

# Information Literacies of PhD Students in the Health Sciences: A Review of Scholarly Articles (2009 - 2018)

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Article abstract

**Objective** – Doctoral studies offer a unique phase in the development and legitimization of researchers, in which PhD students shift from the consumption to the production of knowledge. If librarians are to support this process in an evidence based manner, it is essential to understand the distinct practices of this user population. While recent reviews exist concerning the information behaviours of graduate students and researchers, there is little knowledge synthesis focused on the information literacies of PhD students in specific disciplines. The aim of this article is to explore the depth and breadth of recent evidence which describes the information literacies of students pursuing a doctoral degree in the health sciences.

**Methods** – Strategic searches were performed in databases, hand-searched key journals, and reference lists. Records were screened independently by both authors based on pre-determined criteria. General trends within the literature were mapped based on the extraction of the following data: geographic location, population, study aims, and method of investigation. Further analysis of the articles included charting the academic disciplines represented, summarizing major findings related to PhD students in health sciences, and which databases indexed the relevant articles.

**Results** – Many studies fail to treat doctoral studies as a unique process. PhD students are often grouped together with other graduate students or researchers. Studies tend to be based on small populations, and the number of PhD students involved is either unclear or only equals a few individuals within the entire group of study. In addition, of the limited number of studies which focus exclusively on PhD students, few conduct explicit examination of information practices in the health sciences. The result is that this user group is underrepresented within recent journal publications.

**Conclusion** – This review highlights the need for more primary, in-depth research on the information literacies of PhD students in the health sciences. In addition, librarians are encouraged to share their knowledge in scholarly publications which can reach beyond their own professional circles.

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*Review Article*

**Information Literacies of PhD Students in the Health Sciences: A Review of Scholarly Articles (2009 - 2018)**

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**Abstract**

**Objective** – Doctoral studies offer a unique phase in the development and legitimization of researchers, in which PhD students shift from the consumption to the production of knowledge.

If librarians are to support this process in an evidence based manner, it is essential to understand the distinct practices of this user population. While recent reviews exist concerning the information behaviours of graduate students and researchers, there is little knowledge synthesis focused on the information literacies of PhD students in specific disciplines. The aim of this article is to explore the depth and breadth of recent evidence which describes the information literacies of students pursuing a doctoral degree in the health sciences.

**Methods** – Strategic searches were performed in databases, hand-searched key journals, and reference lists. Records were screened independently by both authors based on pre-determined criteria. General trends within the literature were mapped based on the extraction of the following data: geographic location, population, study aims, and method of investigation. Further analysis of the articles included charting the academic disciplines represented, summarizing major findings related to PhD students in health sciences, and which databases indexed the relevant articles.

**Results** – Many studies fail to treat doctoral studies as a unique process. PhD students are often grouped together with other graduate students or researchers. Studies tend to be based on small populations, and the number of PhD students involved is either unclear or only equals a few individuals within the entire group of study. In addition, of the limited number of studies which focus exclusively on PhD students, few conduct explicit examination of information practices in the health sciences. The result is that this user group is underrepresented within recent journal publications.

**Conclusion** – This review highlights the need for more primary, in-depth research on the information literacies of PhD students in the health sciences. In addition, librarians are encouraged to share their knowledge in scholarly publications which can reach beyond their own professional circles.

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## Introduction

A practical objective of library and information science (LIS) is to investigate the information practices of different groups in order to be able to invest in appropriate information resources and services. Understanding the information literacies of PhD students is of particular importance to academic libraries, since these students are often present or future faculty, and librarians can provide support in the transformation from students to scholars (Fleming-May & Yuro, 2009).

### *Information Literacy – Debate and Definitions*

Information literacy (IL) has traditionally been defined by organizations in terms of explicit

learning goals for the use of information. Several models for IL have been put forth over the past few decades, including the recent Association of College and Research Libraries' (ACRL) "Framework for Information Literacy for Higher Education". This document represents an effort to shift from normative standards to a more nuanced definition of IL as "the set of integrated abilities encompassing the reflective discovery of information, the understanding of how information is produced and valued, and the use of information in creating new knowledge and participating ethically in communities of learning" (American Library Association, 2015).

