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Scoping the nascent: An analysis of K-12 OER research 2012-2017

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Abstract

Awareness and use of Open Educational Resources (OER) has grown at all levels of education. Higher education researchers actively study OER but K-12 OER research indicates limited published results. To address this gap, this study examined articles meeting defined criteria and analyzed the results. Findings include cohesion of author-supplied keywords and ten primary categories of focus. From 38 articles studied, a variety of research methods were represented. Analysis showed Professional and Applied Sciences were overwhelmingly represented with the majority of articles within the discipline of Education and its fields with Humanities a distant second category of publication. The equal distribution between open and closed access journals may reflect changes to past scholarly publication practices. Citation analysis revealed divergences and reinforces the nascent quality of this topic. Future K-12 OER research that studies the complex change from resource scarcity to resource flexibility and digital abundance is needed.

Keywords: K-12, OER, open education, open educational practice, open pedagogy, literature analysis

Introduction

Since UNESCO's early open courseware forum in 2002, public domain or open licensed educational materials - referred to as Open Educational Resources (OER) - have increased in three significant ways: awareness of these malleable educational resources; the use of OER through the development of a variety of public repositories; and, the concomitant support for OER by an array of advocates. Educators' practices, informed by the educational publishing legacy who traditionally contributed to and shaped content and curriculum at all levels of education, has amongst some circles begun to embrace the pedagogical changes wrought by an open web and participatory technologies. As Merkley (2018) notes, there has generally been a rapid rise in the use of open licenses, suggesting approximately 1.4 billion licenses had been issued by 2017.

The understanding and awareness of OER continues to evolve. UNESCO (2012) defined OER as including a wide range of learning materials, from "textbooks to curricula, syllabi, lecture notes, assignments, tests, projects, audio, video and animation (UNESCO, 2012, para 1)." Wiley (2014) later suggested 'the 5Rs' of OER. The 5Rs function to i) *retain* an open license that permits ii) *reusing*, iii) *revising*, iv) *remixing*, and v) *resharing*. To further enhance the definition of OER and its growth toward Open Educational Practice (OEP), Cronin (2017) suggests that OEP involves "collaborative practices that include the creation, use, and reuse of OER, as well as pedagogical practices employing participatory technologies and social networks for interaction, peer-learning, knowledge creation, and empowerment of learners" (p. 18). The combining of these changes has

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helped engender a pedagogical reframing through the eight attributes of open pedagogy (Hegarty, 2015), with less reliance on the legacy practices of educational publishing at all levels of education.

Within higher education, the awareness, use, and support for OER has been widely discussed with a focus on specific topics such as quality assurance (Atenas & Havemann, 2013) or within broader domains including open scholarship (Pearce, Weller, Scanlon & Kingsley, 2012; Veletsianos & Kimmons, 2012), and open pedagogy (Hegarty, 2015). In part due to a search for solutions to the high cost of higher education textbooks, there has been a slow increase in the use of user-generated content and open textbooks in higher education classrooms (Janghiani & Janghiani, 2017). Synthesizing studies of efficacy and perceptions of use have affirmed that at higher education, students achieve comparable learning outcomes with OER, with both students and instructors having positive perceptions of using OER (Hilton, 2016).

But what about K-12 environments? Because of the unique nature of the K-12 educational system and its prominent role within all countries, this study seeks to examine recent research in K-12 OER from the years 2012- 2017.

In this paper we have used a set of researching decisions to determine a broad yet rigorous catchment of K-12 OER scholarly articles published from the years 2012- 2017. From these results, we have sought to answer two questions: *What are the predominate areas of focus in published K-12 OER research?* And, secondly, *what research methods do scholars apply when investigating K-12 OER topics?* The research methods used are those identified by West and Borup (2014) who examined a decade of research to identify trends within instructional design and technology scholarship. Because OER involves participatory technologies, these established classifications were applied for the purposes of this paper.

Unlike traditional academic scholarship, the intended benefactors of this overview of K-12 OER research casts a broader net. There is increased expectation for practitioners inclusive of classroom teachers, school principals and senior school authority leaders to “stay current with educational technology research; participate in and apply research to learning and teaching” (Alberta Education, 2013, p. 3). Additionally, with the growth of open scholarship, access to openly licensed educational research has the potential to contribute to aspects of citizen science (Silvertown, 2009 as cited by Anderson, 2013), to support undergraduate and graduate students, and to enhance scholarly access throughout the world (Anderson, 2013). Concomitantly, the movement toward evidence-based decision-making has been buoyed through annual professional dues such as the Alberta Teachers Association (ATA) financing digital library access of subscription-based research journals (ATA, 2018). Such systemic library support for classroom-based teachers is likely rare but with the rise of Open Access journals, educators without access to subscription-based journals may still be able to read and consider pedagogical implications of current educational research. These developments point to a greater movement toward reading, applying, and creating research as part of K-12 school culture that has thus broadened the readership of educational research. Thus, this paper supports the teaching profession and the ongoing cultural change that may further research findings and discussions by a professional yet previously underserved audience. Additionally, as OER is part of the broader Open movement (Cronin, 2017), open scholarship also aligns with expanding research dissemination known as Knowledge Mobilization (KM) strategies extending the distribution of research beyond the conventional audience (Social Science and Humanities Research Council of Canada [SSHRC], 2018) through pursuits such as open data and open practices. In short, interest in K-12 OER research may increase not only because of topic growth but also because of increased practitioner readership through KM dissemination activities and Open Access journals.

It is only within recent years that stakeholders have begun to nurture K-12 OER awareness. In part, this awareness catalyzed in 2015 with the United States Department of Education's (USDE) successful #GoOpen initiative. Similar to the use of OER within higher education, the USDE identifies a monetary rationale for reassigning funds away from traditional textbooks to supporting digital learning through OER (USDE, 2018a, para 9). However, as OER advocates often state, the financial benefits come with pedagogical advantages as well (Blomgren, 2017; Wiley, Hilton, Ellington & Hall, 2012). The #GoOpen initiative encouraged a

> …broader dialogue and dissemination of information on the policies and practices that impact teaching, learning, and collaboration. ... [and] documenting and sharing [of] new approaches to professional learning for teachers, and curating resources that offer… options for personalizing learning, and strategies to support curating, creating, adapting and sharing OER (USDE, 2018b, para 2-3).

Within the three years since the initiative, 20 American states have developed OER and these states may act as ambassadors to support districts embarking upon OER (USDE, 2018b, para 6). Prior to #GoOpen, K-12 OER had little prominence in the USA and this extends to Canada because of the complex political, historical, and geographic ties between the two countries. OER research significance for K-12, unlike within higher education, lays in potentiality but as this paper demonstrates, interest grows in this topic.

