

Student knowledge creation for assessments in higher education

Abstract: Conducting research online to find resources for assessment tasks is now a common everyday activity for students at most education levels and settings. When the students access study material via the Internet and without the presence of an instructor, especially in distance education settings, then students can face difficulties in understanding the complete purpose of an assessment. Such difficulties can lead to poor information search practices resulting in a poor knowledge gain, which may in turn lead to poor information synthesis and poor knowledge creation. This study focuses on the use of information tool by novice and experienced university students to gain and create knowledge for their assessment tasks. An intervention in the form of a learning tool was introduced to create a visual and textual support scaffolding for the students, and thus provide them with some relevant learning cues to improve knowledge creation and their engagement with online assessments tasks.

Keywords: Knowledge gain, knowledge creation, visualisation, assessments, online and distance education.

1 Introduction

Accessing technology is a regular part of the daily routines of students and most students appear to be quite comfortable with its usage, yet they still struggle with aspects of information literacy (Jones and Shao, 2011). It is essential therefore that the students learn how to select the correct search tool, construct a

meaningful search criteria, and be able to evaluate the retrieved information to create the knowledge required. It is only through this customisation of technology use and practices that real knowledge gains will occur, and learning will be capitalised.

Teachers in higher education also need to be familiar with latest learning tools, online content creation and presentation techniques to maximise knowledge transfer. This is especially important in distance education environments, where a face to face teacher-student interaction is lacking. In such environments, narratives need to be fashioned in such a way that learners can construct and reconstruct knowledge and ideas independently on their end (Earl, 2012, p. 55). Therefore, the purpose of this study is to investigate how and what information is sought by students when carrying out independent online research related to their assessments, and how that information is used to gain and create knowledge. The created knowledge can thus be used to address the assessment requirements.

A key component of this study was the use of an intervention aimed at improving the knowledge gain and creation of the students. The intervention was in the form of a software application, which was introduced to the students to help them understand the tasks better, and hence provide an additional scaffold in their learning process. The participants for this study were all university students either at entry level, or experienced ones in their 3rd or 4th year of studies. These students participated in a recorded research session, which was usually followed by a short retrospective interview.

2 Review of the literature

Nonaka, Umemoto and Senoo (1996) define knowledge creation as “a dynamic human process of justifying a personal belief towards the truth and/or embodying a technical skill through practice”. In education, Earl (2012, p. 42) describes

knowledge creation as a process that requires important concepts to be organised and classified so that useable knowledge can be drawn from them. These definitions conform very well to the notion of online information searching of students where the important concepts are discovered, gathered, and organised so that useful knowledge can be derived from them.

First phase to happen during this information seeking is the discovery process, and usually students conform to a conventional pedagogy and use generalist information searching platforms (Judd and Kennedy, 2010). Judd and Kennedy research also indicates that the search platforms used by students are usually simple solutions such as Google or Wikipedia, which are made available to them by their instructors (Li, 2012) and are fairly limited in number (Qayyum and Smith, 2015). Therefore, the students will usually make do with conventional uses of technology rather than to try and use them in a sophisticated manner. Even the teaching staff are reluctant to make use of any emerging technologies, especially those in the social sphere, for their teaching purposes (Springer, 2016). As students are influenced in their technology use by their instructors (Beckman, Bennett and Lockyer, 2014; Lai, Wang and Lei, 2012) therefore, established technological tools and methods are usually deemed sufficient by students to seek knowledge, and for the staff to disseminate it.

Finding the relevant information for knowledge creation is another challenge for students, for example, Weinreich, Obendorf, Herder and Mayer (2008) analysed nearly 60,000 first page visits from the web logs of 25 students to conclude that 17% of new pages were visited for less than 4 seconds, while nearly 50% of the first page visits lasted less than 12 seconds. Therefore, users are quickly skimming or scanning the content to locate the useable information. That may be the reason that Thompson (2013) recommends students should be given explicit training in forming searches and evaluating the discovered information. Along with training, a student support scaffold needs to be created so that it becomes integral to student

learning, furnishes staged support (Puntambekar and Hübscher, 2005), and thus enables the generation of knowledge. Such a scaffold can simply be in the forms of hints and prompts, or could be somewhat more complex in the shape of technological tools, and classroom group interactions. Similarly, Georgas (2014) also recommends including some analysis of the topic as a support structure within the assignment task itself to help students create and carry out better searches while seeking knowledge.

