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Sampling Bias: Full-Text Online Databases and Article Selection

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Abstract

The purpose of this study was to examine the affect of full-text online databases on graduate education students' article sampling and selection. Students were surveyed regarding article retrieval behavior and the reason(s) for most utilized method of retrieval. Results of the study indicated that students retrieved significantly more articles full-text online. The significantly higher rate of full-text utilization created a sampling bias that systematically precluded sampling from the full-content universe (i.e., content population). Data also indicated proportions of articles retrieved full-text online did not differ based on time impediments. Qualitative responses revealed that students who relied on full-text online articles identified convenience as the most common reason for its use. Implications for teacher educators and scholars are presented, as well as suggestions for future research.

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Literature Review

According to Jackson, Brook, and Sisk (1999), college students in professional schools often struggle to allot time for academic tasks involving article retrieval and research reviews. As a result, students place high value on convenience. Rapid advances have increased the availability of convenient electronic sources, including full-text databases (DiMartino & Zoe, 1996). The magnitude of growth was reflected in the addition of more than 40 million documents to full-text online systems between the years of 1983 and 1993 (Tenopir & Burglund, 1993). McDonald and Dunkelberger (2000) purported that increased availability of full-text databases has created greater expectations for access to full-text information among college students.

Use of full-text online databases has been associated with several positive, as well as negative aspects involving search-behaviors and literature exposure. Convenience reportedly contributes significantly to increased use and overwhelming satisfaction with full-text systems. A study conducted by Bane (1995) examined the satisfaction of 140 predominantly graduate students who utilized a full-text database for research projects. Results of the study reflected strong satisfaction with the full-text system, as well as several system attributes including ease of use, timely access, immediate information on relevance, speed, and access to a large number of journals. Positive attributes such as these have lead many to identify full-text databases as the preferred method of search for students and database users (McDonald & Dunkelberger, 2000; York, Sabol, Gratch, & Pursel, 1988).

Despite their popularity, full-text databases have several shortcomings. For example, full-text systems have been found to contain content inaccuracies, poorly linked or missing graphics, indexing weaknesses (Grzeszkiewicz & Hawbaker, 1996), and incomplete articles with missing data (Ebbs & Preston, 1997). The limited number of articles available full-text also represents a significant weakness. According to Carlson (2001), only six percent of academic journals are currently available online. Full-text users in the Bane (1995) survey noted this limitation and reported only 50% of articles available in full-text form. At present, articles contained in full-text databases constitute only a small portion of the available content, as many are not available in full-text form (Ebbs & Preston, 1997). Both the quality and quantity of research exposure are negatively affected. Consequently, student reliance on the current full-text systems may result in inadvertently compromised learning experiences.

Several studies have begun to investigate this issue by examining retrieval behaviors and literature exposure of database users. McDonald and Dunkelberger (2000) studied undergraduate search-behavior and found students equally as likely to limit their search to only full-text databases, as they were to use any of the other non-full-text databases. Additionally, two-thirds of the sample reported always, almost always, or occasionally limiting searches to full-text only. The authors described the results as troubling as students failed to consider other journals in the library. Results of this study were similar to those of a study conducted by York et al. (1988) that found 31% of database users expressed an unwillingness to use other sources for research materials.

Similarly problematic has been student willingness to modify research topics to fit the information available in full-text databases. Research by Bane (1995), and McDonald

and Dunkelberger (2000) found undergraduate and graduate students often changed research topics according to materials contained in full-text databases and disregarded relevant information if unavailable in full-text form. Results of these studies have lead some to assert that students are increasingly demonstrating an uncritical acceptance of articles in full-text databases (Momenee, 1987). Tenopir (1999) examined survey responses completed by 58 of 100 randomly selected librarians and found the availability of full-text to be of utmost importance for online searches: “full-text often overrides all other factors, in particular for undergraduates” (p. 38). Further, librarians reported that college students frequently rely on databases recommended by peers, rather than seeking the most appropriate database.