Method

Scope and search

We performed literary searches using the library search engines of two universities with graduate programs in education (Athabasca University and University of Ontario Institute of Technology) providing access to JSTOR (http://www.jstor.org), Project Muse (https://muse.jhu.edu), ProQuest (http://www.proquest.com) and ERIC (https://eric.ed.gov) databases. To replicate the experience of K-12 practitioners who have limited or no access to post-secondary databases, we performed a third search using the publicly available Google Scholar (https://scholar.google.ca).

The materials analyzed are limited to 2012 and later. This study's authors perceived 2012 as a suitable start date for the research analysis. Searches for the terms "K-12" paired with "Open Education Resources" or "OER" returned few results prior to 2012, thus, suggesting K-12 OER seemed to have had little prominence in the USA or Canada and that there were limited materials that might contribute to an analysis of research trends. Grey literature was not included although we later discuss its role in the changing face of OEP and the shifts experienced in KM with the scholarly use of open sharing platforms.

Initial searches focused exclusively on scholarly (peer reviewed) articles within the discipline of education. Due to the timelines for research / publication and the need to analyze the materials further, only full-text articles were selected for each search. In an effort to ensure that we had not missed relevant materials, the top 100 results from each inquiry were sorted by relevance and cross-referenced. Items after the top 100 items appeared to yield no relevant results.

We applied the following search terms with relevant Boolean operators: *Open Educational Resources, OER, K-12, and PreK-12.* Subject delimiters included all of "open educational resource," "education," "oer," "k-12," "open textbooks." Because the principle investigators only speak English, we included the further delimiter of "only articles in 'English'". We saved results as searchable pdf

format documents, loaded into the reference software Mendeley and then exported to Nvivo software for detailed analysis.

Analysis and Results

A two-member research team used member checking to ensure consistency in coding decisions and a series of research notes were recorded and further guided descriptive coding decisions. The analysis included: word frequency searches of both full articles and author-supplied keywords; categories, topics, and subtopics including topical root keyword analysis and the degree of inclusion by source; classification of research methods; the discipline and field of publication output; journal type; and, lastly citation patterns. We decided to not include authorship, in part because of the nascent quality of K-12 OER with only 38 articles meeting the scoping criteria (list available in Appendix A).

To begin, an overview analysis included searches for word frequency and source attributes (e.g. journal articles by year and by title.) Word frequency searches included stemmed words (e.g. the result for *educators'* includes: educ OR educate OR educated OR educating OR education OR educational OR educationally OR education' OR educative OR educator OR educators OR educators'). Extraneous common words (Appendix B) were excluded.

As to be expected the most common results included *educators, OERS, teachers, students, use, learns,* and *opens*. However, frequency of use does not indicate alignment on how the term is being used. The word *open* provides such an example. Depending on the researcher, *open education* varies from an emphasis on empowering learners, to networked learning, participatory technologies, collaborative practices, and open educational practice (DeVries, 2018). Further analysis of the word cloud revealed other important results. Some third tier words only appeared in two articles (e.g. "schools'") while some of second tier terms (e.g. "students'") appeared in multiple articles. As might be expected, the overall frequency of a term did not, necessarily, suggest breadth of interest or degree of discussion. More rigorous analysis was then applied.

Ultimately, rather than rely upon a pre-determined set of categories, we decided to perform a second and third round of grounded coding (Saldaña, 2016). We extracted and performed a word frequency search on the author-supplied keywords that appeared more than once. Any that returned multiple results provided the basis for enhanced text searches of the full articles. To capture variations and/or related concepts, we used the Oxford English Dictionary and a thesaurus to derive a list of synonyms. Synonyms that were not applicable to the intended OER focus of the search were excluded. Three non-keyword terms (i.e. adoption, integration, and support) were also included in this level of coding as through the coding iterations they were observed to be integral to understanding OER research yet had not been identified as keywords, either by authors or journal editors. The articles meeting the criteria were coded, the coding reviewed, and unsuitable instances of coding removed. The results were then grouped into themes, topics, and sub-topics.

Table 1 provides the terms used, number of resources, and total number of references produced by this coding process. A comparative overview of the number of references by keyword is provided in Figure 1 and the number of sources in which the keywords are referenced in Figure 2.

Table 1 results show the catchment themes, topics, and sub-topics of keyword search results. At this level of coding, Khan Academy was noted to be overrepresented because three articles specifically focused on this non-profit web-based open learning resource that provides exercises, instructional videos, and a student dashboard for support in subjects such as high school mathematics. In the iterative coding steps that followed because of its specificity and lack of similarly narrow subtopics appearing, we decided to not further pursue Khan Academy in this level of coding. In combination with Figure 1 and 2, there appears to be a strong interest in the significance of *teaching and learning*,

Table 1: Categories & Topics / Sub-topics by Author-Supplied Keywords (Condensed).

Themes	**Topics**	**Subtopics**	**Files**	**References**
All Themes			38	89,622
Teaching & Learning			38	24,997
	Learning		38	9,418
		Student	38	2,649
	Literacy		33	308
	Teaching		38	15,271
		Instruction	38	7,336
Administration	Administration		38	24,265
	Schools, Courses, Programs		38	1,071
		Courses, Programs	38	1,773
		Schools	38	5,787
	Practice		38	1,042
	Policy		38	24,265
	Management		38	1,071
	Professional		38	1,773
Access	Access		38	11,581
	Search		38	10,629
		Research	38	10,270
		Analysis	38	3,694
		Information	38	3,460
Resources	Resources		38	7,593
	Material		38	3,320
	Text		21	1,221
Development	Development		38	5,921
	Growth		38	2,187
	Model		38	1,663
*Adoption & Integration^^*			38	3,713
	Adoption ^^		38	2,334
	Integrate		38	773
	Support ^^		38	606
Quality	Quality		38	3,742
Defining Characteristics of OER			38	3095
	4Rs; 5Rs		38	1,660
	Share		38	1,435
Technology			38	2,784
Khan Academy	Khan Academy		12	1,021
Cost, Expense			37	910