Once a resource has been discovered, extracting knowledge related to the assessment task is another evolving area in the online arena where information is abundant. Online readers now prefer to skim and scan text rather than do any careful or in-depth reading (Stoop, Kreutzer and Kircz, 2013) as they are overwhelmed by the vast amounts of information (Thompson, 2013). For example, a study of usage logs of a university library indicate that users typically spend 4 minutes on e-book and 8 minutes on journal sites (Rowlands *et al.*, 2008). The internet as medium can also have a distractive influence on user reading (Subrahmanyam *et al.*, 2013), who should devote longer times to read on computer screens, to digest the words, and to reflect on ideas to pursue knowledge (Cull, 2011). Knowledge may then be created through this practice of deep reading and reflection.

3 Methodology

The study was undertaken at Charles Sturt University in Australia, and participating students were volunteers either at the starting levels (novice students), or experienced students in their 3rd of 4th year of studies in the discipline of Education. The participating students were required to undertake a 30-40 minute usability study in a computer lab located on one of the university campuses. The tasks used in this study required users to simulate carrying out

research required for their respective assessments, and ethics approval was granted by the Faculty of Arts human research ethics committee.

The usability sessions were digitally recorded using a desktop mounted Tobii X120 eye tracking unit (shown in figure 1) running a Tobii Studio application, which recorded the eye movements on the screen as well as all other screen activity including web browser sessions, applications used, mouse movements, typing etc. Therefore, all the on-screen information seeking activities of the users in context of an assessment were captured and recorded. After that session, the users participated in a short 10 minute retrospective interview with one of the researchers.



Tobii X120 desktop eye tracking unit



Tobii wearable eye tracking unit

Figure 1: The two types of eye trackers used in this study

An extension of this study later used a glasses style Tobii wearable eye tracking unit (as shown in figure 1). Five undergraduate participants used these units to carry out information searching, again in context of their assessment, and this study was conducted in a library study room instead of the lab. One difference was that before the students started their information searching, they used a software app called 'Wordsift', which is an open source software developed by Stanford University. This visual intervention was introduced to assist the students in forming some refined information search terms as the app identifies the 50 most

used words in the assessment text as a word cloud. Also listed by the app were highlighted words as were used in their original context, along with a Google image, and visual thesaurus results. Figure 2 shows one of the participants in this study looking at the word cloud of the assessment task as is generated by WordSift. The red circle is automatically generated by the eye tracker to indicate where the user is looking on the screen.

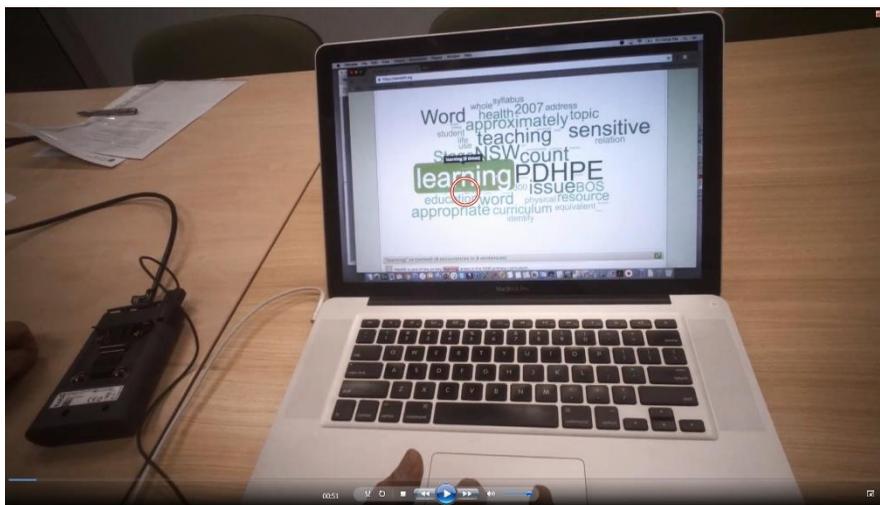


Figure 2: A participant using WordSift and being recorded by the wearable eye tracker

4 Findings

The preliminary findings from this study were compiled into two categories; knowledge gained during the search process, and knowledge gained and created from information synthesis.