Uncritical acceptance can have negative affects including the selection of lower quality articles. Jackson et al. (1999) examined 798 articles utilized by graduate students for a research project before and after the introduction of a full-text database. Results indicated that the number of scientific articles used declined from 27% to 15% over the three-year period, while the number retrieved online increased from 8% to 30%. The authors suggested that the availability of online databases reduces the quality of journal articles used by graduate students.

As currently utilized, availability of full-text databases may have reduced rather than expanded student exposure to quality research articles. The problem can be conceptualized using research terms. Literature reviews should be based on a comprehensive sample selected from the content universe (i.e., population). This process is governed by the principles of sampling. Of critical importance in research is the selection of a sample that reflects the larger population or content universe. While

sampling is often described in terms of individuals, samples and populations technically consist of observations (Heppner, Kivlighan, & Wampold, 1999). In the case of literature and research reviews, populations and samples are composed of the articles available and those selected for review respectively. According to Borg and Gall (1989), the “method of selecting a sample is critical to the whole research process” (p. 215). Selection from a restricted sample significantly diminishes results of a study and can substantially weaken the validity of a review by introducing bias. Students who utilize only full-text databases for research reviews often present their research as if they are relying on the entire content universe for a given topic.

Although existing literature indicates that college students express a preference for, and satisfaction with, full-text databases, limited empirical evidence exists comparing articles retrieved using full-text and non-full-text methods. Bane (1995) indicated that published research on the impact of databases is needed due to the popularity of this research tool. Studies examining the sampling and retrieval behaviors of graduate students are also lacking. The behavior of graduate students is of interest as Tenopir (1999) has suggested that advanced users might demonstrate retrieval behaviors that differ from others. According to McDonald and Dunkelberger (2000), “the greatest fear ... is that students might be too eager to take the easiest route and be satisfied with whatever article they find online, instead of the ones more ideally suited to their research” (p. 305).

Method

Sample

The sample for the current study consisted of 191 graduate students enrolled in a graduate education program in Western New York. Professors in the education department were invited to offer participation to students in their graduate courses. Only courses that required assignments involving research reviews were invited to participate. Based on this criterion, participation was offered to 206 graduate students from a variety of courses in the teacher education program. From the population of 206 eligible students from 13 classes, 191 usable surveys were completed. This represented a 92.7% completion rate.

Participants ranged in age from 21-52 years. Although the age range varied substantially, 77.5% were between the ages of 21 and 30, and the overall median age 25 years. Due to the college's close proximity to the Canadian border, information was also collected on country of citizenship. The sample consisted of 169 Canadian students (88.5%), 21 American students (11%), and one student identified as "Other" (.5%). Course sections meeting the inclusion criterion were given an invitation and briefing one class period prior to administration of the survey.

Instrument

The instrument used in the current study was a survey, a method of examining research behaviors recognized and common in studies involving computer and database use (McDonald & Dunkelberger, 2000). The anonymous survey was researcher-generated, consisted of 12 items, and required approximately 15 minutes to complete, including review of the implied consent form. Survey items included background

demographic information, number of articles retrieved using one of two methods, and the reason(s) for retrieval method preference. Background demographic items included data on participants' age, college rank, academic department, citizenship, and type of assignment on which the survey responses were based. Several items on the survey also gathered information on time impediments that affect time availability. These included items involving employment, number of hours employed, children, number and age(s) of child(ren), and number of hours per week spent commuting to and from college classes. An additional item was included on the settings where participants had online access.

Two items were used to answer the primary research questions involving sampling bias in retrieval methods and the reason(s) for method preference. A three-part item was used to gain specific information on the students' self-reported method of article retrieval. Specifically, participants were required to identify the "Total Number of Articles Obtained Using Full-Text Online Databases," "Total Number of Articles Obtained Using a Library/Academic Setting," and the "Total Number of Articles Reviewed" overall. This last category represented the sum total derived by adding the number retrieved using both online and library/academic settings.