As a research field, IL has been under development and debate for several decades (Bruce, 2000; Pinto, Cordón, & Díaz, 2010;

Tuominen, Savolainen, & Talja, 2005); however, it can be asserted that IL is now a well-established concept within its own mature research domain (Bruce, 2016). For the purposes of this review, the concept *information literacies* is used in the plural form to denote dynamic learning activities that take place through interactions within specific social contexts. In other words, information skills evolve in domain specific areas such as disciplines or communities of practice (Lave & Wenger, 1991; Nicolini, Gherardi, & Yanow, 2003). This situated understanding of IL “calls for empirical research efforts to analyze how specific communities use various conceptual, cultural, and technical tools to access printed and digital documents and to evaluate and create knowledge” (Tuominen et al., 2005, p. 342).

### *Information Literacies of PhD Students*

There is a wealth of research regarding information practices within educational settings, but few studies have concentrated on PhD students as a discrete group. In a meta-synthesis of the literature on graduate students’ information-seeking behaviour, Catalano (2013) only found 11 studies published between 1997 and 2012 that focus specifically on PhD students. These studies typically center around efforts to improve library services, e.g., identifying information source preferences or investigating research and writing processes during a literature review. Catalano’s (2013) review considered graduate students on both the master’s and doctoral level, and only a few patterns of behaviour were pointed out as unique to PhD students. Like master’s students, PhD students were found to begin their research on the Internet. However, PhD students were also more inclined to consult their faculty advisors when seeking information.

Spezi (2016) augmented Catalano’s (2013) findings through a narrative review covering the years 2010 – 2015, focusing on whether there has been a change in PhD students’ information seeking behaviours due to developments in

information and communications technologies. Only a handful of the identified research looked solely at PhD students, instead most studies grouped PhD students together with other graduate students or with other researchers. Spezi’s (2016) review confirms Catalano’s (2013) earlier observation that PhD students are inclined to begin their searches on the Internet and that this is now an established and recognized trend. At the same time, library e-resources are, after “a period of disenchantment”, still useful enough to compete with web searches. Spezi (2016) also points to the previously documented importance of academic journals to PhD students during the research process, and that more articles tend to be read in the medical and life sciences. PhD students were also found to over-estimate their ability to search for information effectively, e.g., constructing effective search strategies.

### *Disciplinary Differences and the Health Sciences*

In LIS research, there has been a tendency to generalize about metadisciplines, i.e., group fields into broad discipline categories such as science or the humanities (Case & Given, 2016). Against this backdrop, a common assumption is that scholars within the natural sciences mainly use journals and humanities scholars mainly use archives and books. These generalizations “may be true as they go, but they do not further our understanding of the important mechanisms of information seeking, nor are they particularly useful in application, as in designing university information systems to serve particular disciplines” (Case & Given, 2016, p. 288). As noted previously, there is a strand of LIS research which asserts the importance of the disciplinary context. Disciplines have different research cultures and traditions (Talja, Vakkari, Fry, & Wouters, 2007) and an “academic discipline ‘disciplines’ its members to behave in certain ways” (Sundin, Limberg, & Lundh, 2008, p. 22). For this review, the *health sciences* as a concept is defined as narrower than a metadiscipline but wide enough as a field to encompass several smaller disciplines of science,

which focus on health or health care, e.g., medicine or nursing.

### Aims

PhD students are a unique library user group, marked by a period of transition. They are not merely graduate students; they are researchers in training. Academic disciplines provide the social contexts through which PhD students learn what it means to be information literate in their fields. Although there have been recent reviews about the information-seeking behaviour of PhD students, there is little knowledge synthesis about these students that is connected to the broader concept of information literacies or to the discipline-specific culture of the health sciences.

The aim of this article is therefore to explore the depth and breadth of research in scholarly articles concerning the information literacies of PhD students within the health sciences.

### Methods

To “identify the nature and extent of research evidence” and to provide “a preliminary assessment of the potential size and scope of available research literature” (Grant & Booth, 2009, p. 101), a review of scholarly articles was conducted based on scoping review methodologies (Arksey & O'Malley, 2005; O'Brien et al., 2016; Peters et al., 2015).