4.1 Knowledge gained during the search process

Google Scholar (GS) seemed to be the favoured option adopted by users in this study when they searched for information to gain knowledge online. A reason for this may be perhaps because of its perceived usefulness and loyal following

(Cothran, 2011). For example, one participant stated that, “*Google Scholar will give you all your peer reviews, what specific information that you need*”.

However, before moving to GS, novice students relied on online tools such as Google (as also indicated by Qayyum and Williamson (2014)) and Wikipedia to gain some preliminary knowledge about the topic, which could then be used to carry out further searches. One comment around this was, “*if you just go to standard Google it’s more in layman’s terms and it’s really easy to understand and then you can get your ideas, get your concepts and then build off it with the Google Scholar*”.

Knowledgeable search terms were formed by experienced students by using GS or library catalogue as the starting point. These students first gained the preliminary knowledge from their readings of the assessment, related resources, and subject guides before they were able to form these knowledgeable terms. As one student pointed out, “[I] *start with the subject guide first, because that has recommended texts and sources*”.

Eye tracking data indicated that Google results were hardly read by novice students, as they skimmed and scanned mostly the top half of the results page. A result was quickly selected, scanned quickly, and the resulting knowledge was used to modify the search term. Thompson (2013) terms such behaviour as ‘*get in, get the answer, get out*’, which can potentially result in a gain of only shallow knowledge.

Experienced students on the other hand exhibited similar fast reading behaviour initially, and that too for only the higher placed results. However, once they read some of the preliminary documents discovered from the initial search, that behaviour changed. The knowledge gained from their preliminary reading was

reflected in the formation of better search terms, and after that the search engine results pages were read all the way down. This behaviour was described by one participant as, *“kind of just followed the trail really and I don’t really think in a very logical sequence. I tend to just be really messy, but in my mind it’s all making connections to prior learning”*.

Therefore and thereafter, the users mentioned creating mental models between the task, the discovered resources, and learning from their previous searches to create new terms and carry out further searches. Such a behaviour indicates that gaining shallow knowledge from fast reading of initially discovered information was exhibited by experienced students also, but that early knowledge was supplemented by more information and users seemed to have ended with some semblance of meaningful knowledge.

Intervention via the Wordsift program was added by the researchers to this study as an online intervention strategy, and the students used this program to discover the keywords present in the assessment task. This strategy was used to provide an extra layer of scaffold to assist students in coming up with a better search strategy, because the students often search for knowledge in a disorganised manner. For example, one participant stated that, *“I guess I kind of just put in like keywords I suppose and read lots and lots of articles until I find something”*. Another participant was a little more organised, *“[In an assessment] I find is a lot of small questions that you have to answer, so I kind of break it down and then start the research for each question”*.

Three of the five participants who used WordSift were observed to have carefully read through the words in the word cloud, using contextual sentences and visual thesaurus. These participants then used the words from the word cloud to form

their search terms. During the retrospective interviews, these students confirmed that their search terms yielded desired outcomes as their words were used in the correct context, and therefore resulted in the knowledge they wished to gain prior to beginning their search. For example, one participant stated that, *“But when I actually read that, with the WordSift 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.”* Another stated that, *“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“.*

After using Wordsift, the searching behaviour of the participants seemed to be more productive as the participants were observed by the eye tracking unit to be seemingly better engaged with the search tasks. 3 of the 5 participants started with Google and read through most results on the first search result page. Library catalogue visitors even went to the second page of results when seeking further information. Engagement with the search results was visible in all cases as all participants followed some of the links from the search results for reading the discovered resources. Therefore, the knowledge extracted as a result of their connection established with the preliminary results earlier on seemed to have spurred students in their pursuit to gain more focused knowledge later on, and hence fulfil the task requirements effectively.