Note: ^^ indicate non-keyword

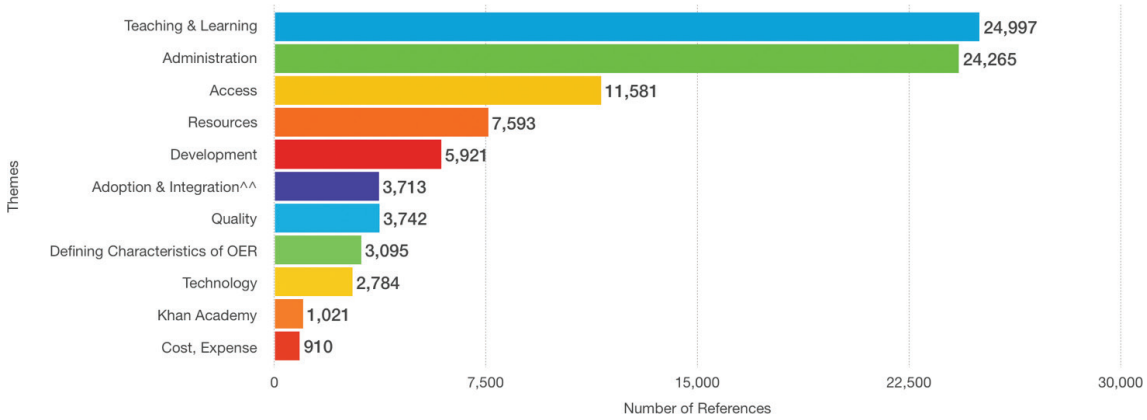

Figure 1: Number of References by Category

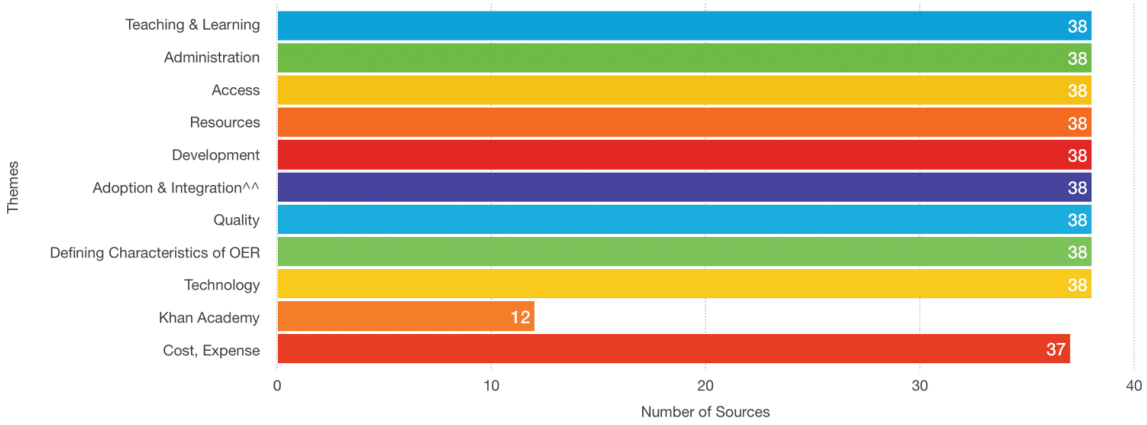

Figure 2: Number of Sources in Which Categories Are Referenced.

and secondly *administration.* The next seven categories (*access; resources; development; adoption and integration, quality; defining characteristics of OER; and technology*) highlight a focus on the pragmatic nature of K-12 OER awareness and use. Classroom teachers and educational leaders perceive potential financial shifts with OER with *cost* being the least identified category generated by the coding processes. Figures 1 and 2 reflect the "how" of "doing OER" which relates to the following areas and concerns: the changes brought to *teaching and learning* (e.g. understanding and applying Creative Commons licenses and the 5Rs); *administration* (e.g. institutional processes to successfully incorporate OER); *access* (e.g. computer connectivity); *resources* (e.g. the relationships among copyright restricted practices, OER digital pedagogies, and instruction); *development* (e.g. administrative supports for teachers creating and sharing OER); *adoption and integration* (e.g. how to successfully apply the 5Rs); *quality* (e.g. assurances for high-quality open resources); *defining characteristics of OER* (e.g. defining OER practices and how they relate to the legacy publishing system); *technology* (e.g. the degree and manner in which digital technologies are woven into using OER); and lastly, *cost/expense* (e.g. examining the monetary expenditures that are required when moving to OER).

Article Types & Research Methods

From the qualifying articles, seven groupings were applied that represent "broad and easily identifiable paradigms of educational research and theoretical inquiry" (West & Borup, 2014, p. 547). As indicated in

Table 2: Article Types and Research Method

Type	# of Sources
Theoretical & Philosophical	10
Combined methods	8
Descriptive analysis	7
Inferential analysis	6
Interpretative analysis	3
Content & discourse analysis	2
Other	2

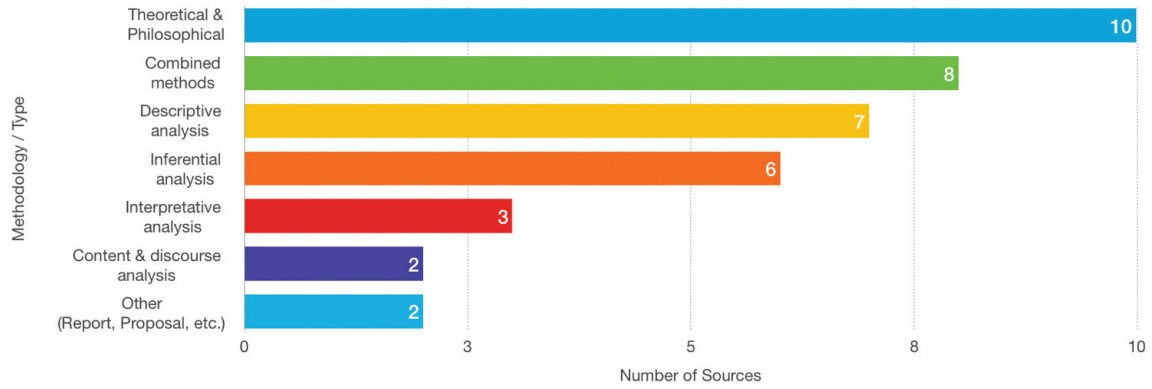

Figure 3: Number of sources by research method

Table 2, these research methods revealed the following breakdown: 10 theoretical/philosophical articles; eight combined (mixed methods) analysis, seven descriptive analysis, six inferential analysis, three interpretative/qualitative; two content analysis and two 'other' types - an opinion piece and 'how to' article'.

Although West and Borup (2014) had a much larger study based on analyzing a decade of ten journal publication patterns, a comparison reveals that for both their study and this one, theoretical/philosophical articles held the first spot. However, similarities end there and the combined methods, descriptive analysis, and inferential analysis account for half of the methods identified. Interpretative analysis which held the second spot (West & Borup, 2014) was in this study, the fifth most common K-12 OER research method, with content and discourse following next and lastly, "other," which included practical expository discussion papers of classroom OER collaboration and an overview of the OER field targeted at librarians.

The emphasis on theory is not surprising in a nascent area such as K-12 OER. Theory speculation and development spawns new approaches and pedagogical models that reflect ongoing technological changes and their incumbent application including the societal implications of near ubiquitous mobile devices. Theories evolve, respond, and reflect how people are using and understanding digital technologies, so it is not surprising that numerous articles reflected this theoretical and philosophical orientation. Additionally, the variety and distribution of research methods (figure 3) suggest that from 2012- 2017 there has been various research perspectives and approaches used to study K-12 OER. These results could be viewed as unsurprising but also confirmation that no one research perspective dominates which speaks to a healthy and varied research landscape.