This review involved structured searches of subject-specific as well as multidisciplinary databases for the years 2009 – 2018. This date range was chosen in order to locate the most current publications available on the topic of IL. While the phrase *information literacy* was introduced as early as the 1970s (Zurkowski, 1974), it can be argued that IL has only recently been established as a research domain (Bruce, 2000; Bruce, 2016).

Different databases were searched to identify the scope of the evidence, i.e., not only *what*

research is available but also *where*. LISA (Library & Information Science Abstracts) was chosen to find research within LIS and ERIC (Education Resource Information Center) for education. CINAHL (Cumulative Index to Nursing and Allied Health Literature), MEDLINE, and PsycINFO were used to broaden the search to encompass the health sciences. Scopus was chosen in order to cover multidisciplinary publications. Search strings were constructed using the individual databases' thesauri in combination with variations of the keywords *doctoral student* and *information literacy*. Searches were conducted in September 2018 and detailed documentation of the strategies, including which database platforms were used, is provided in the Appendix.

Through a series of test searches, the following four journals were recognized as particularly relevant for additional hand-searching: *College & Research Libraries*, *EBLIP (Evidence Based Library & Information Practice)*, *Journal of Academic Librarianship*, and *Journal of Information Literacy*.

The inclusion criteria of this review are reflected within its search strategies and screening criteria. It was limited to peer-reviewed journal articles that report on empirical evidence written in English. This narrow focus was used to identify publications that are commonly used and perhaps most valued by professionals supporting PhD students within the health sciences, e.g., academic supervisors and medical or academic librarians. Commentaries and essays were excluded, as were theses and dissertations, conference proceedings, book chapters, and policy papers, since these documents tend to be secondary sources rather than primary studies. Review articles were also excluded, but only after consulting the reference lists of these articles to identify additional original studies.

The included research articles could employ qualitative, quantitative, or mixed methods. The information literacies of PhD students could be

examined from the perspective of the PhD students themselves or from other groups involved in doctoral studies, such as thesis supervisors or librarians. However, the articles had to clearly identify and examine PhD students within the health sciences as a distinct group.

Both authors conducted the the literature search, screening, and data extraction. The search results were imported into EndNote Desktop for de-duplication according to a comprehensive and

strategic method (Bramer, Giustini, De Jong, Holland, & Bekhuis, 2016) and then independently screened using Rayyan (Ouzzani, Hammady, Fedorowicz, & Elmagarmid, 2016). Conflicting decisions were discussed in order to reach consensus. The following data was charted from the included studies: geographic location, population, aims, methodology, academic disciplines represented, major findings related to health sciences, and which databases indexed the relevant articles.

