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RESEARCH REPORT

MA RESEARCH PSYCHOLOGY

RESEARCH TOPIC

Digital search literacy, self-directed learning and epistemic cognition in a South African undergraduate student sample

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Declaration

I declare that this research report is my own unaided work. It is submitted for the degree of Master of Arts in Psychology by Coursework and Research Report in the University of the Witwatersrand, Johannesburg. It has not been submitted before for any other degree or examination in any other university.

_____

Taryn Elise Herselman

_____day of _____, 2016

Dedication

This report is dedicated to my great aunt, Maggie Teasdale, who passed away last year and to my dear student Pamela du Rant who passed away in February 2016. Aunt Maggie, you taught me to strive for excellence and I felt your strength during those trying moments, reminding me that giving up was simply not an option. Pam, you inspired me to be the finest teacher I could be by continuing to learn and grow as a person and mentor. Thank you for the lessons you have both taught me.

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Abstract

Undergraduate students' require a certain degree of digital literacy in order to make use of the internet as a resource and educational tool. This report argues that two critical aspects of digital search literacy are the student's ability to effectively execute and monitor the search strategies used to navigate the ever-increasing number of webpages; and the critical thinking skills required to evaluate those documents in an academic context. Therefore, digital literacy requires effective self-directed learning (SDL) skills and appropriate epistemic cognition (EC). The present research used a sequential explanatory design, which comprised of two phases: Stage 1, N = 119 and Stage 2, N=17. The sample for both phases of the project was drawn from students enrolled for first-year level psychology courses at the University of the Witwatersrand. The sample for Stage 2 was drawn from students who had already completed Stage 1, which required the completion an online questionnaire. During the second phase, students were tasked with conducting a web-based search on an essay topic relating to the discipline of psychology. Several research objectives were examined; general self-reported epistemic cognition and readiness for self-directed learning levels of a sample of undergraduate South African university students; self-reported self-directed learning behaviours, epistemic cognition and digital search literacy issues; the impact of search strategies on the type and quality of information sources located; and the psychology-specific epistemic beliefs involved in the evaluation of source features of web based documents.
Findings showed that students did indeed engage specific self-directed learning and epistemic cognition behaviours while searching for resources online. The key components of digital search literacy included, self-directed learning (monitoring and strategy use) and epistemic cognition (source evaluation). In terms of rating the sources, personal justification and justification by authority were the most predominant when students rated the most credible sources; while relevance to task, personal justification and format/style were applied more often when rating the least credible web documents. In conclusion, future research on digital literacy should include the relative contribution of SDL and EC components as important mechanisms for online search strategies and critical source evaluation.
Keywords: self-directed learning, epistemic cognition and beliefs, source evaluation, web search, navigation behaviour, strategies

Chapter One

1.1 Introduction

In today's technology-driven world, a strategic objective for students and educational institutions at all levels will be developing digital skills (Van Dijk & Hacker, 2003; Joint Information Systems Committee (JISC), 2009). Although studies of digital learning have examined the various cognitive skills required to develop competence in digital literacy (Gee, 2007), an in-depth study has not been undertaken to see how different cognitive factors, mediated by cultural and historical influences unique to South Africa, manifest in the current student population. There is a common misconception that all students born in the *digital age* are presumably uniformly digitally literate, i.e., they are 'digital natives' (Prensky, 2001). In South Africa, a large number of university students lack even basic computer skills and their initial exposure to internet technology and computers only comes when first entering tertiary education (Naidoo & Raju, 2012). Inequitable access to technology for tertiary students in university residences contributes to vastly different levels of computer skills and abilities (Naidoo & Raju, 2012).

For educational institutions to meet their objectives to induce change and progress in a knowledge-based society, requires an understanding that digital skills refer not only to the means to operate hardware and software, but also the ability to strategically and critically use digital information and apply it in a meaningful way (Van Dijk & Hacker, 2003). The sheer volume of information available and the profusion of ways it is presented, provides a challenge to learners, who need to understand and integrate the various sources of information (Greene, Seung, & Copeland, 2014). The internet plays an important role in both the home and classroom; therefore, there is a need to understand how technology interacts with learners' knowledge gains (Greene *et al*., 2014). Beyond information and communications technology (ICT) and information skills, the Learner Experiences of e-Learning study (JISC, 2009), revealed that learners require a manifold range of digital capabilities in order to succeed. These skills include the ability to communicate in different media, manage identities, critical reading, choosing suitable combinations of technology, and handling public–private boundaries in online social spaces (JISC, 2009).

While it is essential to consider how the use of digital media affects learners ' diverse cognitive processes (Reinking, 2005), likewise, it is as relevant to reflect on how these cognitive processes in turn influence learners ' interaction with online resources (Strømsø & Bråten, 2010). Greene *et al*. (2014), suggest that self-regulated learning (SRL) and epistemic cognition (EC) are critical cognitive components to developing digital literacy. Self-regulated learning skills and strategies (Zimmerman & Tsikalas, 2005) include the ability to make efficacious plans, monitor and control

those plans, and then to effectively follow through on them (Azevedo & Jacobson, 2008). Nevertheless, even learners that successfully self-regulate their learning often lack adaptive beliefs and critical thinking skills, i.e., epistemic cognition (Greene, Azevedo, & Torney-Purta, 2008). These epistemic cognition skills are essential in order to identify credible online sources of information, avoid biased websites and integrate divergent thinking into valid and generalisable knowledge (Clark & Slotta, 2000; Mason, Ariasi, & Boldrin, 2011). Given the infinite amount of information accessible online and the inconsistencies in its quality, both self-directed learning (SDL) (Guglielmino & Guglielmino, 1991) and epistemic cognition (EC) (Greene *et al*., 2014) are critical components of digital information literacy, thus warranting further research.

In this two-phased mixed-methods sequential explanatory design study, quantitative and then qualitative data were collected and analysed in two consecutive phases. During Stage 1, self-reported data was gathered by means of an online questionnaire which measured self-directed learning (SDL), epistemic cognition (EC) and general online search behaviours (OSB), such as using Google, E-journals, electronic databases and so forth. There are several psychometric concerns about self-report measures. For example: response bias, spurious responses, an inability to measure how much attention is paid to the different parts of the questionnaire, as well as their interpretation and use of the scale items (Austin, Gibson, Deary, McGregor, & Dent, 1998; Veenman, 2007). Therefore, a second stage was also conducted using qualitative methods to address these limitations. The second phase of this project required learners to locate multiple online documents (no more than 10) and then to rate each source on a 4-point Likert type scale (ranging from highly credible to not at all credible) and, finally, to provide a brief motivation for rating one of their sources as either the most or least credible.

