information portion of the MLA citations, while EDS had the most trouble with the article title portion of the citation.

Fig. 3 shows the APA errors by type. Formatting errors were the largest error type across all four citation tools. Even though Zotero, EndNote Basic, and RefWorks all retrieved their citation data from EDS, they showed fewer errors across every category than EDS.

Fig. 4 shows the MLA errors by type. While the same types of errors were generally made across all four products in APA style, the MLA errors show more variability. EDS and Zotero still made mostly formatting errors, but EndNote Basic and RefWorks had different areas of concern. EndNote Basic made most of its errors by including incorrect information—designating a source as “print” when it was a “web” source. RefWorks, on the other hand, was missing crucial information from its citations. RefWorks designated its sources as “web,” but did not include the database name or access date for any of the sources. Thus, though both RefWorks and EndNote Basic could not correctly replicate the access portion of an MLA electronic journal citation, their method of handling this portion of the citation resulted in different types of errors.

Table 3 shows the types of formatting errors occurring in the APA electronic journal citations. Capitalization, punctuation, and spacing are fairly self-explanatory. “Author name” refers to formatting errors, such as authors’ names being in the wrong order, or spelled out, instead of using initials. The “issue number” formatting error refers to an APA guideline dictating that issue numbers are only included for citations in which the journal is paginated by issue (*American Psychological Association, 2010*). The “Article URL” error refers to an article URL being provided in the access portion of the citation, rather than the DOI or the journal homepage URL. Finally, the “Italics” category refers to citations that italicized parts of the citation beyond the journal title and volume number.

Capitalization and issue number errors were the largest sources of formatting errors across the APA citations. RefWorks had less than half the capitalization errors of any of the other products. However, all four products struggled uniformly with formatting the issue number,

MLA Citation Errors by Location

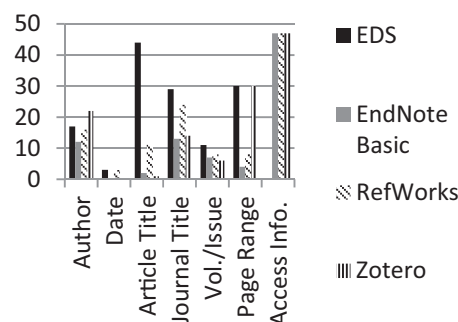


Fig. 2. MLA citation errors by location.

because they largely replicated the information provided by EDS. In the majority of error categories, EndNote Basic, RefWorks, and Zotero were able to lower or maintain the number of errors from the EDS citations.

Table 4 shows the types of formatting errors occurring in MLA electronic journal citations. Capitalization, punctuation, spacing, author name, and italics formatting errors all occurred in MLA citations as well as APA citations. However, there were some formatting error categories that only applied to MLA citations. The “page numbers” formatting error refers to citations that did not adhere to MLA guidelines for shortening page ranges over 100. The “journal title” category designates citations that did not adhere to MLA title formatting conventions, such as removing the initial article from titles. Table 4 shows that EDS electronic journal citations continue to be plagued by capitalization errors, and that MLA conventions for formatting page numbers were also a problem. The page number formatting was less of a problem for RefWorks, and posed no challenge for EndNote Basic. Zotero, on the other hand, had the same problem with page numbers that EDS did. It is worth noting that many of the MLA formatting errors were introduced in the EDS citation, then simply replicated across the other three products’ citations. In several cases, EndNote Basic, RefWorks and Zotero were able to improve upon the formatting errors introduced by EDS. However, RefWorks somehow introduced more errors with the handling of authors’ names than were present in the EDS citations, and Zotero introduced more punctuation errors than were present in the EDS citations.

DISCUSSION

Comparing the errors generated by the four citation tools quickly reveals that none of them is capable of consistently creating perfect citations. Many of the errors generated by RefWorks, EndNote Basic, and Zotero were a result of the data they imported from EDS. For several

APA Citation Errors by Location

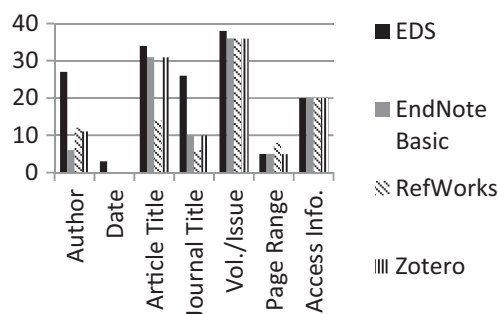


Fig. 1. APA citation errors by location.