Discipline, field and sub-fields

A fifth analysis involved discipline and field representation to investigate if any predominated. Because of the broad and varied nature of OER within K-12 and its links to discipline and areas such as computing, educational technology, learning sciences, curriculum, and pedagogy, the overview of articles included disciplinary and sub-disciplinary analysis of where the journals were being published, including if these journals were open access. The two main categories represented were Humanities but with only one article included. Within Professional and Applied Sciences, Library and Museum Studies also had one article and the Education discipline held the remaining 36. The fields within Education included: open education, distance education, educational technology, and science education. Because of the nature of education and its fields, movement between and among fields was noted and indicates cross-fertilization (Table 3).

Figure 4 excludes fourteen documents that met the scoping criteria (i.e. book sections and conference proceedings) and therefore illustrates article distribution published in non-open or open journals. The equal breakdown between non-open and open journal publication reflects the nature of academic habit and precedent. Because they are not behind a paywall, open access journals may attract users who may not have subscription-based access through a university library. Additionally, newer articles also attract more traffic and there is the disputed "open access citation advantage" (Piwowar et al., 2018, p. 5). Because of the nature of OER and its relationship to openness and the open movement, researchers investigating K-12 OER may be more inclined to support Open Access journals. This support represents a philosophical orientation and a strategic choice as the readership of open journals may reflect those interested in open scholarship. The equivalent choice

Table 3: Sources by Discipline

Discipline	**# of Sources**		
Humanities	1		
The Arts (Literature)		1	
Professional & Applied Sciences	37		
Education		36	
Distance Education (includes Distributed Learning)			12
Educational Technology			4
Open Education			18
Science Education			2
Library & Museum Studies		1	

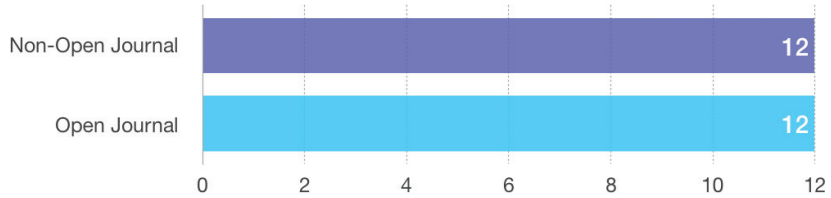

Figure 4: Number of Articles published in Open vs. Non-Open Journals

by K-12 OER researchers regarding closed or open access journal publication reflects a growing trend (Piwowar et al., 2018), a philosophical stance, and a considered understanding of changes to citation patterns.

Citation analysis

To analyze citation patterns, we used the Publish or Perish software (version 6.33.6259, Harzing, 2007), which uses Microsoft Academic Search and Google Scholar with its more inclusive search capacities (i.e. languages other than English, book chapters, books). This decision is similar to that of West and Borup (2014). Citation metrics are used for academic promotions and as a means to measure scholarly impact but they were designed for the Sciences and are less representative of the contributions to an area within the Social Sciences, Humanities, and Education. Using the software, a broad net was cast which this literature-scoping task required. Pertinent findings were highlighted, especially the substantial range difference in the number of Google Scholar citations and four citation groupings were established: high, moderate, minor and uncited. In the high category, only one article was included as it had received 134 citations. In the moderate category seven articles were cited 77-25 times. The minor category held twenty articles with citations ranging from 12-1. There were seven articles with no citations at the time of analysis (Figure 5).

Discussion and Future Research

This study highlights several key findings. Although higher education has been writing and researching OER for quite some time, even before the 2002 UNESCO Global Forum adoption of the term OER (UNESCO, 2002), this study reveals that K-12 OER activity substantially lags behind. With only 38 articles meeting the criteria, yet with K-12 OER potentially influencing vast numbers of educators, students, and public dollar investment, this significant research area will likely continue to grow.

The scoping of OER K-12 research provides a sense of the current landscape. Through initial analysis, we determined the writing cohesion of researchers explicating their results and through the processes of coding pertinent categories, topics, and sup-topics emerged. Overall, the topics generated indicate that procedural and pragmatic sub-topics have been initially studied, and with the demanding nature of K-12 teaching this procedural emphasis comes as no surprise. Having OER research explore what it means to teach students with public domain and openly licensed, accessible, and manipulative resources marks the transition to resourcing and teaching options that previously were unavailable in the legacy publishing system. The consistent appearance of these practical topics in all of the articles studied reinforces their inter-relationships and suggests that further and deeper research within each of these sub-topics (Figure 1) merit attention. This movement toward more

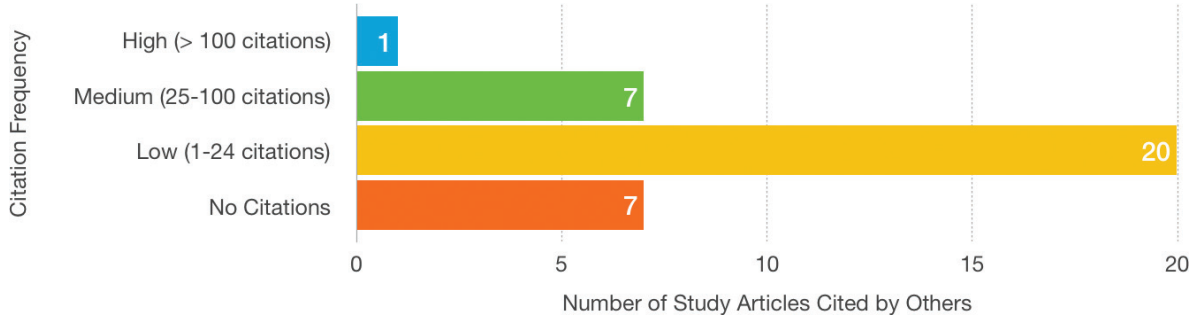

Figure 5: Study Articles Cited by Others

specificity is supported by the outlier Khan Academy articles and suggests how research pursuits may organically evolve and deepen over time.