The aim of this research project was to describe the critical components of digital literacy learners require to effectively conduct online searches for academic purposes and, finally, to vet the information obtained during a search task. This report further aims to expand on, and contribute to, the existing body of work in understanding which digital literacy skills learners employ when using online resources within a South African context.

1.2 Literature Review

1.2.1 Definitions of digital literacy

The term ‘digital literacy’ is used incongruously throughout the literature: certain authors choose a more narrow definition, referring purely to the technical aspects related to digital frameworks, while others incorporate more of the socio-emotional and cognitive aspects of digital literacy (Yoram, 2004; Scott, Cole, & Engel, 1992). Yoram (2004) defines digital literacy as a term that embodies a coordination of multiple skills and strategies that learners use in digital environments. Digital literacy requires not only the recognition of numerous forms of representation, but also a unified comprehension of these representations (Gee, 2007). Hockley (2012) has equated digital literacy with search literacy, i.e. searching online for information, and information literacy.

Greene *et al*. (2014) claim that these contemporary definitions of digital literacy fail to sufficiently emphasise the critical cognitive and metacognitive processes needed to learn successfully from the copious representations of content available online. Greene *et al.* (2014) view digital literacy as comprehensive of searching, reviewing and consolidating information into a meaning-making process during online learning. Learners making use of digital information for learning, therefore, require effective self-regulated learning skills (Azevedo & Jacobson, 2008; Zimmerman & Tsikalas, 2005) in conjunction with an understanding of the process of knowledge construction, and the ability to make judgements, i.e., epistemic cognition (Mason, Ariasi, & Boldrin, 2011; Greene, Torney-Purta, & Azevedo, 2010).

1.2.2 Self-directed and self-regulated learning

Knowles (1975), explains self-directed learning as a process ‘in which individuals take the initiative, with or without the help of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, choosing and implementing appropriate learning strategies, and evaluating learning outcomes’ (p. 18). Two very closely linked concepts are self-directed and self-regulated learning (Saks & Leijen, 2014). One distinguishing feature between the two is that self-directed learning is suggested to be situated at the macro-level, while self-regulated learning is stated to be a micro-level concept that concerns processes within task execution (Jossberger, Brand-Gruwel, Boshuizen, & Wiel, 2010). A contrast between the two constructs is summed up in the following table (Table 1) (Guglielmino & Guglielmino, 2006).

Table 1. A hypothetical proposition of differentiation between SDL and SRL

	Self-Directed Learning	Self-Regulated Learning
Domain of application	Adult education	Educational psychology
Principal population	Adult learners	Children, adolescents, students
Range of application	Learning projects	Learning activities

(Jossberger, Brand-Gruwel, Boshuizen, & Wiel, 2010).

Self-directed learning at the macro-level refers to setting long-term learning goals and seeing the route towards achieving them. A self-directed learner is able to implement the correct strategy that enables them to achieve their learning objectives. A skilful self-directed learner diagnoses his learning requirements, formulates learning goals, finds suitable resources for learning, and monitors his learning activities (Jossberger *et al.,* 2010). A self-directed student works independently to prepare, execute and complete their learning goals. The first step in self-directed learning is to develop the skills needed to self-regulate learning activities and task performances (Jossberger *et al.,* 2010). Another measure of self-regulation is the degree to which learners are metacognitively, motivationally and performance based active shareholders in their learning (Zimmerman & Tsikalas, 2005). Whilst digital environments can be used to accelerate mature conceptual aptitudes, learners require self-regulation to take advantage of what these digital platforms can offer in terms of sophisticated learning advancements (Greene & Azevedo, 2009; Azevedo, 2005).

According to the social cognitive perspective (Bandura, 1977), self-directed learning develops dynamically in four recurrent phases. These include defining tasks, setting goals and planning, enacting study strategies, and metacognitively adapting studying techniques (Knowles, 1975). Self-regulated learning occurs in three phases (Zimmerman & Tsikalas, 2005). The first phase, *forethought,* involves processes that precede endeavours to learning and improve performance. Along with certain metacognitive processes (e.g. evaluating tasks, goal creation and strategic organisation), the forethought phase also consists of determinants of self-motivation (e.g. personal values and interests, self-efficacy beliefs and innate motivation), which empower this self-initiated model of learning (Bandura, 1977; Zimmerman & Tsikalas, 2005). The second phase, *performance*, comprises the adoption of metacognitive and behavioural procedures (e.g. self-instruction, imagery and directing attention) in addition to two methods of self-observation and introspection – namely *metacognitive monitoring* and *recounting behaviours* (Zimmerman & Tsikalas, 2005). These self-driven mechanisms are constructed to augment the quantity and quality of learners' achievements.

Finally, the *self-reflection* phase of self-regulation refers to one's own evaluation and responses to the performance phase functioning. (Zimmerman & Tsikalas, 2005).

Computer Self-Efficacy (CSE)

Studies conducted by Zimmerman and Tsikalas (2005) on self-regulation in conventional learning environments have shown that consecutive multilevel training promotes the development of metacognitive competence. Not only does training improve metacognitive proficiency it also reinforces learners' motivational self-beliefs, an illustration of which is self-efficacy (Zimmerman & Tsikalas, 2005). Self-regulation can therefore bolster proactive learning, even when a student is faced with intimidating obstacles. Computer self-efficacy (CSE) is a term that derives from Bandura's (1997) Social Cognitive Theory. In his theory, Bandura (1997) constructs self-efficacy as a person's belief in their ability to achieve in particular contexts. This term can also be applied to the field of digital literacy development. Learners with negative perceptions of their computer self-efficacy may find themselves more easily discouraged by obstacles to their performance and could respond by decreasing their belief in their competency at using computers or information technology (Punnoose, 2012). According to research conducted by Zimmerman and Tsikalas (2005) on self-regulation, there is a lack of focus on the role of learners' motivational beliefs and self-reactions, which could encourage learners to continue their studies, in spite of the barriers to learning.