APA Citation Errors by Type

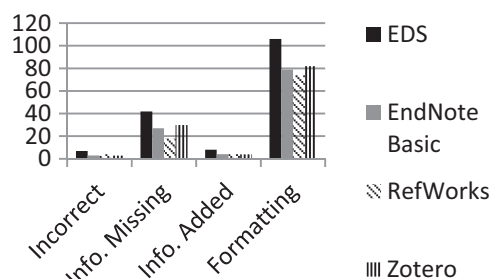


Fig. 3. APA citation errors by type.

MLA Citation Errors by Type

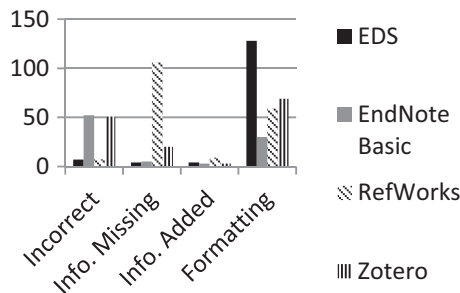


Fig. 4. MLA citation errors by type.

of the journal articles used in this study, EDS had records with the entire article title capitalized, or only the first initial of an author's name listed, even if the article itself showed the author's entire first name. Therefore, the bibliographic managers could only do so much to correct the incomplete or incorrect data they were given. However, throughout the course of this study, it became apparent that EDS had updated certain database records. For example, certain article titles that had formerly been displayed in all capital letters were corrected, which necessarily improved the data with which the citation managers could work. This indicates that the citations generated from all four products may continue to improve as EDS updates and corrects database records.

Despite working with sometimes flawed data, all three citation managers were largely able to improve upon the EDS-generated errors. In the case of APA citations, RefWorks actively attempted to use sentence capitalization for article titles. RefWorks manually changed capitalized words in the article titles into lowercase ones when it generated citations, leaving only the first word of the article title and the first word of the subtitle capitalized. This led to a lower number of capitalization errors than was evidenced by the other products. However, this attempt to correct the errors in the data generated problems of its own. The RefWorks bibliographic manager was unable to identify proper nouns, which meant that it routinely un-capitalized words that should have been left capitalized. While the other products habitually over-capitalized article titles in APA style, RefWorks went to the other extreme and did not capitalize enough. Issues with capitalization were less pronounced in the MLA citations, which do not adhere to sentence capitalization style.

The other major areas for errors in both MLA and APA citations were the access information portion of the citation. For APA, none of the products knew how to handle an electronic journal citation if no DOI was given. According to APA style, if an article lacks a DOI, the citation should then include the web address for the journal's homepage (American Psychological Association, 2010). RefWorks attempted to provide a direct link to the article in the database, which goes against APA guidelines. Zotero and EndNote Basic essentially treated articles without a DOI as print articles, leaving out the access portion of the citation entirely. EDS followed the same tack, including the DOI if available and otherwise leaving out the access information entirely. This particular aspect of APA electronic article citations has proven challenging for students

Table 3
APA formatting errors.

	EDS	EndNote Basic	RefWorks	Zotero
Capitalization	61	40	14	39
Punctuation	3	1	2	2
Spacing	5	1	0	0
Author name	4	4	5	7
Issue number	33	33	30	33
Article URL	0	0	20	0
Italics	0	0	3	0

Table 4
MLA formatting errors.

	EDS	EndNote Basic	RefWorks	Zotero
Capitalization	73	10	25	9
Punctuation	8	2	4	18
Spacing	4	1	1	1
Author name	9	9	11	7
Page numbers	26	0	7	26
Journal title	8	8	8	8
Italics	0	0	3	0

to master, and none of the citation generators was able to consistently implement it correctly, either.

The MLA access information provided different challenges. For MLA citations, no DOI is used. Instead, the citations contain the name of the database from which the article was drawn, "web," and the access date (Modern Language Association of America, 2009). EDS was the only product to generate zero errors in the access portion of the citation. It reliably included the name of the database from which the article was drawn, along with "web" and the access date for each of the 47 citations. Zotero, RefWorks, and EndNote Basic all seemed incapable of importing this access information from EDS. Yet each of the three products handled this situation a bit differently. EndNote Basic defaulted to print citations for all of the articles, thereby negating the need for a database name or access date. These citations, while incorrectly representing the medium consulted, would look correct to anyone who did not know the electronic version of the article was used.