Similar to higher education OER research, the concern regarding quality echoes studies and reports previously identified by a number of scholars (Allen & Seaman, 2014; Atenas, Haveman & Priego, 2014; Camilleri, Ehlers & Pawlowski, 2014; Misra, 2013). For K-12, in part because of its unique parameters, definitions of quality require precision, such as the comparison of OER to copyright restricted textbooks providing a springboard to discern such criteria (Kimmons, 2015). In a similar vein, adopting the 5Rs requires unambiguous articulation of these processes to strengthen future research studies as "open education narratives and initiatives have evolved in different contexts, with differing priorities. …[and] open education often means subtly or substantively different things to different people" (Cronin, 2017, p.16). The varieties of research methods also suggest that despite the immaturity of the K-12 OER topic, researchers are not favouring one research approach over the many available. The equal break down of closed versus open journals submissions also suggest that there is a balanced approach when publication decisions arise. Why some authors choose to research OER but select a closed access journal in which to publish results would prove a worthwhile research topic and may reflect the complexities involved with OER publication decisions (Weller, Jordan, DeVries & Rolfe, 2018). Additionally, having inter-topic research answer questions regarding attitudes of OER awareness, use, and advocacy would further pedagogical and theoretical understanding of the changes that teaching and learning with K-12 OER involves.

The citation patterns indicated four divergences. The first occurred with the most frequently cited article that discussed OER quality being nearly twice in impact (i.e. 134 to 77 citations) to the second most cited article regarding cost savings. Within the moderate range of seven articles, four had a stronger level of citation (i.e. 77-47) and the remaining three somewhat less vigorous use (i.e. 39-25); the titles and keywords of the moderately cited articles covered cost, Khan Academy, textbooks, barriers to OER, general OER discussion, educator perceptions, and implementing OER at the high school level. The 26 articles that were cited in a minor way (12- 1) spread out in a long tail, with two thirds of these receiving five or less citations. Lastly, there were seven articles that had no citations but no obvious explanation emerged regarding this disbursement. These findings were surprising because within an emerging topic and its lack of scholarship, one would anticipate that citing published K-12 OER papers would provide a clustering of citations. However, the overall pattern indicates one strong leader, a small clustering of moderately cited papers and then a thinning of scholarly impact by the majority of papers included in this scoping exercise. Low citations are not necessarily indicative of impact and these patterns could dramatically change in a short amount of time.

We do note that the topic is a small part within the discipline of education and even within the field of distance education that historically spawned OER. Additionally, although OER forms part of current higher education librarian scholarship, only one article came from library studies. This can perhaps be explained with the decline of print materials and the rise of the digital, many school based library programs dissolved into learning commons and the role of school librarians weakened; however, with the rise of OER and its concomitant relationships to curation, review, and copyright, school librarians may experience another change in their role. Nevertheless, this void remains active as reflected by these scoping results.

Limitations of this study include only a five-year span and the results produced are admittedly small. However, due to the nascent element of K-12 OER and of openness education in general (Jordan & Weller, 2017; Peter & Deimann, 2013; Weller, Jordan, DeVries & Rolfe, 2018), a greater time period may not have substantially shifted the results. Additionally, keyword frequency count provides a useful starting place for scoping purposes but the depth and complexity of teaching with OER cannot be easily captured. Keywords provide an initial representation of the article and

aide search engine optimization, with suggestions to use keywords every 100-200 words (Eassom, 2017, para 3), something that authors are noting especially with Google Scholar becoming more prominent. Keyword analysis was useful for our study but as this area of research matures, other approaches would prove beneficial. It would be fruitful to complete more in-depth analysis of the sub-topics and inductively code them for thematic results. A final limitation is that this study did not include grey literature such as scholarly blogs or comprehensive reports, in part due to the difficulty in defining grey literature as well as the challenges in consistently locating these documents, even with the efficacies engendered by the internet (Mahood, Van Eerd & Irvin, 2014). However, with the growth of social software such as Twitter to announce and share information as part of a professional learning network, the sharing of grey literature and KM practices are being redefined in the digital age.

Future research will no doubt pursue more detailed analysis of the financial benefits and challenges of K-12 OER because of the inherent monetary implications associated with assembling and offering educational resources. K-12 education is a public pursuit and forms UNESCO's fourth sustainable development goal. Effective education affordably delivered with high quality resources that reflect participatory and digital pedagogical practices align with research of systems based, broad or *big OER* whereas *little OER* (Weller, 2010) studies pursue smaller scale more individually founded, procedural, and pragmatically inclined explorations.

It is clear that significant changes are afoot. With the movement toward K-12 teachers accessing, reading, and applying evidence-based research - in tandem with the rise of open journals and the continuing ease of access and sharing of grey literature through professional learning networks and social media - these practices highlight professional change. The access, manner, and readership of taking up K-12 OER research and its concomitant results reflect broader knowledge mobilization transformations.

Broadly speaking, the pedagogical and educational resource practices of the previous century are changing because of pervasive, participatory technologies. This fundamental change from resource scarcity to resource flexibility and digital abundance contributes to leadership and administrative concerns, including issues related to copyright and publishing, and thus reinforces the need for thoughtful responses of how to support K-12 OER. Pragmatic professionals, at all levels, educators are looking for answers. Whether big or little OER, our study highlights the vast number of research possibilities still yet to come.

References

Alberta Education (2013). *Learning and technology policy framework*. Retrieved from https://education.alberta.ca/media/1046/learning-and-technology-policy-framework-web.pdf

Alberta Teachers Association (ATA) (2018). *Using your library*. Retrieved from https://www.teachers.ab.ca/For%20Members/Programs%20and%20Services/ATA%20Library/Pages/Library%20Services.aspx

Allen, E. & Seaman, J. (2014). *Opening the Curriculum: Open Educational Resources in U.S. Higher Education*. Babson Survey Research Group. Retrieved from https://files.eric.ed.gov/fulltext/ED572730.pdf

Anderson, T. (2013). Open access scholarly publications as OER. *The International Review Of Research In Open And Distributed Learning, 14*(2), 81-95. http://dx.doi.org/10.19173/irrodl.v14i2.1531

Atenas, J., & Havemann, L. (2013). Quality assurance in the open: an evaluation of OER repositories. *INNOQUAL-International Journal for Innovation and Quality in Learning*, *1*(2), 22-34. Retrieved from http://eprints.soas.ac.uk/17347/1/30-288-1-PB.pdf

Atenas, J., Havemann, L., & Priego, E. (2014). Opening teaching landscapes: The importance of quality assurance in the delivery of open educational resources. *Open Praxis, 6*(1), 29-43. http://dx.doi.org/10.5944/openpraxis.6.1.81

Blomgren, C. (2017, March). Benefits of OER for K-12 Learning. [Audio podcast]. *Multiply K-12 OER Project.* Retrieved from http://bolt.athabascau.ca/index.php/oer/multiply-k-12-alberta-oer-project/oer-podcasts/

Camilleri, A. F.; Ehlers, U. D.; Pawlowski, J. (2014). *State of the Art Review of Quality Issues related to Open Educational Resources (OER)*. Luxembourg: Publications Office of the European Union (JRC Scientific and Policy Reports).