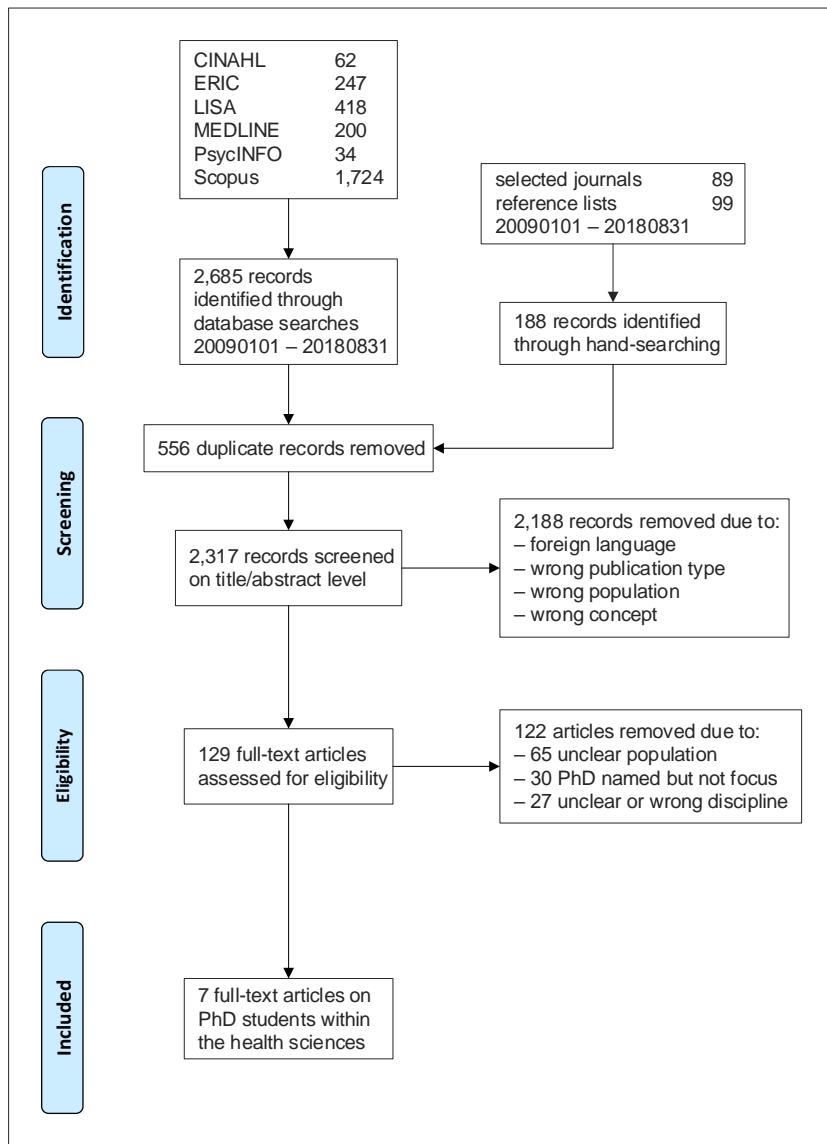


Figure 1  
Modified PRISMA diagram.

## Results

### Identification of Relevant Articles

An adapted version of the PRISMA flow diagram (Moher, Liberati, Tetzlaff, Altman, & Group, 2009) summarizes the search and screening process (Figure 1). The literature search identified 2,685 records and an additional 188 records were found through hand-searching. After duplicates were removed, the titles and abstracts of the 2,317 remaining records were screened independently by both authors.

Full-text was retrieved for 129 articles. Following full-text screening, only seven articles (0.3% of the initial data set of 2,317 records) met the inclusion criteria.

### Indexing Practices

Table 1 shows which databases indexed the relevant articles. The journals represented were mainly within LIS (six of the seven), apart from one journal within education. None of the databases indexed all seven articles, but all the articles were retrieved through Scopus, a multidisciplinary database. LISA indexed all six LIS journals, but not the education journal. In addition to the education journal, ERIC indexed two of the six LIS journals. None of the articles were found in the databases covering nursing or medical research, i.e., CINAHL and MEDLINE. However, PsycINFO indexed the education journal and five of the six LIS journals.

Table 1  
Included Articles – Respective Journals and Database Indexing

Article	Published In	CINAHL	ERIC	MEDLINE	PsycINFO	Scopus
(Carpenter, 2012)	<i>Information Services &amp; Use</i>	NO	NO	NO	YES	YES
(Edwards & Jones, 2014)	<i>Evidence Based Library and Information Practice</i>	NO	NO	NO	YES	YES
(Green, 2010)	<i>Journal of Academic Librarianship</i>	NO	YES	NO	YES	YES
(Grigas, Juzeniene, & Velickaite, 2017)	<i>Information Research</i>	NO	YES	NO	NO	YES
(Ramlogan, 2014)	<i>Library Philosophy and Practice</i>	NO	NO	NO	YES	YES
(Trafford & Leshem, 2009)	<i>Innovations in Education and Teaching International</i>	NO	YES	NO	YES	YES
(Warburton & Macauley, 2014)	<i>Australian Academic and Research Libraries</i>	NO	NO	NO	YES	YES

### *The Nature of the Evidence*

This review revealed that the literature rarely treats doctoral studies as a unique process. PhD students are usually grouped together with other graduate students or researchers (65 articles with an unclear population, 30 articles with PhD students named but not the focus). Studies tend to be based on small populations, and the number of PhD students involved is either unclear or only equals a few individuals within the entire group of study. Few studies were about PhD students in the health sciences (27 with unclear or wrong discipline). In other words, we assert that PhD students in the health sciences are underrepresented in recent scholarly journals.