1.2.3 Epistemic cognition and beliefs

Following the work of Greene *et al*. (2008), and in the context of this research project, epistemic cognition (EC) is used as an umbrella term encompassing an array of tangible or implicit cognitions relevant to epistemic or epistemological matters. Epistemic cognition consists of a network of interconnected cognitions that cluster into at least five distinguishable components (Chinn, Buckland, & Samarapungavan, 2011). Firstly, epistemic aims and values (goals that people adopt and the worth of particular epistemic achievements). Secondly, the structure of knowledge and other epistemic accomplishments. Thirdly, the sources and justification of knowledge (people's reasons for their beliefs) together with related epistemic stances (these are attitudes that people take with respect to an idea). Fourthly, epistemic virtues and vices (intellectual courage and open-mindedness versus characteristics that hinder the achievement of epistemic aims) and, finally, dependable and unpredictable processes for achieving epistemic aims (the processes can be cognitive and social) (Chinn, Buckland, & Samarapungavan, 2011). Schommer's (1990) ground-breaking work in the area of epistemic cognition as a

multidimensional system of beliefs, specified the following five dimensions of epistemological beliefs. Namely, the extent to which learners believe that (a) knowledge is complex, (b) knowledge is certain, (c) learning is quick, (d) the ability to learn is innate, and (e) information is received from authoritative sources as opposed to reason (Schommer, 1990).

Epistemic cognition (EC) encompasses an array of cognitive phenomena that guide and facilitate the acquisition and embodiment of knowledge (Greene *et al*., 2008). EC assists in producing the conditions within which adaptive learning occurs (Bromme, Pieschl, & Stahl, 2010), while also increasing the possibility of higher quality digital learning (Tu, Shih, & Tsai, 2008). EC includes criteria such as the evaluation of sources of knowledge claims and the reconciliation of conflicting claims by multiple sources (Bråten, Britt, Strømsø, & Rouet, 2011). A further example of the application of epistemic cognition is that it is often considered most helpful to learning when one believes knowledge is complex rather than simple (Schommer, 1990). Schommer (1990) defines learning, in this context, as an amalgamation of networked information brought into a coherent whole. This is as opposed to simply memorising discrete information without making any external or broader associations (Schommer, 1990).

Within the field of EC, there is a tendency to focus upon learners' beliefs about the nature of knowledge – for example, simplicity and certainty and the nature of knowing, such as the source of a knowledge claim and its justification (Hofer & Pintrich, 1997). However, current research in this field has emphasised a broader set of cognitive processes, including the multiple kinds of justifications that learners adopt (Greene, Azevedo, & Torney-Purta, 2008; Greene, Seung, & Copeland, 2014) and the numerous aspects of goal setting learners establish for learning (Chinn, Buckland, & Samarapungavan, 2011).

1.2.4 The role of internet-specific epistemic beliefs during internet based searches

Bråten, Strømsø, and Samuelstuen (2005) investigated the role of epistemic beliefs during web searches. They justify focusing specifically on epistemic beliefs related to the internet as a particular type of knowledge resource due to its specific characteristics – for instance, the nonappearance of editorial gatekeeping and the great diversification of data sources. Bråten *et al*. (2005) empirically found two dimensions to internet related epistemic beliefs. The first dimension, general internet epistemology, concerns the degree to which learners believe the internet provides correct, expert and reliable information (Bråten *et al*., 2005). The second dimension, justification for knowing, involves the extent to which learners believe there is a need

to critically evaluate internet based, course-related knowledge claims using multiple information sources, reasoning and prior knowledge activation.

Using self-reported data on study-related searches, Bråten *et al*. (2005) looked at the correlation between search and evaluation behaviour and internet specific epistemic beliefs. The results showed that those learners with strong views that the internet is a reliable knowledge source, containing correct and detailed information, were more competent and had fewer problems performing web searches than those who questioned its reliability. A similar study by Strømsø and Bråten (2010) found a positive relationship between beliefs that knowledge claims made by internet based sources should be verified against alternative information sources and prior knowledge as one point of view; and the reported use of self-directed learning strategies (such as planning, monitoring, and regulating cognition and performance) during web searches, as another. Additional research (Lee, Chiu, Liang, & Tsai, 2014) indicated that these beliefs were also positively related to high-school learners' reported use of search engines and expert websites to solve academic problems. Beliefs that the internet provides a wealth of detailed information were also positively associated to similarly reported web search strategies (Lee *et al*., 2014).

Whereas the research outlined above used only self-report data, Kammerer and Gerjets (2012) and Kammerer, Bråten, Gerjets, and Strømsø, (2013) examined the relationship between internet-specific epistemic beliefs and assessment procedures using more direct data collection methods. Qualitative data was collected by means of eye-tracking data, log files and verbal protocols that were recorded while participants used a search engine to learn about a conflicting medical topic. Kammerer and Gerjets (2012) found during a web search task, that if university freshmen had strong epistemic beliefs that the internet is a reliable knowledge resource, then they tended to access more objective (i.e. academic, factual) websites. Kammerer *et al*. (2013) also established that university learners, with stronger epistemic beliefs that the internet is a reliable knowledge resource, were more certain about their post-search decisions (i.e., which of the two therapies they would recommend to a fictitious colleague). However, the results also indicated that learners with such beliefs verbally reflected less on the nature or credibility of different varieties of knowledge sources (e.g., forum websites or official institutions' websites) encountered in the search engine results pages (Kammerer *et al*., 2013). Whilst this could be an indication of a lower degree of source evaluation, another explanation for this finding might be that they mainly focused on reliable information sources whilst avoiding those they believed to be biased.

While prior research on internet-specific epistemic beliefs has not provided evidence of a relationship between beliefs concerning justification for knowing and source evaluation, as proposed by Bråten *et al.*'s (2011) theoretical model, Strømsø, Bråten, and Britt (2011) did find a relationship for topic-specific beliefs regarding rationalisation for knowing. If university learners strongly believed that they needed to critically evaluate a knowledge claim about climate change, then they relied more heavily on popular science articles written by scientists (i.e., a reliable source) when informing themselves about the contradictory disputes of climate change. A potential explanation for the lack of empirical evidence associating internet-specific beliefs concerning rationales for knowing and source evaluation processes, might be that measures of justification for knowing beliefs, for example, the Internet-Specific Epistemological Questionnaire (ISEQ) (Bråten *et al*., 2005), often include items that address justification through both external and internal sources. Specifically, these scales include justification by cross-checking multiple sources or by relying on external authorities as well as items that address the justification through the use of prior knowledge or own reasoning (i.e., internal sources). However, only beliefs regarding the former type of justification might be positively associated with source evaluation processes (Greene, Azevedo, & Torney-Purta, 2008).