Zotero also defaulted to print citations for some articles, though others were treated as electronic sources with the generic "Ebscohost" listed as the database accessed for each of them. RefWorks uniformly represented the resources as electronic by including "web" in the citation, but failed to include a database name or access date for any of them. These RefWorks citations, while correctly representing the medium consulted, at first glance might actually appear more incorrect than the citations generated by EndNote Basic because they are missing several necessary aspects of an electronic article citation.

This dichotomy between a citation looking correct and actually being correct is important to note. The citations in this study were judged quite strictly according to MLA and APA guidelines. However, there are indications that instructors grading the quality of citations might have found some of the errors noted in this study acceptable. For example, Martin (2009) found that fewer than 45 percent of instructors would reduce a grade due to citation formatting errors. Therefore, the formatting errors that were noted in this study might not have actually resulted in a penalty had students submitted the citation in their work. For example, APA style dictates that the issue number of a journal only be included in the citation if the journal is paginated by issue (American Psychological Association, 2010). This was a common formatting error in the citations in this study, yet it is unlikely that students who include the issue number in their APA citations would actually have those citations marked wrong. Similarly, the MLA citations had frequent errors related to formatting journal titles. Again, it is debatable whether these types of formatting errors would actually result in students being penalized. Discounting these types of formatting errors would result in lower error rates across the four citation tools.

The error rate for EDS is high enough that it suggests librarians should do more to educate our students about the dangers of simply copying and pasting the citations generated by its citation tool. Although the Library offers citation tutorials as part of its in-class instruction, it is clear from the students' work that many are using the citation generator in EDS, rather than creating the citations on their own. They seem to be unaware of just how often these citations are incorrect.

This study reveals that, generally, the students would be better off using Zotero, EndNote Basic, or RefWorks than EDS to generate their APA citations, though none of these products is perfect. For MLA electronic journal article citations, students may be unable to generate an

error-free electronic journal article citation using any of the products tested in this study, so it is especially important that they understand how to put the citations together themselves—or at least know to turn a more discerning eye to the citations generated by these products.

CONCLUSION

Examining the accuracy of the citations generated by RefWorks, EndNote Basic, Zotero, and EDS was done in conjunction with the Library's annual database evaluation. Yet the results of the study could not argue persuasively for the Library supporting one product over the others, based on accuracy alone. RefWorks had the lowest average error rate for APA citations, but this error rate was not statistically significant when compared to the two alternatives, EndNote Basic and Zotero. EndNote Basic had the lowest error rate for MLA citations, and although this was statistically significant compared to RefWorks and Zotero, this significance was overshadowed by the fact that none of the products was able to generate an error-free MLA electronic journal article citation.

These results may prove instructive for the Library's instruction efforts. Although students are shown how to construct citations in the Library's instruction exercises, it is clear from the students' submitted citations that many of them are using the EDS Cite tool, which was the least accurate of the products examined in this study. Students seem unaware that these citations could contain errors, so it is a cue for our librarians to reiterate that these citations must be proofread carefully before they are added to students' bibliographies. Additionally, by examining the errors by location and type, we can emphasize which areas are likely to be incorrect, so students know to pay special attention to areas like capitalization and access information.

Currently, none of products in this study can consistently generate error-free electronic journal citations. These flawed citations are likely due to a number of factors, but the fact remains that the four products examined in this study all averaged at least 1.5 errors per citation, in both MLA and APA electronic journal citations. Students' preferences for these automatically-generated citations indicate that they may not be aware of how many inaccuracies these citations can contain.

FUTURE RESEARCH

This study focused on electronic journal article citations because these are the citations our students predominately use in their library exercises. However, it would be instructive to repeat this study with other types of electronic sources, for example, e-books, to see if the bibliographic management products were better able to handle these types of sources.

It would also be worthwhile to examine other major database vendors' citation tools. This study examined EDS because it is the Library's major discovery tool and is used frequently by our students. However, other libraries that use different vendors' products could study whether these products could better match the citations generated by dedicated bibliographic management products like RefWorks, EndNote Basic, and Zotero.

Finally, this study examined citations that had been prepared using the export feature of EDS. There was therefore no need to manually enter any data into the three bibliographic management products. By skipping this step, human error did not enter into the equation. It could be instructive to examine the quality of citations generated by RefWorks, EndNote Basic, and Zotero when the data is input by students, rather than exported from another database.

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Appendix list of citations studied

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