In order to assess "why" students' utilized one particular method of retrieval, an open-ended item was included. For this item, participants were required to provide a reason(s) for using one method for the "majority" of their articles. Participants were instructed to provide a reason(s) for the method that constituted the "majority" of the articles only, unless the number of articles was evenly split between retrieval methods. "Majority" was operationally defined as more than 50% of the total articles obtained.

Procedures

Graduate school of education faculty were invited to offer participation to students in their courses. Faculty were informed that students were eligible to participate in the survey if the course(s) included a research proposal, research paper, article critique(s), or other assignment that required a research review. Courses in which full-text online sources were prohibited were not eligible. A total of 13 course sections met inclusion criterion.

One class period prior to formal administration of the survey, a scripted invitation letter was read to eligible students by the course professor. The scripted letter provided an overview of the study, and indicated that participants would need to review their references in order to accurately identify the number of articles retrieved by either going to a library/academic setting or using an online full-text database. Students were also informed that participation was voluntary and anonymous, and that non-participation would not affect course performance/grade. During the invitation session, an operational definition of each retrieval method was read aloud. In addition, each student was given a written operational definition of what constituted an article retrieved using an online full-text database and what constituted an article retrieved in a library/academic institution (i.e., non-online full-text).

The following class meeting, researchers administered the formal survey. Course professors were required to leave the classroom to avoid potential coercive influence. The letter of implied consent was read aloud by the researcher prior to administration of the survey. Students were informed that completion of the survey constituted implied consent. Each researcher then read an administration script verbatim to each course

section. Researchers read general directions, as well as each item aloud to ensure comprehension and accuracy. Verbatim invitation and administration scripts were used to increase reliability across administrators.

Results

Quantitative and qualitative methods were used to determine whether graduate education students demonstrated a sampling bias, and if so the reasons for the bias. Two primary statistical procedures were employed to examine the data. Initially, mean scores were compared for actual number of articles retrieved using full-text online or library/academic setting. Analyses of variance were then conducted to determine whether the proportion retrieved using full-text online differed based on demographic characteristics and/or time impediments. Qualitative responses were then used to determine the reason(s) “why” students utilized a particular sampling method.

Mean scores were initially compared for actual number retrieved. Results of the t-Test (Table 2) indicated a significant difference in the number of articles retrieved using each method, $t(109)=9.54$, $p<.001$. A significantly higher number was retrieved using full-text online than library/academic setting.

Due to variability in number of articles retrieved resulting from differing assignments (e.g., fewer for article critiques compared with research proposals), proportion of articles retrieved full-text online was used for subsequent analyses. Several types of demographic data were collected including Demographic Characteristics (Yes/No), Categorical Characteristics, and Cumulative Number of Time Impediments (Table 3). Three ANOVA's were conducted to determine whether demographic factors were associated with the proportion of articles retrieved full-text online (Table 4).

Results of the ANOVA for Proportion x Demographic Characteristic (Table 4) indicated non-significant differences in proportions of full-text online retrievals for Employment, $F(1,181)=.041$; Children, $F(1,181)=.668$; Home Access, $F(1,181)=.176$; College Lab Access, $F(1,181)=.153$; Library Access, $F(1,181)=.246$; Employment x Children, $F(1,181)=.169$; and Home x College x Library, $F(3,181)=.363$. These results indicated that graduate students in the sample demonstrated similar proportions of full-text online retrievals regardless of whether they indicated Yes or No to these demographic characteristics.