Only seven articles met the inclusion criteria. The following synthesis is based on the extracted data from these articles. Table 2 provides an overview of the geographic locations as well as the populations, aims, and methodologies reported in the articles. The studies took place in predominately English-speaking countries such as the UK, the US, and Australia. PhD populations varied greatly in size from under 20 (Green, 2010) to several thousand (Carpenter, 2012), but the exact number of PhD students representing health sciences was often unclear (Carpenter, 2012; Green, 2010; Ramlogan, 2014; Trafford & Leshem, 2009). Four studies were about the PhD students themselves or their academic supervisors/librarians (Carpenter, 2012; Green, 2010; Trafford & Leshem, 2009; Warburton & Macauley, 2014), and three studies investigated written scholarly output, i.e., citation practices (Edwards & Jones, 2014; Grigas et al., 2017; Ramlogan, 2014).

Both quantitative and qualitative methods were used to achieve the aims of the studies. Citation analysis was employed within two of the articles (Edwards & Jones, 2014; Grigas et al., 2017) to evaluate various aspects of library services for PhD students, e.g., relevance of library collections and the usefulness of freely available

full-text information. Numerical evidence concerning the provision of thesis/dissertation checking was presented in one study (Ramlogan, 2014). Interviews and grounded theory were used to challenge the assumption that PhD students are information illiterate in one study (Green, 2010). Several qualitative methods, including coding into vignettes, were used within one study to identify the difficulties that PhD students encounter (Trafford & Leshem, 2009). Mixed methods, i.e., a combination of surveys and interviews, were used within two of the articles (Carpenter, 2012; Warburton & Macauley, 2014). The aims of these latter studies included comparing research behaviour based on generational differences and determining the impact of early research consultation services during candidature.

### *The Breadth and Depth of the Evidence*

Table 3 charts the discipline-specific data collected from the articles. While all the articles focused on PhD students, it was often difficult to locate data specific to the health sciences. For two of the articles (Ramlogan, 2014; Trafford & Leshem, 2009), no data could be identified relating to health science PhD students in particular. For one article (Green, 2010), the data fit under generalizations made for the entire population of study regardless of discipline. For the remaining four articles (Carpenter, 2012; Edwards & Jones, 2014; Grigas et al., 2017; Warburton & Macauley, 2014), the reporting was clearer concerning which findings pertained to PhD students in the health sciences, but the amount of data was limited. The health science most commonly named was medicine (Carpenter, 2012; Grigas et al., 2017; Ramlogan, 2014; Trafford & Leshem, 2009; Warburton & Macauley, 2014), and all the studies examined other disciplines outside the health sciences at the same time, e.g., education or engineering.

### *Summarising the Evidence*

Overall, the studies identified in this review provide a regrettably limited amount of data



Table 2  
Overview of Included Articles

Article	Country	Population	Aim	Methodology
(Carpenter, 2012)	UK	6,161 Generation Y (born 1982 - 1994) doctoral students and 7,432 older doctoral students; cohort of 30 full-time doctoral students	Identify the research behaviour among doctoral students in Generation Y	Mixed; three annual surveys and a longitudinal, qualitative cohort study
(Edwards & Jones, 2014)	US	107 doctoral dissertations	Compare how well library collections support doctoral research	Quantitative; citation analysis
(Green, 2010)	US and Australia	42 participants including 5 American and 6 Australian librarians, 8 American and 10 Australian doctoral candidates, and 6 American and 7 doctoral advisors	Examine and reconsider the assumption that doctoral students are information illiterate	Qualitative; interviews coded through grounded theory
(Grigas et al., 2017)	Lithuania	39 doctoral theses	Evaluate how useful freely available full-text information sources can be when writing PhD theses; determine to what extent the library may be an information resource provider and intermediary	Quantitative; citation analysis
(Ramlogan, 2014)	Jamaica	696 theses/dissertation checks	Examine the service of thesis and dissertation checking provided by liaison librarians	Quantitative; statistical analysis
(Trafford & Leshem, 2009)	UK	55 PhDs, 7 supervisors, texts from examiners	Identify the difficulties that doctoral candidates encounter	Qualitative; open-ended questionnaire, discussions, and text analysis, all coded into vignettes
(Warburton & Macauley, 2014)	Australia	79 PhD candidates and 32 PhD supervisors	Profile PhD candidate usage of research consultation service; explore if consultations make a difference in the early stages of the PhD candidature	Mixed; open-ended questionnaire, survey, both online