Bråten, Ferguson, Strømsø, and Anmarkrud (2014) found evidence that, in a multiple-documents comprehension task, utterances concerning justification by multiple sources (as measured by verbal protocols) were related to an increased number of source references included in the essays participants wrote after reading. Whereas utterances regarding justification by authority and personal justification (i.e., justification through their own reasoning or the use of prior knowledge) were not, which supports the previous reasoning by Bråten *et al*. (2011). Therefore, in the present research, a distinction was made when analysing the data between beliefs concerning justification by multiple sources and beliefs concerning personal justification.

1.2.5 Searching online resources

Halavais (2009) provides a conceptual definition of a search engine in his book, *Search Engine Society*, as namely, 'an information retrieval system that allows for keyword searches of distributed digital text' (pp. 5 – 6). Halavais further differentiates between various classifications of search (i.e., subject-specific or 'vertical', general or 'horizontal', geographically-specific and 'local', or 'social', (pp.4, 7 – 8). Halavais (2009) takes a representative approach to the technology of the search engine, arguing that despite serious trepidations, we need search engines to organise the infinite amount of information stored online. With the development of the internet based search engine, students living in the digital age execute searches differently. Long-standing ways

of searching have been incorporated into the search engine – for example, performing an academic literature search (Halavais, 2009). Previously, distinct steps were marked out for different queries, but currently every search begins with a search engine such as Google Scholar or an electronic database accessed through a university library's website, such as the e-Wits Library Catalogue. Learners therefore require self-directed learning (SDL) (Jossberger *et al*., 2010) and epistemic cognition (e.g., critical thinking, argument evaluation and inquiry) skills to navigate this vast ocean of potentially incorrect or biased information (Greene *et al*., 2014).

Improving the Quality of Search Results

In terms of possible intervention strategies to assist learners in developing their digital literacy skills, it would be useful for learners to understand the basic technical mechanisms that occur during a web search. One such mechanism, query ambiguity, is one of the problems that undermine the quality of search results. For example, if the term 'bank' was used in a search, this query term could refer to a financial institution or the slope directly bordering a stream (Qi & Davison, 2009). As a result, several methods have been suggested to resolve this issue of the potential ambiguity of query terms. One such method, suggested by Chekuri *et al*. (1997), was to work with classification of webpages in order to improve the quality of the search results. This would require that a statistical classifier, which has been trained on current web directories, would be used on new webpages to create an ordered list of categories. The webpage can then be placed in this new category and, at query time, the user can select the relevant categories for their search. This would result in only the category relevant results being returned. The alternative is that a list of categories would be returned by the relevant search engine, thereby resolving the issue of query ambiguity (Qi & Davison, 2009).

The method proposed by Qi and Davison (2009) would be useful if the student is searching for a known term such as in this study, where learners were searching for evidence of the polygraph's validity, because in such cases, it is not difficult to specify the preferred categories (e.g. psychology, criminal law, etc.).Another perspective on the functions of a search engine is proposed by Introna and Nissenbaum (2000). They advocate for a more political understanding of the power relations that exist behind the technical specification of a search engine. This perspective looks at the potential impact of commercial websites on search engine's results pages. Many search engines give prominence to popular, well-funded and marketed websites. This is made possible through the procedural tools of using spiders, indexing and ranking algorithms, along with options such as Google AdWords, where commercial websites can pay a fee in order to be listed on the first page of returned results, where the keywords match their product or service

offering (Introna & Nissenbaum, 2000). The justification behind Introna and Nissenbaum's (2000) objections to the existing practices of search engines, is that internet users may use them to gain access to the types of information that could potentially aid upward social mobility. The internet allows access to information that could result in informed decisions being made with regards to personal and family health, education and politics.

The ideal functioning of the web would also include facilitation of associations and communication that could provide a platform to those minority groups who, conventionally, may have been ignored. It would not be possible to navigate the 800 million, and growing, (Introna & Nissenbaum, 2000) webpages without search engines. They cannot be eliminated, therefore, they must be critically examined by internet users in order to develop a more democratic and transparent process to understand their potential bias (Halavais, 2009). If learners are made aware of these issues, they may be able to make better, informed choices as to which search engines to use for academic purposes.

Internet search engines versus academic library resources

Google represents the archetype of the straightforward and easy-to-use search engine that provides free access to public websites. Despite the issues raised by Introna and Nissenbaum (2000), Google remains one of the most popular search engines, with the term 'Googling' now being synonymous with searching (Library Journal News, 2003). Tenopir (2005) examined the evolution of Google into more specialised search engines, such as Google Scholar, which allows learners to access non-copyright academic content. Other offerings also include Google Print, which grants users access to printed materials from libraries, publishers and booksellers, as well as previews or summaries of copyrighted documents (Fialkoff, 2005).

Hargittai (2005) investigated the dynamics of more recent types of online information sources, such as content created by regular users or bloggers, who may not necessarily experts on the topic. Users now face the dilemma of how to accurately assess the credibility of these types of data sources. One such example is Wikipedia (a collaboratively written online encyclopedia), where contributors are generally unidentified, fellow web users. As a result, research suggests that many web users have become sceptical of this type user generated of information source content (Flanagin & Metzger, 2011).

Journal coverage

Google Scholar's offering has grown exponentially, with many scholarly publishers wanting to take advantage of the Google brand's ever-increasing popularity (Jacso´, 2005). This is also due, in part, to the improved quality of source now available, accessed through full-text indexed

accredited academic peer-reviewed journals made available through the publishers websites (Jacso´, 2005). Two noteworthy journal publishers have collaborated with Google Scholar, the American Chemical Society (ACS) and Elsevier (Jacso´, 2005). Even though a relatively small proportion of these publishers' digital collections (for example, Elsevier has over 7 million items and the ACS's 0.75 million items) have been indexed so far by Google Scholar, once the Google Scholar robots are sent to their routes, it is anticipated their dividends will swiftly increase (Jacso´, 2005).