Cronin, C. (2017). Openness and praxis: Exploring the use of open educational practices in higher education. *The International Review of Research in Open and Distributed Learning*, *18*(5). http://dx.doi.org/10.19173/irrodl.v18i5.3096

DeVries, I. (2018). Day 3: Tracing themes in OER research. In *Making sense of open education.* [Mooc lecture notes] Retrieved from http://www.open.edu/openlearncreate/mod/page/view.php?id=138710

Eassom, H. (2017, June 8). How to Choose Effective Keywords for Your Article. *The Wiley Network* (Blog post). Retrieved from https://hub.wiley.com/community/exchanges/discover/blog/2017/06/07/how-to-choose-effective-keywords-for-your-article

Harzing, A. (2007). Publish or Perish [Computer software]. Retrieved from https://harzing.com/resources/publish-or-perish

Hegarty, B. (2015). Attributes of open pedagogy: A model for using open educational resources. *Educational Technology*, *4*, 3–13.

Hilton, J. (2016). Open educational resources and college textbook choices: A review of research on efficacy and perceptions. *Educational Technology Research and Development,* 64, 573. https://doi.org/10.1007/s11423-016-9434-9

Jhangiani, R., & Jhangiani, S. (2017). Investigating the Perceptions, Use, and Impact of Open Textbooks: A survey of Post-Secondary Students in British Columbia. *The International Review of Research in Open and Distributed Learning, 18*(4). http://dx.doi.org/10.19173/irrodl.v18i4.3012

Jordan, K. & Weller, M. (2017). *Openness and education: a beginner's guide*. Global OER Graduate Network. Retrieved from http://oro.open.ac.uk/id/eprint/53028

Kimmons, R. (2015). OER Quality and Adaptation in K-12: Comparing Teacher Evaluations of Copyright-Restricted, Open, and Open/Adapted Textbooks. *The International Review Of Research In Open And Distributed Learning, 16*(5). http://dx.doi.org/10.19173/irrodl.v16i5.2341

Mahood, Q.; Van Eerd, D. & Irvin, E. (2014). Searching for grey literature for systematic reviews: challenges and benefits. *Research Synthesis Methods, 5*(3), 221-234. https://doi.org/10.1002/jrsm.1106

Merkley, R. (2018, May 8). A transformative year: State of the commons 2017 [Blog post]. Retrieved from https://creativecommons.org/2018/05/08/state-of-the-commons-2017/

Misra, P. (2013). Pedagogical quality enrichment in OER based courseware: Guiding principles. *Open Praxis, 5*(2), 123-134. http://dx.doi.org/10.5944/openpraxis.5.2.60

Pearce, N., Weller, M., Scanlon, E., & Kinsley, S. (2012). Digital scholarship considered: How new technologies could transform academic work. *In education*, *16*(1). Retrieved from https://ineducation.ca/index.php/ineducation/article/view/44/508

Peter, S., & Deimann, M. (2013). On the role of openness in education: A historical reconstruction. *Open Praxis, 5*(1), 7-14. http://dx.doi.org/10.5944/openpraxis.5.1.23

Piwowar, H., Priem, J., Lariviére, V., Alperin, J.P., Matthais, L., Norlander, B., …Haustein, S. (2018), The state of OA: a large-scale analysis of the prevalence and impact of Open Access articles. *PeerJ* 6:e4375; https://doi.org/SS10.7717/peerj.4375

Saldaña, J. (2016). *The coding manual for qualitative researchers*. Thousand Oaks, CA: Sage.

Silvertown, J. (2009). A new dawn for citizen science. *Trends in Ecology & Evolution (Personal edition), 24*(9), 467-471. Retrieved from http://linkinghub.elsevier.com/retrieve/pii/S016953470900175X

Social Science and Humanities Research Council of Canada (2018). *Guidelines for effective Knowledge Mobilization.* Retrieved from Social Science and Humanities Research Council of Canada. http://www.sshrc-crsh.gc.ca/funding-financement/policies-politiques/knowledge_mobilisation-mobilisation_des_connaissances-eng.aspx

UNESCO (2002). *UNESCO promotes new initiative for free educational resources on the Internet* [Webpage] Retrieved from http://www.unesco.org/education/news_en/080702_free_edu_ress.shtml

UNESCO (2012). What are open educational resources (OERs)? [Webpage] Retrieved from http://www.unesco.org/new/en/communication-and-information/access-to-knowledge/open-educational-resources/what-are-open-educational-resources-oers/

United States Department of Education (USDE) (2018a). Office of Educational Technology: Open Education. [Webpage] Retrieved from the Office of Educational Technology https://tech.ed.gov/open/

United States Department of Education (USDE) (2018b). Office of Educational Technology: *#GoOpen States*. [Webpage] Retrieved from the Office of Educational Technology https://tech.ed.gov/open/states/

Veletsianos, G., & Kimmons, R. (2012). Assumptions and challenges of open scholarship. *The International Review of Research in Open and Distance Learning, 13*(4), 166-189. https://doi.org/10.19173/irrodl.v13i4.1313

Weller, M. (2010). Big and little OER. In: *OpenED2010: Seventh Annual Open Education Conference*, 2-4 Nov 2010, Barcelona, Spain. Retrieved from http://oro.open.ac.uk/id/eprint/24702

Weller, M., Jordan, K., DeVries, I., & Rolfe, V. (2018). Mapping the open education landscape: citation network analysis of historical open and distance education research. *Open Praxis, 10*(2), 109-126. http://dx.doi.org/10.5944/openpraxis.10.2.822

West, R. E., & Borup, J. (2014). An analysis of a decade of research in 10 instructional design and technology journals. *British Journal of Educational Technology*, *45*(4), 545–556. https://doi.org/10.1111/bjet.12081

Wiley, D., Hilton III, J. L., Ellington, S., & Hall, T. (2012). A preliminary examination of the cost savings and learning impacts of using open textbooks in middle and high school science classes. *The International Review of Research in Open and Distributed Learning*, *13*(3), 262–276. http://dx.doi.org/10.19173

Wiley, D. (2014, March 5). The access compromise and the 5th R [Blog post]. Retrieved from https://opencontent.org/blog/archives/3221

Appendix A: Materials Analyzed

Amiel, T. (2013). Identifying barriers to the remix of translated Open Educational Resources. *The International Review of Research in Open and Distributed Learning*, *14*(1), 126–144. Retrieved from http://www.irrodl.org/index.php/irrodl/article/view/1351/2428

Bagiati, A., Yoon, S. Y., Evangelou, D., Magana, A., Kaloustian, G., & Zhu, J. (2015). The landscape of PreK-12 engineering online resources for teachers: global trends. *International Journal of STEM Education*, *2*(1), 1–15. http://doi.org/10.1186/s40594-014-0015-3