Table 3  
Health Science (HS) Discipline-Specific Data from Included Articles

Article	HS Population	HS discipline(s)	Other discipline(s)	Usability of Findings	Major HS Findings
(Carpenter, 2012)	Number of respondents from HS disciplines is unclear	Medicine, dentistry & health, veterinary sciences	Social sciences, engineering & computer sciences, arts & humanities, biomedical sciences, physical sciences, biological sciences	2012 report based on studies performed in 2007 and 2009; limited amount of data that could be identified as specific to HS discipline	E-journals dominate as a research resource for HS students; cohort students strongly indicate that difficulty accessing and obtaining relevant resources due to licensing is a severe constraint on their research; citation databases and e-journal search interfaces are equally as popular as Google; with the exception of veterinary sciences, PhD students work alone and not in collaborating research teams
(Edwards & Jones, 2014)	Out of 107 dissertations, 28 (26%) within psychology and 22 (21%) within social welfare	Psychology, social welfare	Education	Clear discipline-specific reporting yet limited amount of data that could be charted	Psychology students cited the highest percentage of journals; social welfare students cited free web resources (primarily government documents or reports from NGOs and advocacy groups) but psychology students did not; both disciplines cited older material than anticipated; surprisingly cross-disciplinary nature of research, e.g., social welfare students frequently cited journals in psychology
(Green, 2010)	Number of respondents from HS discipline is unclear	Nursing	Education, physical & biological science	Limited amount of data that could be identified as specific to HS discipline	PhD students from all disciplines indicated that they used the strategy of backward and forward citation tracking to evaluate the quality of sources and expand their bibliographies; most PhD students developed their literacy skills without direct instruction; librarians are predisposed toward the view that PhD students are information illiterate

(Grigas et al., 2017)	Out of 39 theses, 2 (5%) within psychology and 5 (13%) within medicine	Psychology, medicine	Humanities, social sciences, biomedical sciences, technological sciences, physical sciences	Clear discipline-specific reporting yet limited amount of data that could be charted	PhD students from the biomedical sciences are substantial users of peer-reviewed e-journals; biomedical sciences students use books and e-books less than students within the humanities
(Ramlogan, 2014)	Unclear reporting for 176 theses/dissertation checks; out of 520 theses/dissertation checks, 47 (9%) within medical sciences yet unclear if on master's or PhD level	Medical sciences	Science & agriculture, humanities & education, engineering, social sciences	Focus is on prevalence of the service rather than the impact it has on PhD students; no data that could be charted as specific to HS discipline	Not applicable
(Trafford & Leshem, 2009)	Number of respondents/documents from HS discipline is unclear	Bio-medical sciences	Botany, management and business, education, English, geography, history, law, linguistics, surveying	No data that could be identified as specific to HS discipline	Not applicable
(Warburton & Macauley, 2014)	43.4% of PhD candidates and 40.6% of PhD supervisors within medicine, dentistry and health sciences (MDHS)	MDHS	Arts, education, engineering, architecture, building & planning, veterinary science, business & economics	Clear discipline-specific reporting yet limited amount of data that could be charted	More than half of part-time MDHS candidates rated their information skills as "less than adequate"; 78.8% of MDHS students spoke of information "chaos", "floundering" and "random" approaches to locating information; the main reasons MDHS students sought library research assistance were for help with search terms and keywords, and for literature searching strategy design; 100% of MDHS students thought library consultations could assist in refining literature search strategies and 88% thought consultations could assist in undertaking thorough or systematic literature searching

about the information literacies of PhD students in the health sciences. It has already been noted that few studies in recent LIS literature are devoted solely to PhD students, and the results of this review confirm this knowledge gap. Even fewer studies were found addressing information literacies specific to health science disciplines, and the few studies identified were mainly found in LIS journals.