Book coverage

In addition to the academic journal coverage mentioned previously, Google Books has also been added to the Google Scholar offering (Jacso´, 2005). Books were generally inaccessible via the web, even in an indexed or abstracted version, let alone as full-text documents in the majority of multidisciplinary large scale databases (Jacso´, 2005). This addition is certainly to the advantage of learners wanting to access credible information sources via the internet. There are, however, certain drawbacks to the Google Scholar's indexing system. One example concerns author's names, which are not made distinct to other portions of the query term using its parsing algorithm (Jacso´, 2005). This results in the real authors failing to receive due credit for their published work, which further prevents them from obtaining a proper h-index (Jacso´, 2005).

A potential negative consequence to the rise in popularity of the search engine, is the perception it has created that web sources can be obtained without much effort on the part of the user (Lawrence & Miller, 2000). This, in turn, has led learners to favour these faster and more efficient means of conducting searches at the expense of more formal and well-established information sources, such as academic libraries (Mostafa, 2005). Bell (2004) claims that learners may perceive library searches to be more complex and time consuming compared to the easy-to-use interface of the search engine, such as Google. Libraries are simply unable to accommodate this new generation of searcher, who has expectations of convenient access to unlimited, full-text content without requiring much critical evaluation (Bell, 2004). Fast and Campbell (2004) concluded that learners had a partiality for web based searches, even though the information is not categorised into any meaningful order as opposed to the organisation of library based OPAC.

According to Bell (2004), the academic library is in direct competition with Google. James Morris (Dean of the School of Computer Science at Carnegie Mellon University) coined the phrase 'infobesity' to highlight the similarity with current information searches and the appeal of quick take-away meals, even though both may have questionable value in terms quality (Bell, 2004). Bell (2004) states that learners frequently conduct searches without concern for the credibility of

web based documents. The alterative would be to use the specialised databases, which are accessible through an academic library, to obtain reliable information sources (Bell, 2004). Tenopir (2005) debates the quantity of reliable information learners can obtain through search engines such as Google compared to the 'hidden web' of library databases. Several studies (Flanagin & Metzger, 2007; Scholz-Crane, 1998) support these arguments – their findings confirm that internet users are rarely attentive with regards to confirming the integrity of the information they obtain online. The final point is that if learners continue to conduct web searches (without engaging critical thinking) and fail to make use of the academic library, the quality of material retrieved may well be questionable (Herring, 2001).

1.2.6 Models for Evaluating Online Information

Critical Evaluation Skills

In line with the arguments presented above an understanding emerged that the skills required to critically evaluate online content are similar to those a student would need in more traditional channels of communication (Alexander & Tate, 1999; Fritch & Cromwell, 2001). In the fields of psychology and communication, credibility is customarily defined as the believability of information, and it relies on the trustworthiness and expertise of the information source, as construed by the recipient of the information (Rieh & Danielson, 2007; Tseng & Fogg, 1999). Studies based solely on self-reported data have identified five benchmarks that users *should* engage in their valuations of the credibility of internet-based information: accuracy, authority, objectivity, currency, and coverage or scope (Alexander & Tate, 1999; Fritch & Cromwell, 2001; Meola, 2004). The models (in particular checklist, dual processing and cognitive authority) are discussed below to give an overview of what is currently available. However, the risks involved in relying solely on self-reported data to build models is that the data may not provide a real sense of which cognitive processes are actually engaged in the critical evaluation process. This becomes clear when these contemporary models are contrasted with those that used a mixed-methods approach, where, for example, discrepancies between focus group discussion data and observation of actual online behaviour (Eysenbach & Kohler, 2002) demonstrate that what people self-report doing is not necessarily congruent with their actual behaviour.

The first criteria, *accuracy* refers to the degree to which a website is void of inaccuracies, whether the information can be corroborated offline, and the consistency of the documents. The second principle, *authority* is ascertained by observing who authored the webpage and what their credentials, qualifications and affiliations are, and whether the website is endorsed by a trustworthy organisation, such as an academic institution (Meola, 2004).

Objectivity concerns categorising the function of the website and if there is potential bias, i.e. if the information is fact or opinion based. This also includes understanding whether there might be a conflict of interest or commercial intent on the part of the source, (e.g., 'sponsored links' on a Google search output page) (Meola, 2004).
Currency is whether or not the content is current or outdated. *Coverage* relates to the extensiveness or complexity of the documents available on the website (Meola, 2004). These suggested criteria require learners to engage multiple cognitive processes. Ranging from a quick visual assessment of a website to more time consuming information authentication as well as efforts to triangulate multiple data sources to confirm its veracity (Alexander & Tate, 1999; Fritch & Cromwell, 2001; Meola, 2004).

Metzger and Flanagin (2000) conducted several studies to assess to what extent internet users make use of the suggested list of precedents to verify the reliability of web documents. Survey data from college learners and general adult users were collected over a 3 period. Participants rated their engagement with the aforementioned 'checklist', marking off the frequency with which they used the criteria, specifically, accuracy, authority, objectivity, currency and coverage to evaluate web content (Metzger & Flanagin, 2000). The results indicated that most students executed each of nine criteria 'rarely' to 'occasionally'. Comprehensiveness, currency and objectivity were more only moderately performed, and confirming the author's identity, credentials and contact details, were the least implemented criteria (Metzger & Flanagin, 2000). The trends indicated that 'easy to perform' actions that only required personal justification or assessment (e.g., judging that a website contains current and comprehensive data) were scored highest. On the other hand if a criterion was more labour intensive, for instance confirming if the author is competent or an expert in the field, it was scored lowest (Metzger & Flanagin, 2000).

A Dual Processing Model of Credibility Assessment

Aside from the 'checklist' style approaches newer models, such as those proposed by Metzger (2007) offer an alternative explanation for internet reliability assessment. Metzger's (2007) dual processing model examines the role of consumer motivation and aptitude along with the circumstantial basis for when a user would need to evaluate web sources. The basic structure of the model is outlined in Figure 1 below. The dual components of motivation and ability are considered crucial as to how extensively a consumer will assess a web based data source. Motivation, in this situation will be based on the extent to which inaccurate information may directly impact the user. In terms of ability, this would be determined by how familiar a user is

with the type of checklist criteria mentioned earlier, such as authority, objectivity, currency, etc and the level of skill they require to implement an in depth evaluation (Metzger, 2007).