Additional items gathered information on actual numbers of children, hours employed, hours commuting, and locations of computer access (Table 3). Responses to these items were categorized for comparison purposes. Specifically, Children was categorized into subjects with or without; Employed into zero hours per week, 1-20 hours per week, and 21+ hours per week; Commuting into fewer than four hours, four to six hours, and more than six hours; and Computer Access into access in one setting, two settings, or three settings. Results of the ANOVA for Proportion x Categorical Characteristic (Table 4) indicated no significant differences in proportion of full-text online retrievals for Children, $F(1,183)=.411$; Hours Employed, $F(2,183)=.071$; Hours Commuting, $F(2,183)=1.287$; and Computer Access, $F(2,183)=.280$.

A final ANOVA was conducted to examine the cumulative affect of increasing numbers of impediments on full-text online proportions. Results of the ANOVA (Table 4; Proportion x Time Impediments) indicated no significant affect for number of impediments, $F(5,174)=1.97$. Specifically, proportions of articles retrieved full-text

online were not significantly affected by the presence of more or fewer time impediments.

Subjects were also required to indicate the reason(s) for using one retrieval method for the majority of articles. Qualitative responses were categorized to reveal several common reasons for retrieval method preference. A total of 27 surveys were excluded from qualitative analyses due to subjects reporting an even split between retrieval methods. From the remaining surveys, a total of 303 qualitative responses were analyzed and categorized. Subjects provided between one and four reasons for method preference, with the average number per subject 1.85. For students who utilized full-text online for the majority, four distinct categories emerged including convenience; online selection was greater, better, or at least as good; library deficiencies; and poor library skills. A total of 273 responses were given for full-text online preference. Approximately 78.75% of responses involved convenience, 10.98% indicated that online selection was greater, better, or at least as good, 6.59% cited library deficiencies, and 1.46% noted poor library skills. Six responses (2.19%) were unable to be categorized.

For students who utilized the library/academic setting for the majority of retrievals, a total of 30 responses were provided. These fell into three categories including setting characteristics (ease, support, and familiarity), online full-text inadequacies, and printing. Approximately 63.33% of the responses involved setting characteristics, 23.33% online full-text inadequacies, and 13.33% printing explanations.

Discussion

Results of the current study strongly indicated a sampling bias in favor of full-text online sources among those in the study. This finding empirically validates previously

noted concern involving the potential negative affect of full-text online resources on literature selection of college students (e.g., Bane, 1995; McDonald & Dunkelberger, 2000). Specifically, graduate education students in this study reported a significantly higher number of articles retrieved using full-text online databases over articles obtained at a library/academic setting (non-full-text online).

Examination of the number of full-text online articles indicated that students reported approximately 75% of all retrievals from full-text online sources. This result is consistent with previous research that found undergraduate and graduate students expressed a preference for full-text databases (Jackson et al., 1999; McDonald & Dunkelberger, 2000). Although some have suggested that more advanced users, such as graduate students, might utilize different retrieval behaviors (Tenopir, 1999), the current sample of graduate education students demonstrated a similar sampling preference to that of undergraduate students.

Additional comparisons were conducted on variables that commonly affect time availability including employment, number of hours employed, children, number of children, and hours commuting to and from college classes. Access to computers was also examined to determine whether increased access affected the proportion of full-text retrievals. For students in the current study, the proportion of articles selected full-text online was similar across all time availability categories, as well as the number of settings in which students had computer access. This result is significant as students with few or no time impediments demonstrated a similar sampling bias toward full-text online retrievals as students with many time impediments. Lack of association between time availability and full-text proportions suggested that the sampling bias was pervasive, and

not contingent upon time impediments. Students also failed to differ in proportion of online retrievals based on number of locations for computer access.

The sampling bias toward full-text online databases is significant as only six percent of academic journals are currently available online (Carlson, 2001). At present, full-text databases do not possess the volume of articles needed to represent the content universe (i.e., population of articles). Of those in the study, 45.5% (n=87) used only full-text online articles, whereas only 8.4% (n=16) used library/academic articles exclusively. Students who relied on full-text online sampling restricted the available articles to a limited sample that was significantly smaller than the overall volume of existing information. This type of sampling behavior is systematic and excludes the majority of available resources. As previously noted, observations that systematically differ from the population represent a biased sample (Heppner, Kivlighan, & Wampold, 1992). This systemic sampling bias is additionally concerning as Jackson et al. (1999) found full-text use to be associated with lower quality journals and fewer scientific studies in literature reviews.