## Discussion

### *Comparing the Evidence*

The small amount of relevant data available for analysis (Tables 2 and 3) corresponds well with the previous discoveries of Catalano (2013) and Spezi (2016).

As established by Catalano (2013), several studies were centered around efforts to improve library services (Edwards & Jones, 2014; Grigas et al., 2017; Ramlogan, 2014; Warburton & Macauley, 2014). In keeping with a common assumption in LIS research (Case & Given, 2016, p. 288), Spezi (2016) confirmed the importance of academic journals to PhD students and that more articles tend to be read in the medical sciences. The same evidence is found in the article reporting on the largest population (Carpenter, 2012) as well as the two smaller studies based on citation analysis (Edwards & Jones, 2014; Grigas et al., 2017). Both Catalano (2013) and Spezi (2016) observed that PhD students are inclined to begin searching on the Internet; however, Spezi also argued that library e-resources are still able to compete with web searches. This varied approach was also reported in the Carpenter article (2012).

A few new findings were discerned from the limited data of the included articles. While Spezi (2016) described how PhD students overestimate their ability to search for information effectively, the students in the study by Warburton and Macauley (2014) often rated their skills as “less than adequate” and spoke of information “chaos”, “floundering”, and

“random” approaches to locating information. Green (2010) asserts that librarians are predisposed toward the view of PhD students as information illiterate and calls for the profession to question this assumption; in part this is because the students in Green’s study were found to develop their literacy skills without direct instruction.

Additional findings moved beyond information-seeking and discovery into the realm of “how information is produced and valued” (American Library Association, 2015). While Edwards and Jones (2014) found students cited older material than anticipated, Green (2010) reported that students strategically tracked citations backward and forward in order to evaluate the quality of sources and expand their bibliographies. Regarding “the use of information in creating new knowledge and participating ethically in communities of learning” (American Library Association, 2015), Warburton and Macauley (2014) discovered that students mainly sought library research assistance for their information-seeking, i.e., search terms, keywords, and strategy design. It should be noted that their respondents were very confident in library research support, e.g., 100% thought that library consultations could refine search strategies and 88% thought they could get help with thorough or systematic searches. With regards to communities of learning, Carpenter (2012) reported that PhD students in medicine, dentistry, and health generally worked alone and not in collaborating research teams.

### *Charting the Evidence Base*

As indicated in Table 1, the few relevant articles identified in this review were mainly found in LIS journals. However, if librarians wish to inform faculty about IL and how librarians can help, it is the disciplinary publications which faculty value that can serve as the most effective medium (Stevens, 2007). In the health sciences, these publications are usually scholarly articles found in databases such as PubMed.

Within the LIS community, there is a call for evidence based library and information practice (Booth, 2002; Crumley & Koufogiannakis, 2002) and a concern that there is not enough research from which to draw conclusions. As a former editor of the *Journal of the Medical Library Association* remarked, “We have many articles; we do not have a body of evidence” (Plutchak, 2005). In an overview identifying research gaps, Koufogiannakis and Crumley (2006) also noted several issues that librarians face when publishing articles, including a lack of indexing and open access options in LIS journals.

Where is the evidence about information literacy to be found and who is publishing this research? In a small-scale reference analysis of articles on how academic libraries contribute to student success, findings suggest an uneven relationship between LIS and other disciplines. More specifically, LIS is borrowing concepts and methods from the field of education, but other disciplines rarely cite LIS research (Kogut, 2019). Another exploratory study investigating the visibility of librarians as authors in scholarly journals within higher education, teaching, and learning between 2000 and 2012, found that less than 2% of articles published in these journals were written by librarians; while IL was the most common topic for librarians, most articles were theoretical and not based on empirical research (Folk, 2014). Pilerot (2014) notes in another small-scale investigation how the established assumption is that there is a disconnect between research and practice, and that the prevailing gap-metaphor should be abandoned to allow for a more nuanced discussion between librarians as a professional group and LIS faculty. Is there a gap in the evidence base concerning the IL of PhD students in the health sciences? This review points to the possibility, but perhaps there is also too little communication between library practice, library research, and those who benefit from both.