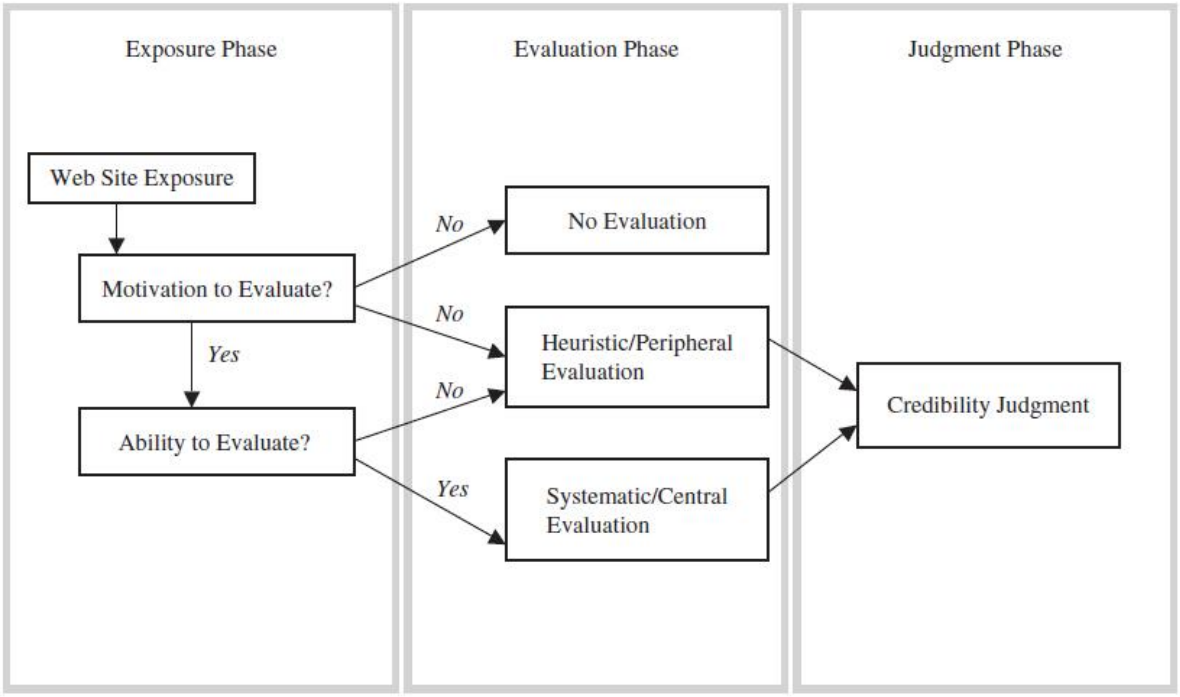


Figure 1: Elements of a dual processing model of a website credibility assessment (Metzger, 2007)

Chen and Chaiken (1999) also found that 'accuracy goals' will be influenced by how motivated a user is in terms of their determinations for obtaining the information. As such motivations levels will vary for different types of online searches, and will be context specific, as in searching for 'entertainment' as opposed to performing an academic literature review. If a user is not generally concerned with the trustworthiness of the data source they would most likely not exercise any cognitive evaluation of its credibility (Chen & Chaiken, 1999). Metzger (2007) claims that a dual processing model not only accounts for the circumstances under which a user will be motivated to critically evaluate a data source but also explains the cognitive processes involved in making these types of judgements.

For a consumer using the web to find information relating to general entertainment purposes (such as when their sports team will be playing their next match or for music events in their area), they will most likely be content if the website demonstrates ease of use, simple navigation and a clear layout as sufficient justification for its credibility. In the case of users that are more highly motivated to find information that is trustworthy (such as a student completing an academic assignment, or a medical patient looking for alternative types of treatment) it is more probable that

they will use a systematic approach and evaluate more than just the design characteristics of a webpage. This type of user may well make the cognitive effort to search for the author or original source of the web document (Fogg *et al*., 2003; Walthen & Burkell, 2002).

Additional Models of Web Information Evaluation

Whilst other evaluation models have been recommended, the checklist approach remains the most commonly used amongst educators. One alternative is the model developed by Fritch and Cromwell (2001, 2002). They developed the term *cognitive authority* to encompass the concepts of credibility and quality. Cognitive authority is what people evaluate 'to know what credence and impact to impart to any specific body of information' (2002, p. 243). Fritch and Cromwell (2001) designed an iterative model whereby authority and credibility are evaluated first at the levels of author, document, institution and affiliations, and then they are incorporated into a comprehensive judgment of web based data integrity. The author or institution is verified by their global status or listed credentials, along with the factual accuracy of the web page, its design and organisation and inspecting both explicit and covert associations are all combined into a strategy to gain an overall indication of its cognitive authority (Fritch & Cromwell, 2001).

Although offered as an alternative to the 'checklist' model it ultimately relies on the same principle as providing a list of criteria for information searchers to use. One differing feature however is that this model does encourage the use of web-based tools to assist in making critical assessments. Fritch and Cromwell (2003) recommend using online applications such as Whois, Traceroute and NSlookup/Dig to ascertain the author's identity and any website associations. Technology can aid a web user in identifying who owns a particular website and to find any ambiguous affiliations that may not be clearly stated (Fritch & Cromwell, 2003); however these would require a specific set of digital literacy skills.

The model developed by Walthen and Burkell (2002) is framed within the domains psychology and communication. The premise is that there are three stages involved in evaluating online data sources. The first stage is where information seekers develop an overall impression of how credible a website is based on its more superficial characteristics (e.g., colours schemes, illustrations, typographical inaccuracies), if there is a clear and easy to use navigational structure, the usability and the logic behind which the information is structured (Walthen & Burkell, 2002). Once the initial assessment has been made, the second stage involves constructing evaluations of the source characteristics (such as, expertise, trustworthiness and credentials) and message presentation (e.g., date stamp, correctness, relevance to the user). In the final stage, cognitive and

individual-level factors are considered. For example how much time the user has available to locate and process the information, any existing knowledge they have on the given topic, etc these elements are then framed within the specific context for the search (Walthen & Burkell, 2002). There are similarities with Fritch and Cromwell's (2001) cognitive authority model, which also advocates varying levels of cognitive processing during the credibility evaluation which are then included in a final comprehensive assessment (Rieh, 2002). The distinguishing feature of the Walthen and Burkell (2002) model is its inclusion of the user as a key element of the evaluation process. Every time a website is evaluated, the information seeker brings with them a variety of contextual and individual-level factors, their personal needs will therefore determine the extent to which the content is reviewed (Rieh, 2002).

