Research Article

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Using Visualisation Software to improve student approaches to HE Online Assessment

Abstract: Studying via the Internet using information tools is a common activity for students in higher education. With students accessing their subject material via the Internet, studies have shown that students have difficulty understanding the complete purpose of an assessment which leads to poor information search practices. The selection of relevant information for particular learning assessments is the topic of this paper as it describes a case study that focuses on the information tool use of a small group of participants and is a continuation of similar research studies. The study and discussed research findings point to the benefit of students use of a visualisation tool to provide relevant learning cues and to transition to improved engagement with online assessment.

Keywords: Visualisation; Open source; Online; Assessment

1 Introduction

Enhancing the learner experience through the customization of technology use and practices can provide students with a range of affordances (Jones & Shao, 2011) and learning opportunities. However, despite students' increasing use and familiarity with technology, many still lack the necessary elements of information literacy to successfully identify what information is relevant in a productive and efficient manner (Jones et al., 2010). "[K]nowing when and why you need information, where to find it and how to evaluate, use and communicate it in an ethical manner"

(CILIP, 2017) is increasingly important, yet many students still struggle with selecting appropriate search tools, often opting for generalist platforms such as Google or Wikipedia rather than more advanced or academic options available (Judd & Kennedy, 2010). Constructing effective search criteria also poses a challenge as the ability of students to articulate their information needs through key terms is a common cognitive barrier stemming from insufficient knowledge of the topic at hand (Savolainen, 2015). This also has the potential to influence students' abilities to evaluate the appropriateness of retrieved information.

These challenges faced by students are heightened by the fact they now have to sift through excessive amounts of information available digitally and online (Porcel et al., 2010). Consequently, in their study of their 25 participants' web browser logs, Weinreich et al. (2008), analysed nearly 60,000 first page visits, finding that less than 4 seconds were spent on new page visits 17% of the time and less than 12 seconds were spent in 50% of cases. This indicates that scanning or skimming of information for key terms or details is more common than actual focused reading. Thompson (2013) reported similar search behaviours in her survey of 388 first year university students, highlighting the importance of providing students with explicit directions regarding search term formation and the evaluation of search results. While students' technology and internet use are influenced by the example set by their instructors (Beckman, Bennett & Lockyer, 2014), Springer (2016) found that educators are hesitant to use emergent social technologies and those who try newer technologies, usually revert back to established tools and methods.

This paper reports on the findings of the third phase of a pilot study exploring student online information search behaviours. This phase acts on the findings of the previous phases which indicated an intervention may prove beneficial to student search behaviours (Smith & Qayyum, 2015). In a world with an increasingly visual culture (Rose, 2007) driven by big data and the preferences of digital natives, the use of tools to help students extract key information from texts through a visual means has increasing validity (Pendergast, 2010). As such, the researchers chose a text visualization tool developed by academics at Stanford for

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the purpose of improving literacy skills to use with students as they formed their information search behaviours online. Text visualization techniques synthesize and summarise text into more concise visual representations that hope to provide insights and document comprehension. Cao and Cui (2016) outline five categories of visualization tools based on their purpose of use. These include 1) for visualising document similarity, 2) for revealing the content of text data, 3) for visualising the sentiments and emotions of the text, 4) for exploring the document corpus, and 5) for analysing various domain-specific rich text corpus (e.g. social media). For the purposes of this paper focusing on the meaning of assessment questions, the second category proves most applicable. Word clouds (wordles) or tag clouds which provide visual representations of texts through sizing text according to its frequency of use are common examples of such visualization tools.

Literature regarding the use of visualisation tools in higher education is growing although still tends to lack formal and extended research. In discussing the possibilities of tag or word clouds, Gill and Griffin (2010) highlight their potential to reveal obscured discourses or text where the meaning is not immediately clear. Their effectiveness in engaging different learners, sparking class discussions and pushing the learning focus back on the students themselves was affirmed by Baralt, Pennestri and Selvandin (2011) in their action research project exploring the effect of introducing the use of Wordles in the teaching of Spanish. In this sense, text visualization tools provide a scaffold that can support "objective thinking" (deNoyelles & Reyes-Foster, 2015, p. 18) and the important learning students engage in as they investigate a topic and shape their own understandings of the themes in question (Casas, 2006; Wilson & Lowry, 2000). Practically speaking, visualization tools are often used on students work, either grouped together (Baralt, Pennestri & Selvandin, 2011; Kitchens, 2014) or individually to analyse understandings of topics (pre and post intervention), breadth and appropriateness of vocabulary, student feedback, reflective papers and to provide formative feedback (DaPaolo & Wilkinson, 2014).

Building on this potential and calls for further research into the application of visualization tools in education (Gill & Griffin, 2010), this paper aims to shed light on how the use of one such tool (WordSift) can provide university students with additional insights about their research questions and discusses its impact on the way the students approached their assessment task and information searching. While only detailing a single case study, this paper seeks to add to the limited discourse on this topic, provide insights for practice and encourage further in-depth research in this area.