Bennett, P. W. (2017). Digital learning in Canadian K-12 Schools: A review of critical issues, policy, and practice. In A. Marcus-Quinn & T. Hourigan (Eds.), *Handbook on Digital Learning for K-12 Schools* (pp. 293–315). Springer International Publishing. http://doi.org/10.1007/978-3-319-33808-8_17

Bliss, T., Tonks, D., & Patrick, S. (2013). *Open Educational Resources and Collaborative Content Development: A Practical Guide for State and School Leaders*. Vienna. Retrieved from https://oerknowledgecloud.org/sites/oerknowledgecloud.org/files/inacol_OER_Collaborative_Guide_v5_web.pdf

Boston Consulting Group. (2013). The Open Education Resources ecosystem: An evaluation of the OER movement's current state and its progress toward mainstream adoption. Boston Consulting Group. Retrieved from https://www.hewlett.org/wp-content/uploads/2016/08/ The Open Educational Resources Ecosystem.pdf

Charles, K., & Rice, O. (2012). How science teachers can use Open Educational Resources to revitalize lessons. *Science Educator*, *21*(2), 55–56. Retrieved from https://media-proquest-com.uproxy.library.dc-uoit.ca/media/pq/classic/doc/2904653761/fmt/pi/rep/NONE?cit%3Aauth=Charles%2C+Karen%3BRice%2C+Olivia&cit%3Atitle=Emerging+Issues%3A+Open+Educational+Resources+How+Science+Teachers+Can+...&cit%3Apub=Science+Educ

Christou, C. (2017). What's up with OER adoption. *Information Today*, pp. 1, 26–27. Retrieved from https://search-proquest-com.uproxy.library.dc-uoit.ca/docview/1951423584/fulltextPDF/C4C96CC85E6F47E4PQ/1?accountid=14694

Clements, K. I., & Pawlowski, J. M. (2012). User-oriented quality for OER: understanding teachers' views on re-use, quality, and trust. *Journal of Computer Assisted Learning*, *28*(1), 4–14. http://doi.org/10.1111/j.1365-2729.2011.00450.x

Cohen, A., Reisman, S., & Sperling, B. B. (2015). Personal spaces in public repositories as a facilitator for Open Educational Resource usage. *International Review of Research in Open and Distributed Learning*, *16*(4), 156–175. Retrieved from https://media-proquest-com.uproxy.library.dc-uoit.ca/media/pq/classic/doc/3915031561/fmt/pi/rep/NONE?cit%3Aauth=Cohen%2C+Anat%3BReisman%2C+Sorel%3BBarbra+Bied+Sperling&cit%3Atitle=Personal+Spaces+in+Public+Repositories+as+a+Facilitator+for+Open+Educationa

Dabrowski, A., & Lodge, J. M. (2017). Pedagogy, practice, and the allure of open online courses: implications for schools and their students. In A. Marcus-Quinn & T. Hourigan (Eds.), *Handbook on Digital Learning for K-12 Schools* (pp. 443–454). Springer International Publishing. http://doi.org/10.1007/978-3-319-33808-8_27

De Arcos, B., Farrow, R., Perryman, L., Pitt, L.-A., & Weller, M. (2014). *OER Evidence Report 2013-2014*. *Open Research Online*. Milton Keynes: Open Research Online. Retrieved from http://oerresearchhub.files.wordpress.com/2014/11/oerrh-evidence-report-2014.pdf

de los Arcos, B. (2014). Flipping with OER: K12 teachers' views of the impact of open practices on students. In *OCWC Global 2014: Open Education for a Multicultural World , 23-25 April*. Ljubljana, Slovenia: OCWC Global 2014. Retrieved from http://oro.open.ac.uk/40093/1/Paper_73-Flipping.pdf

de los Arcos, B., Farrow, R., Pitt, R., Weller, M., & Mcandrew, P. (2016). Adapting the curriculum: how K-12 teachers perceive the role of Open Educational Resources. *Journal of Online Learning Research*, *2*(1), 23–40. Retrieved from http://oro.open.ac.uk/46145/1/paper_151664.pdf

Goodier, S. (2017). Tracking the Money for Open Educational Resources in South African basic Education: What We Don't Know. *International Review of Research in Open and Distributed Learning*, *18*(4), 16–34. Retrieved from http://0-content.ebscohost.com.aupac.lib.athabascau.ca/ContentServer.asp?T=P&P=AN&K=123906378&S=R&D=ehh&EbscoContent=dGJyMNHr7ESep7U4wtvhOLCmr0%2Bep7ZSsaa4SbaWxWXS&ContentCustomer=dGJyMPGrrk2zr7FJuePfgeyx43zx

ISKNE. (2013). *Composing Possibilities: Open Educational Resources and K-12 Music Education*. Retrieved from http://www.iskme.org/file?n=Composing-Possibilities-Open-Education-and-K-12-Music-Education&id=939

Jimes, C., Weiss, S., & Keep, R. (2013). Addressing the local in localization: A case study of open textbook adoption by three south african teachers. *Journal of Asynchronous Learning Network*, *17*(2), 73–86. http://doi.org/10.24059/olj.v17i2.359

Karno, D., & Glassman, M. (2013). Science as a web of trails: redesigning science education with the tools of the present to meet the needs of the future. *Journal of Science Education and Technology*, *22*(6), 927–933. http://doi.org/10.1007/s10956-013-9439-7

Kelly, D. P., & Rutherford, T. (2017). Khan Academy as supplemental instruction: a controlled study of a computer-based mathematics intervention. *International Review of Research in Open and Distributed Learning*, *18*(4), 70–77. http://doi.org/10.19173/irrodl.v18i4.2984

Kelly, H. Y. (2014). A path analysis of educator perceptions of Open Educational Resources using the Technology Acceptance Model. *International Review of Research in Open and Distance Learning*, *15*(2), 26–42. http://doi.org/10.19173/irrodl.v15i2.1715

Kelly, H. Y. (2015). *Open Educational Resource use in K-12: prevalent practices of teachers engaged in educational technology communities*. University of Florida. Retrieved from https://media-proquest-com.uproxy.library.dc-uoit.ca/media/pq/classic/doc/3988527931/fmt/ai/rep/NPDF?cit%3Aauth=Kelly%2C+Hope+Yvonne&cit%3Atitle=Open+educational+resource+use+in+K-12%3A+prevalent+practices+of+...&cit%3Apub=ProQuest+Dissertations+and+These

Kimmons, R. (2015). Open online system adoption in K-12 as a democratising factor. *Open Learning*, *30*(2), 138–151. http://doi.org/10.1080/02680513.2015.1077109

Kimmons, R. M. (2014). Developing open education literacies with practicing K-12 teachers. *International Review of Research in Open and Distance Learning*, *15*(6), 71–92. http://doi.org/10.19173/irrodl.v15i6.1964