Factors Important to Users of Web-Based Information

One fundamental issue with the aforementioned credibility and evaluation models is that they have not been verified using real information seekers (Rieh, 2002). A second issue, linked to the first, is that these models have not been correlated with studies examining which criteria people *actually do* use to conclude if a web document is credible. This particular critique was considered as one of the justifications for including Stage 2, the online search task, in this research project. Only a few studies (Eysenbach & Kohler, 2002; Fox & Rainie, 2002; Scholz-Crane, 1998) have sought to discover which factors users essentially apply to make credibility judgements. Eysenbach and Kohler (2002) carried out a qualitative study with 21 web users who were asked to assess the reliability of online health information. Their methodology included focus groups (to obtain self-reported data), followed by observations of a smaller sample derived from the focus group and finally post-search interviews. During the interviews, participants were asked about their decision-making processes and the criteria they used when selecting specific websites (Eysenbach & Kohler, 2002).

The findings exposed several discrepancies between the self-reported data from the focus groups and the actual criteria used when being observed by the researchers. During the focus group discussion users stated the following as the key criteria; a professional look and feel to the website, content that was properly referenced and well written by an authority on the topic and language that was easy to comprehend (Eysenbach & Kohler, 2002). Regardless of self-reporting the importance of source identity and quality during the focus group discussion, when they actually conducted the search, users made no attempt to verify the author or data sources, or check the manner in which the information was compiled (Eysenbach & Kohler, 2002). Whilst there was some overlap between the self-reported data and the observations, the actual behaviours seemed to

highlight new criteria, justifying the necessity to use more qualitative methods when conducting research on digital literacy skills.

When using alternative methodologies, such as think-aloud and interviewing procedures (Rieh, 2002) to examine the actual online behaviours of internet users when making credibility assessments, similar findings to that of Eysenbach and Kohler (2002) were revealed. Rieh and Belkin (2000) established that when performing evaluations, users' judgments were based on two

Table 2. Summary of the suggested factors from the literature that influence credibility assessments of online information

Presence of date stamp showing information is current
Source citations
Peer reviewed journals
Online academic journals
Citations to scientific data or references
Author identification
Author qualifications and credentials
Presence of privacy and security policies
Certifications or seals from trusted third parties
Professional, attractive and consistent page design, including graphics, logos, colour schemes, etc.
Sponsorship by of external links to reputable organisations
Notification/presence of editorial review process or board
Absence of typographical errors and broken links
Professional-quality and clear writing
Browser evaluation (particular speed)
Interactive features (e.g., search capabilities, confirmation messages, quick customer service responses)
Domain name and URL (suffix)
The presence of hyperlinks (e.g., external links to similar content)
Comprehensiveness of information provided
Paid access to information
Reasonableness of arguments
Writing that is easily comprehendible

Sources: (Alexander & Tate, 1999; Eysenbach & Kohler, 2002; Fogg, *et al*., 2003; Freeman & Spyridakis, 2004; Rieh & Belkin, 2000; Rieh S. Y., 2002; Walthen & Burkell, 2002) in addition to data coded from the Task 2 transcripts from this study.

rudimentary criteria. Firstly, the characteristics of the information 'objects' that they found online and, secondly, the characteristics of the source of online information. The first criteria included

the category of information object (e.g., journal article vs. blog), its content (i.e., how comprehensive, and methodical the information delivered was), its presentation (i.e., visuals), and its structure (i.e., if there was a clear organisational hierarchy). Source characteristics that web users examined were status and category of source (e.g., commercial vs. non-commercial sites, and the particular domains such as .com versus an .edu, etc.) (Rieh & Belkin, 2000). A comprehensive summary based on the literature review of the factors that may influence how learners rate the credibility of a website are included in Table 2. Several of them were used to develop the coding scheme for analysing the Task 2 rank ordering of web pages data. This is discussed in more detail in the Methods chapter.

1.2.7 Acquiring digital literacy skills in the South African context

Aside from the cognitive process already discussed, various social and cultural factors may also affect how learners might perform on a given task. There are several theories of technology acceptance, for example, Social Cognitive Theory (Bandura, 1977), Social Learning Theory (Vygotsky, 1978), and Engeström's (1999) theory of expansive learning, amongst many others, which draw on a broad range of collective and psychological concepts.

Computers and Education: a cultural constructivist perspective

A social constructivist or sociocultural approach views learner interaction and discourse as crucial to the development of learning (Vygotsky, 1978; Bandura, 1977). According to Vygotsky (1978) behaviour is not merely a direct response to the environment, rather it is interceded by culturally meaningful tools and signs that enable the individual to exert external control. One of Vygotsky's (1978) well-known terms, the *zone of proximal development*, refers to learning as a product of collaborations, which enable an individual to go beyond their current capacity. Building on Vygotsky's foundational work, activity theory (Scott, Cole, & Engel, 1992) seeks to comprehend concurrent influences of multiple cultures and human activity and how these interact with each other, moving outside the more narrow view that we exist within a vacuum of a single culture.

Activity theory places people's actions and behaviour within the context of a socio-technical environment (Thatcher & Mooney, 2008). Vygotskian theory (1978) and activity theory (Engeström, 1987) suggest that tools and artefacts shape our interactions with the world around us. Thatcher and Mooney (2008) suggest that this concept should be viewed within a particular social, cultural and historical framework. Signs and tools are essentially facets of the same phenomenon. 'Signs' designate the internal movement of objects in the social plane (external) to the individual plane (internal) and are psychological in nature (Vygotsky, 1999). While 'tools' are technical in

nature and indicate labour intensive operations, or an outward flow from the individual as they engage with the environment (Vygotsky, 1999). Tools alter the features and development of cognitive processes. These instruments of learning recreate and reorganise the entire structure of our thinking and behaviour (Vygotsky, 1993). From this perspective, traditional forms of conditioned activity are mediated through computers. Therefore, online based activities should be considered for the qualitatively distinctive forms of interaction that these artefacts afford and the collective social engagements that they assist in constituting (Scott, Cole, & Engel, 1992).

The multifaceted concept of access

There have been politically charged, controversial debates in Europe and America regarding a so-called 'digital divide' does in fact exist and whether the gap will diminish or expand in future years (Van Dijk & Hacker, 2003). The first issue that needs to be resolved before conducting research on this topic is that the concept of *access* is multifaceted. Whilst this is a commonly used term, there are multiple meanings that should be considered (Van Dijk & Hacker, 2003). The most common meaning is simply owning a computer that is connected via some form of network to allow communication with other internet users. However, according to Van Dijk (1999), this understanding only covers one out of the four sequential types of access.