2 Methodology

The research study was undertaken at Charles Sturt University in Australia and continues the case study approach used by the authors in two previous research phases. In this study, student volunteers were required to undertake a 45 minute usability study in the library located on one of the university campuses where their information searching was recorded using portable eye tracking software and then participate in a 10 minute interview with one of the researchers. These interviews were then transcribed and analysed on a thematic basis (Braun & Clark, 2013).

This phase of the study concentrated on whether an online visualisation tool assisted students in developing and refining their information searching. The five participating students were enrolled in an initial teacher education degree and all studying a third year physical education subject. During a one-week period at a mutually convenient time, students met with one of the researchers in one of the university libraries. During the observation, students were asked to employ their usual approach for information searching. The data collection process was identical to the previous phases where their computer activity was recorded using eye tracking software followed by a 10 minute interview. However, there was a difference in this research phase. Before students started their information search process they were asked to use a software program called 'Wordsift' which is open source software developed by Stanford University. The user inserts text into the software's dialog box and the program produces four outputs. 'Wordsift' will identify the 50 most used words in the text as a word cloud. The program will also highlight words used in their original context along with Google image and visual thesaurus results.

The research plan was to paste the assignment text into Wordsift and observe how students used the wordsift results in their information searching. Due to work commitments, it eventually transpired that only one student was eventually able to meet with the researcher before starting their assessment. The other 4 students participated after they had started their assessment but they did participate as if they were starting their assessment and then used the software tool in a different approach.

3 Findings

The observations and findings are divided into three categories according to the most common themes emerging from the transcribed interviews; wordsift, information searching and information synthesis.

The use of the wordsift program showed that an online intervention strategy provided an extra layer of scaffold to assist students either with commencing their assessments or checking their ongoing essay scripts, Anderson calls it a solid start to univariate analysis (2016, p. 128). The one student who used the software before starting their assessment selected one word from the word cloud result and then used one of the context sentences as a search term. The eye tracking results indicated that all the search results from the first page were read and the first three results were expanded. The interview with this participant confirmed that the word selected corresponded with an assessment section and the focus provided by wordsift enhanced the search results. The remaining four participants carefully checked some of the words from the word cloud in the contextual sentences and the visual thesaurus. The eye tracking response showed three participants reading every line of their results providing some evidence that the word cloud provided some focus for further research and allows the student to develop this focus in their study (Williams, Parkes & Davies, 2013). The interviews with two of the three participants who used wordsift revealed that they would have liked to have used the software at the start of the assessment but found value in the software as they were able to confirm that their words were used in the correct context. The participants actions and comments confirm that this use of contextual visualisation endorses the student engagement with the task (Brookes et al. 2014). Of the remaining two participants, one found the visual thesaurus element useful to confirm the correct meaning or substitution of words at the start of or during the assessment, however, the remaining participant commented they could not see any value with that type of software.

The searching behaviour of the participants was influenced by two factors, whether students had started their assessment task and the impact of using the WordSift software by the four participants that saw value in its use. For the four participants that had started their assessment they already had gathered some information and referred to notes during their information browsing process as opposed to the participant that was starting from the question alone. However, it was the second factor of using the software that demonstrated a more focused search by participants compared to the previous two research phases, with interview comments about refining and focusing their searching being common. All participants entered productive search terms that yielded results connected to the assessment and the eye tracking software showed that they read every result on the first result page of their search. In all cases references from the first results page were opened for further investigation and use. Accompanying the data searches were findings showing increased elements of higher order thinking where students displayed behaviour that indicates evaluation of the material they were reading (Hung et al., 2010; Smith & Qayyum, 2015).

Characteristics of higher order thinking are apparent in the comparison of sites behaviour, comparison to annotated notes, with four out of five students observed taking notes both digitally and on paper and point to some indication of information evaluation and analysis by the participants in the formation of their answers. Participants all commented about the value of comparison and the ability to select the best information for their purpose, There were other observed behaviours such as 7 instances of returning to a website to compare an overall result and in some cases specific pieces of information when answering the assessment question. All participants were rigorous in carefully checking responses.

4 Implications for practice

WordSift provides a scaffold without undue bias that is freely open to all students and teachers to make use of and incorporate into their learning or teaching approach as works best for them. Moreover, it doesn't require additional hours on the part of the teacher or students to set up. It simply offers another level of potential analysis that can help students identify key terms and grasp key concepts. For example, the only participant to engage with WordSift before commencing their assignment stated that the use of WordSift had influenced her search behaviours because it had identified key terms she had previously not considered.

> So when I looked at it before I came into do this one I was going to think about looking up like the importance of PDHPE and things like that. But when I actually read that, with the Word-Sift like sensitive issues was more prevalent when you actually looked at what was required. So I didn't really notice it until that pointed out. It was mentioned like 10 times and I was like arghhh, I really should look at that. (P1 Interview)

The application of visualization tools in this sense seeks to expand students' understandings of the text at hand but not replace their own critical thought. For example, one participant particularly enjoyed the ability to click on keywords and see them in-context (where they were located in the full text), suggesting that students still valued the ability to determine the relevance and importance of key-terms for themselves. The ability of the visual thesaurus to provide alternatives for keywords and assist in understanding and using academic language was also highlighted by two participants, further demonstrating the functionality of this scaffold.