4.2 Knowledge gained and created from information synthesis

After discovering the information resources, the participants mostly indulged in skimming or scanning the content. One noticeable knowledge gain happened when novice and experienced students sometimes paused to read around the areas

where perceived keywords were spotted; a behaviour that was more noticeable in the case of experienced students. One novice student justified the pausing actions by saying, *“If you can scan it quickly and try to pick up, or know, keywords and information to help, you know, what you know, what you are looking for, yeah”*. Another person stated that, *“Briefly [I] read them [articles] online until I come across some key points that are going to be beneficial”*. Participants who were observed to have paused to read more often performed better on tasks and therefore, they can be said to have created better knowledge.

Eye tracking observations indicated that preliminary knowledge from the sources was gained from the abstracts, and that too usually from the first half of it. Abstracts were said to be read to determine the worth of an article before taking the decision of downloading it or not. After going through the abstracts, the introductory parts of the document were mostly scanned, presumably while seeking keywords, and by the mid-document reading stage users would start skipping content, and possibly skip the last parts. There were some places in the documents which attracted user attention e.g. italicised/bold text, bullet points/lists, and sometimes figures. Therefore, most of the knowledge gain is expected to happen from the reading of the abstracts, texts in the beginning of the document, and from reading around the differentiated parts.

A key aspect noted of the use of WordSift intervention was the visual content it provides. For example, one participant suggested that, *“Probably the visual mind map, which was probably the best thing”*. Therefore, higher engagement of students with the task is thus envisaged through the use of contextual visualisations such as this one, as was also suggested by Brooks, Gilbuena, Krause and Koretsky (2014). Use of such visual tools should therefore help the student gain more knowledge earlier on in their search process, which should carry over

and translate into an increased engagement with the texts in the post-discovery phase.

Accompanying the data searches were also findings showing increased elements of higher order thinking where experienced students displayed some behaviour that indicated an evaluation of the material they were reading, as was also suggested by others (Hung et al., 2010; Smith & Qayyum, 2015). Such higher order thinking is expected to lead to knowledge creation, which was observed in this research to mostly happen during the note taking activities of the student participants. While the novice students mostly tried to create a mental image of the information that had discovered, most experienced students took notes. However, much of this note taking activity was simple copy and paste actions, and very little evidence of information synthesis or knowledge creation was observed in such instances.

The use of Wordsift intervention was observed to have helped the experienced students develop some characteristics of higher order thinking, as the users compared sites (7 instances of returning to a website for comparison and/or note taking) and prepared annotated notes (several instances of note taking by 4 participants). Even for participants observed without the intervention, going back to revisit resources was positively associated with their performances. These observation indicate that experienced participating students did carry out some information evaluation and analysis when forming their responses to the assessment, thus carrying out activities that should result in knowledge creation.

5 Conclusions

The findings of this study indicate that there is some evidence students will learn new approaches to gain and create knowledge with experience. This process can be speeded up through the use of some formatting interventions, which can act as a scaffold for the university students as they carry out research to address the requirements of their online assessments. With this view in mind, this study employed an intervention using Wordsift, in which students discovered keywords in written text using a word cloud like formation.

Two stages are noted in this study where students gain and/or create knowledge. One is at the information searching stage and the second is when they are working with discovered resources. At the search stage, students often resort to a hit and trial kind of approach as they try to figure out which tool to use, and what search terms or keywords will help them find the information they need. Use of an intervening app that will create a visual map of the key concepts in the assessment task may help them streamline their discovery process and enable them to engage better with the search results. In the post-discovery stage, the effect of using an intervening app were observed to have resulted in improved reading behaviour, a better engagement with the texts leading to some information synthesis, and improved knowledge creation activities with the help of notes.

The final conclusion of this study is that the use of a visualisation application should positively influence higher education students in their approach towards assessment related research. The influence was noticeable in improving their focus, engagement, and formation of an initial search strategy right through to the final stages of addressing the requirements of the assessment. This increased efficiency and effectiveness resulted in interrogation of information at greater depths by the students, resulting in superior knowledge creation activities.

The implication here is that for students who are studying online and in distance settings, any automated assistance that students can be provided with and trained on by the university will assist them in gaining a better understanding of academic tasks. Therefore, these results point to a need for the higher education instructors to guide students in the use of tools that are available to enhance learning of university students.

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