Additional evidence of sampling bias was expressed in response to the open-ended item requesting a reason(s) for using one method of retrieval for the majority of articles. For students who used full-text online articles for the majority, convenience was by far the most common reason noted (i.e., 78.75% of all responses). This result is consistent with numerous studies that found convenience to be central to student retrieval behavior (e.g., Bane, 1995; Tenopir, 1999; Joswick & Stierman, 1997). Reliance upon full-text databases because of convenience suggested that participants were content to use the articles available in full-text form. According to Gay (1987) and Borg and Gall

(1989), the use of samples merely because they are available is a common, but substantial error in research. At present, articles available through full-text online databases constitute a restricted and limited sample of the existing literature. Interestingly, 10.98% of respondents indicated that the online selection was greater, better, or at least as good as the overall available information.

Graduate education students in the current study appeared largely unaware of the limitations of full-text online databases, and if aware were willing to settle for the articles available in full-text form. The large number of responses indicating convenience as a reason for use appeared to place significantly greater value on convenience over other factors including content. Results of the current study provide empirical support for Jackson et al. (1999) contention that full-text databases promote convenience over other research factors such as content and quality. Whether resulting from lack of awareness of limitations or need for convenience, the graduate education students in the current study demonstrated a systematic sampling approach that was indicative of a sampling bias.

The current study has significant implications for teacher educators, as well as graduate students. The demonstrated sampling bias requires careful attention, as students will likely continue to fail to access and review critical information not available in full-text online form. Teacher educators can address the issue of sampling bias by restricting the number of allowable articles retrieved from full-text databases. Students can also be required to hand in photocopies of actual articles to ensure adherence to full-text limitations. These externally imposed parameters will help facilitate sampling from a larger content universe and increase student exposure to a broader range of available scholarly work.

In addition to externally imposed full-text restrictions, students can be educated on the limitations of full-text databases. Strategies for conducting comprehensive and representative literature reviews will promote more thorough sampling of the existing content universe. Sampling and sampling bias instruction should also be emphasized such that students understand the implication associated with biased and restricted reviews. This is particularly relevant to the field of education as sampling bias has been identified as one of the factors that weaken educational studies more than any other (Borg & Gall, 1989). Careful instruction and externally imposed restrictions on full-text sources are two strategies that might generate more balanced and representative literature exposure.

According to Bane (1995), students must be monitored to avoid habits that lead to poor research, and be guided to appropriate sources. Student pursuit of convenience poses a significant challenge to the development of solid research skills. The recommendations noted above address McDonald and Dunkelberger's (2000) caution that college faculty need to guard against full-text dependence so "classroom assignments and research do not suffer" (p. 303). Although results of the current study justify concerns over literature sampling among graduate education students, they also provide direction to college faculty seeking to train highly informed and skilled professionals.

Although results of this study indicated a selection bias in literature sampling and exposure of graduate education student, several limitations warrant mention. The sample was composed of graduate education students from a single college only, making generalization to other colleges and disciplines inappropriate. In addition, a large portion of the sample consisted of Canadian students, further limiting generalizations. Based on these limitations, further research is needed. Future research might expand the sample to

overcome the potential limitations previously noted. Comparisons across academic disciplines might also prompt changes in focus and research behaviors taught to students in areas where sampling biases are identified. Additional research involving the literature sampling behaviors of professors and scholars would also be of interest as biased practices among that population have significant implications for the future direction of research and knowledge. Based on increasing reliance on electronic tools, there is an urgent need for research examining the impact of technology on research behaviors (DiMartino & Zoe, 1996).

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