Kimmons, R. M. (2015). OER quality and adaptation in K-12: comparing teacher evaluations of copyright-restricted, open, and open/adapted textbooks. *International Review of Research in Open and Distributed Learning*, *16*(5), 39–57. http://doi.org/10.19173/irrodl.v16i5.2341

Kompar, F. (2016). The trending librarian. *Teacher Librarian*, *44*(1), 58–63. Retrieved from https://media-proquest-com.uproxy.library.dc-uoit.ca/media/pq/classic/doc/4219963661/fmt/pi/rep/NONE?cit%3Aauth=Kompar%2C+Fran&cit%3Atitle=The+Trending+Librarian&cit%3Apub=Teacher+Librarian&cit%3Avol=44&cit%3Aiss=1&cit%3Apg=58&cit%3Adate=Oct+2016&ic=true&

Kwak, S. (2017). How Korean language arts teachers adopt and adapt Open Educational Resources: a study of teachers' and students' perspectives. *International Review of Research in Open and Distributed Learning*, *18*(4), 193–211. http://doi.org/10.19173/irrodl.v18i4.2977

Loertscher, D. V. (2016). OERs, collaboration, and the Library Learning Commons. *Teacher Librarian*, *43*(5), 46–48. Retrieved from https://media-proquest-com.uproxy.library.dc-uoit.ca/media/pq/classic/doc/4220270171/fmt/pi/rep/NONE?cit%3Aauth=Loertscher%2C+David+V&cit%3Atitle=OERs%2C+Collaboration%2C+and+the+Library+Learning+Commons&cit%3Apub=Teacher+Librarian&cit%3Avol=43&cit%3Aiss=

Marcus-Quinn, A. (2016). The potential of high-quality Open Educational Resources (OERs) for the teaching of English poetry. *Journal of Poetry Therapy*, *29*(1), 33–45. http://doi.org/10.1080/08893675.2016.1133085

Marcus-Quinn, A., & Hourigan, T. (2017). The potential of OERs for K-12 schools: why policy is crucial to success. In A. Marcus-Quinn & T. Hourigan (Eds.), *Handbook on Digital Learning for K-12 Schools* (pp. 455–464). Springer International Publishing. http://doi.org/10.1007/978-3-319-33808-8

Murphy, R., Gallagher, L., Krumm, A., Mislevy, J., & Hafter, A. (2014). *Khan Academy in Schools*. Menlow Park, CA: SRI Education. Retrieved from www.sri.com/education

O'Byrne, I. W., Roberts, V., Labonte, R., & Graham, L. (2015). Teaching, learning, and sharing openly online. *Journal of Adolescent and Adult Literacy*, *58*(4), 277–280. http://doi.org/10.1002/jaal.365

Pitt, R., & Beckett, M. (2014). Siyavula Educator Survey Results: Impact of Using Siyavula (Part IV) [Web log post]. Retrieved December 12, 2017, from https://oerhub.net/collaboration-2/siyavula-educator-survey-results-impact-of-using-siyavula-part-iv/

Rao, A., Hilton, J., & Harper, S. (2017). Khan Academy videos in Chinese: a case study in OER revision. *International Review of Research in Open and Distributed Learning*, *18*(5), 305–315. http://doi.org/10.19173/irrodl.v18i5.3086

Robinson, T. J., Fischer, L., Wiley, D., & Hilton, J. (2014). The impact of open textbooks on secondary science learning outcomes. *Educational Researcher*, *43*(7), 341–351. http://doi.org/10.3102/0013189X14550275

Tonks, D. L., Weston, S., Wiley, D., & Barbour, M. K. (2013). « Opening » a new kind of high school: the story of the open high school of Utah. *International Review of Research in Open and Distance Learning*, *14*(1), 255–271. Retrieved from https://media-proquest-com.uproxy.library.dc-uoit.ca/media/pq/classic/doc/3519673231/fmt/pi/rep/NONE?cit%3Aauth=Tonks%2C+DeLaina%3BWeston%2C+Sarah%3BWiley%2C+David%3BBarbour%2C+Michael+K&cit%3Atitle=%22Opening%22+a+new+kind+of+school%3A+The+story+of+the+O

Waters, J. K. (2013). OER and the common Core: will the new state standards push more districts to start using open educational resources? *THE Journal (Technological Horizons in Education)*., *40*(2), 34–39. Retrieved from http://go.galegroup.com.uproxy.library.dc-uoit.ca/ps/i.do?p=AONE&sw=w&u=ko_acd_uoo&v=2.1&it=r&id=GALE%7CA324397569&asid=d7329b39e4c18cf183d816a48c4f7005

Welz, K. (2017). School librarians and Open Educational Resources aid and implement Common Core instructional content in the classroom. *Knowledge Quest*, *45*(4), 62–68.

Wiley, D., Hilton III, J. L., Ellington, S., & Hall, T. (2012). A preliminary examination of the cost savings and learning impacts of using open textbooks in middle and high school science classes. *International Review of Research in Open and Distance Learning*, *13*(3), 262–276. http://doi.org/10.19173/irrodl.v13i3.1153

Ye, L., Recker, M., Walker, A., Leary, H., & Yuan, M. (2015). Expanding approaches for understanding impact: integrating technology, curriculum, and open educational resources in science education. *Educational Technology Research and Development*, *63*(3), 355–380. http://doi.org/10.1007/s11423-015-9377-6

Appendix B: Word Frequency Stop List

The following dates and terms were excluded from the initial Word Cloud key terms search.

> 2010 2011 2011a 2011b 2011c 2012 2012a 2012b 2013 2013a 2013b 2014 2015 a about above after again against all am an and any are aren't aren't as at be because been before being below between both but by can can't can't cannot could couldn't couldn't did didn't didn't do does doesn't doesn't doing don't don't down during each few for from further had hadn't hadn't has hasn't hasn't

have haven't haven't having he he'd he'll he's he'd he'll he's her here here's here's hers herself him himself his how how's how's http i i'd i'll i'm i've i'd i'll i'm i've if in into is isn't isn't it it's it's its itself let's let's me more most mustn't mustn't my myself no nor not of off on once only or org other ought our ours ourselves out over own said same say says shall shan't shan't she she'd she'll she's she'd she'll she's should shouldn't shouldn't so some such than that that's that's the their theirs them themselves then there there's there's these they they'd they'll they're they've they'd they'll they're they've this those through to too under until up upon us using very was wasn't wasn't we we'd we'll we're we've we'd we'll we're we've were weren't weren't what what's what's when when's when's where where's where's which while who who's who's whom whose why why's why's will with won't won't would wouldn't wouldn't www you you'd you'll you're you've you'd you'll you're you've your yours yourself yourselves