> ...that thesaurus was really good. I'm going to have to look up some words cause that is one thing I find that when you are writing you know, you need different words to make it sound more professional instead of just using everyday language. It's good. (P5 Interview)

The ability to support literacy and vocabulary development in this sense is a core function of visualization tools, especially those such as WordSift (Baralt, Pennestri & Selvandin, 2011; Roman, Thompson, Ernst & Hakuta, 2016), as is their provision of reliable and dependable just-in-time support. While manually identified key terms or phrases may be preferable with respect to reliability in some cases, computer generated approaches such as that offered by WordSift are instantaneous and more scalable (Chuang, Manning & Heer, 2012). Being available 24/7, when incorporated into the assessment approach, WordSift has the potential to provide assistance and encouragement when needed most.

It was suggested by participants (3/5) that WordSift had the most potential value when used at the start of an assignment when students had to define key terms and comprehend the question and task at hand.

> I suppose, if you hadn't really read the outline too much, it would be a good way to see what the most important things they're looking for are in the assessment.(P2 Interview)

> I think at the beginning when I was first going through the assessment and defining the key terms to make sure I answered the question properly, I think it would have been helpful then. Just so you can get a few different ways of expressing that, so that if one of those words doesn't make sense like that then you can understand it in a different way. (P4 Interview)

> Yeah, for the start of an assignment...when you are sort of planning it and like breaking everything down cause I didn't realise you could see the assignment outline and the questions and not

just you know, a 10 worded question they are very detailed so I reckon it would be a really good idea. (P5 Interview)

Despite this stated potential at the start of an assessment task, the majority of students engaged with the tool after having already progressed considerably with their assignments. This saw them to engage differently with the tool and illustrated its ability to provide a point of reflection for work completed. Using WordSift as a reflective prompt helped students check if they were on-track with their assessment and whether they had identified and focused on the same key terms in the assignment descriptor. In their interviews two participants highlighted this potential as a double-check or lens by which they could reflect upon their progress so far.

> Yeah it's a good, a good backup to see that you're going on the right track, to see that obviously you're focusing on the right stages and stuff.(P2 Interview)

> ...it was interesting to see what words were brought up you know, several times, more than others, when I was looking at a word that I actually used quite a lot in this assignment and was only like in that once...I found that quite interesting... So to see what words were highlighted a lot was like in a way positive as well because I had used a lot of those words, like in my descriptions and made sure I was referring back to the questions. So you know that was quite interesting.(TA5 Interview)

This application of the tool had not been foreseen by the researchers who had originally anticipated that students participation and consequently, tool use, would occur prior to commencing their assessment task. However, the validity and use of visualization tools to prompt critical reflection is increasingly represented in the literature (See Baralt, Pennestri & Sevandin, 2011; Berson & Berson, 2009; deNoyelles & Reyes-Foster, 2015). While such studies tend to focus on applying the tool to one's own completed work to provide and provoke insights, the students' comments reported here suggest that applying visualization tools to the task description may also foster critical thinking and reflection upon their own work as they progress.

In reflecting upon the functionality and experience in using WordSift throughout this study, the researchers feel that it could also be used by teaching staff to check the readability and clarity of the assessment task. While teachers typically apply such visualisation tools to student work (Baralt et al., 2011; Brooks et al., 2014; Kitchens, 2014), the researchers believe it also has potential to provide formative feedback to teachers about the wording and content of their assessment tasks.

5 Conclusion

The findings from the third phase of this case study provides some evidence that the use of specific visualization interventions can scaffold the way university students approach researching the answers for online assessment. Observation of participants showed that after using Wordsift, the following behaviours were observed, students used the thesaurus for greater interpretation on certain key words and to provide alternatives for words in their essay, students also used the analysis results as search terms providing more initial information results that could be used and certain paragraphs in students answers were evaluated using the software to ensure clarity of meaning.

The overall result indicated that students searched for data with clearly focused search terms resulting in information results that could be used to answer the assessment and thereby reducing the amount of time searching for suitable information. This pilot study highlighted three outcomes that were beneficial for students studying online. The suitability of the software available to all students highlighted keywords for participants to seek and engage with information during their online research for the assessment, including their tool usage, search strategies and reading behaviours. Using the visualisation software influenced the way higher education students approach their investigation for assessment, either in focusing their initial strategy to answer the assessment or to confirm their answers. Finally using such software increased the efficiency and effectiveness in the way that the students approached the assessment enabling better use of time to investigate and interrogate information at a greater depth.

Clearly when students are studying online any automated assistance that students can rely on to assist them in providing greater understanding for academic tasks providing a transitional benefit for those students for whom online learning is new and for those students who need assistance with their assessments. For students studying online the automatic provision of immediate assistance in a learning environment is transformational compared to help not always being available due to the flexible nature of online learning. Such results point to the need to involve a greater number of students engaged in an online subject to compare and validate findings to the previous case study. Such findings will provide direction to those areas of the university involved with either designing online assessment or providing assistance to students in the online environment and may lead to an evolution of the wordsift program to custom built software targeting the learning needs of higher education students.

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