## Limitations

This review is not without its limitations. Very few studies met the narrow inclusion criteria. Generally, the populations of the studies were small and researchers rarely ascribed their findings to discipline-specific practices, resulting in findings that are almost anecdotal in nature, making it difficult to track larger trends. IL was mapped as an established concept, but more studies might have been located if the search strategies had included classic LIS terminology such as information-seeking or literacy skills, or if the date range had been extended to include research from earlier decades. This review may have also missed articles where IL was not named, but rather described as a particular strategy such as help from librarians or using journal articles. Additional studies might have also been found if PhD students had not been treated as unique user group, i.e., labels like graduate students or researchers were used. Moreover, the inclusion of professional doctorates such as MD or DPharm might have also led to a broader review.

A great deal of investigative work devoted to this population is probably being carried out by LIS professionals, and not just by LIS researchers. If more health science librarians were to disseminate the results of their own research, a solid evidence base could be established within our profession (Koufogiannakis & Crumley, 2006). More knowledge about how PhD students interact with libraries is likely to be found in librarians’ grey literature, such as conference posters and institutional reports. Therefore, future attempts to map this user population should also include searches of the grey literature. In addition, if enough original studies are found devoted to this population, these should be subjected to some form of critical analysis before data extraction, to increase the trustworthiness of any resulting synthesis.

## Conclusions

This review found that PhD students in the health sciences are underrepresented in current scholarly journals. Out of over 2,500 possible records, only seven articles met the inclusion criteria. From these seven, six were found in LIS journals, resulting in a lack of evidence about how to support the information literacies of this population. Future LIS research should address this deficiency by studying PhD students as a unique group operating within discipline-specific communities. Furthermore, it is recommended that more health science librarians share their professional experiences in publications that reach beyond their own institutions or organizations, e.g., peer-reviewed articles in journals which are indexed in databases such as CINAHL or MEDLINE.

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## Appendix

### Database Searches

Database	Search String	Limiters
CINAHL (EBSCOhost)	(MH "Students, Graduate" OR TI (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy") OR AB (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy")) AND (MH "Information Literacy" OR TI (information AND (literacy OR literacies)) OR AB (information AND (literacy OR literacies)))	Peer Reviewed; Published Date: 20090101-20180831; English Language
ERIC (EBSCOhost)	(DE "Doctoral Programs" OR TI (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy") OR AB (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy")) AND (DE "Information Literacy" OR TI (information AND (literacy OR literacies)) OR AB (information AND (literacy OR literacies)))	Peer Reviewed; Published Date: 20090101-20180831; English Language
LISA (ProQuest)	(MAINSUBJECT.EXACT("Graduate studies") OR ti(doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy") OR ab(doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy")) AND (MAINSUBJECT.EXACT("Information literacy") OR ti(information AND (literacy OR literacies)) OR ab(information AND (literacy OR literacies)))	Peer Reviewed; Date: From 2009 January 01 to 2018 August 31; English Language
MEDLINE (EBSCOhost)	(MH "Education,Graduate" OR TI (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy") OR AB (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy")) AND (MH "Information Literacy" OR TI (information AND (literacy OR literacies)) OR AB (information AND (literacy OR literacies)))	Published Date: 20090101-20180831; English Language
PsycINFO (ProQuest)	(MAINSUBJECT.EXACT("Postgraduate Students") OR ti(doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy") OR ab(doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy")) AND (MAINSUBJECT.EXACT("Information Literacy") OR ti(information AND (literacy OR literacies)) OR ab(information AND (literacy OR literacies)))	Peer reviewed; Date: From 2009 January 01 to 2018 August 31; English Language

Scopus (Elsevier)	TITLE-ABS-KEY (information AND (literacy OR literacies)) AND (doctoral OR doctorate OR post-graduate OR postgraduate OR graduate OR phd OR "doctor of philosophy")	AND DOCTYPE(ar) AND PUBYEAR > 2009 AND LANGUAGE(english)
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All searches were performed on September 21, 2018.