The four specific barriers are: a *lack of elementary digital experience* caused by the absence of interest, poor computer self-efficacy, and a lack of appeal for new technology ('mental access'); *Not owning a computer or access to a network connections* ('material access'); a lack of *digital skills* due to inadequate ease of use and insufficient formal training or social support ('skills access'); a lack of meaningful *usage opportunities* ('usage access').

Van Dijk (1999), describes the issue of access to digital electronics as evolving from the first two into the final two listed above. Once the initial concerns of mental and material barriers have been addressed, the issue of structurally different levels becomes operative. Van Dijk (1999) expands on the definition of digital skills to include the ability to locate, select, vet and integrate information from an abundance of sources (Van Dijk, 1999). Furthermore, he anticipates the development of a 'usage gap' between web users systematically using and benefitting from advanced digital technology in work and scholastic contexts; and other segments of the user population engaging in more simple applications of digital tools, a large segment of which is for entertainment. Van Dijk (1999) emphasises the view that computers are further developed and more multifunctional than preceding communication technologies.

Looking at this issue from a South African perspective, a technology survey (Technology in the Teaching and Learning of Psychology, currently unpublished) conducted by Dr Pitman of the University of the Witwatersrand, obtained information on an undergraduate sample of 680 learners. Their sample comprised mainly of Psychology 1 (68.68%) learners but also, level 2 (12.65%) and level 3 (14.12%) learners. One item asked student what level of access they had (when they were in secondary/ high school) to a school-owned computer, home computer (not their own), a friend or family member's computer (not at home) or their own personal computer. Out of the 671 respondents 40.87% (n=264) did not have access to a personal computer in high school, whilst 44.89% (n=290) had 'on-demand' access.

Digital divide perspectives and past research seem to suggest that information evaluation strategies and opportunities may vary across demographic characteristics (Hargittai, 2005; van Dijk, 2006). However, research carried out by Metzger and Flanagin (2011) found little evidence that sex, income, education or race greatly affected users' levels of apprehension about trustworthiness or the quantity and types of online information that people believe to be reliable, although some minor differences did emerge. The digital divide is a very multifaceted and ever-changing phenomenon. As a result, it is not an easy task to explicate the most important tendencies and policy directions for this relatively new social problem (Van Dijk, 2006).

1.3 Research Questions and Hypotheses

In this study, the critical aspects of digital literacy (i.e., SDL and EC), related to university students' ability to search the internet and vet the sources they found, were examined. Previous research was expanded on by using several methodologies (online surveys, screen capture videos, semi-structured interviews and written reports) to capture both SDL and EC, and to test their relations with successful online search strategies. However, resource demands posed certain challenges that required the exploration of alternate methodologies for preparing, analysing and representing the data (Greene, Seung, & Copeland, 2014). Taking the review of the literature into consideration, the proposed study seeks to provide possible answers to the following six questions:

1. What general levels of readiness for self-directed learning and epistemic cognition are self-reported in an undergraduate student sample?
2. What do undergraduate university students at the University of the Witwatersrand self-report on the following epistemic cognition and digital literacy issues?
    - What self-directed learning behaviours are evident in the sample?

- What psychology-specific epistemic cognitions are evident in the sample?
- What are their internet-specific epistemic beliefs regarding information sources found online?
- What is their general level of exposure to formal digital literacy and IT training?

3. What are the actual behaviour based digital literacy components of SDL and EC that students demonstrate when performing an online search task?

4. Do the self-reported measures of SDL and EC and the actual behaviour based SDL and EC scores of students associate with constructive online search behaviours (OSB)?

5. Which search engines, online libraries and databases do students consider reliable when conducting academic literature based searches on psychology specific topics?

6. Which epistemic cognitions and source attributes associate with post-search evaluations and the perceived credibility of internet based information sources?

Chapter Two
Method

2.1 Research Design

A mixed-methods sequential explanatory design, comprising of two separate stages, was used to guide the research process. Mixed-methods guides the process for gathering, evaluating and assimilating both quantitative and qualitative data during different stages of the research process, within a single study (Creswell & Plano Clark, 2011). The rationale behind this design to gain a better understanding of the research problem. The mixed-methods sequential explanatory design, is exceedingly popular among researchers. It involves collecting and analysing first quantitative and then qualitative data in two consecutive stages in a single study. The design characteristics are well defined in the literature (Tashakkori & Teddlie, 1998; Creswell & Plano Clark, 2011; Creswell, 2003) and this particular design is applied in both social and behavioural sciences research (Klassen & Burnaby, 1993; Janz, Zimmerman, Wren, Israel, & Carter, 1996).

The first stage entailed collecting self-reported quantitative data measuring the self-directed learning (SDL) skills and epistemic cognition (EC) of undergraduate students by means of a questionnaire. The second stage involved a practical online task whereby students were given an essay question and were required to search online to find potential sources of information that could be used to write the essay. Finally, the students were asked to critically assess the quality of the information obtained using a 4-point Likert-type response scale. Their actions during the online search task were recorded using video screen capture software and, upon completing the search, they answered 7 questions relating to the 10 sources of information they had found (see Appendix B). The video capture screens were replayed to them and the verbal descriptions of their actions were audio recorded and later transcribed and coded using the system developed by (Greene & Azevedo, 2009) to ascertain which SDL and EC components they may have engaged during the search and evaluation process.

2.2 Sampling

Stage 1 of the study made use of a purposive non-probability sample of students enrolled at the University of Witwatersrand's School of Human and Community Development. The students were sampled using purposive non-probability sampling, because it provided a 'maximum chance for any relationship to be observed' (Punch, 2009, p. 252). Purposive sampling ensures that the participants were both willing and able to take part in the study, and that they represent the 'typical' of the population (Terre Blanche, Durrheim, & Painter, 2006). Undergraduate students registered for first-year psychology modules were contacted via the SAKAI student online

platform and later an arrangement was made with the respective course lecturer to do an in-class presentation. A participant information sheet was emailed to all interested participants, containing finer details about the survey and the overall study. In addition to responding to items pertaining to demographic variables, self-directed learning and epistemic cognition scales; the questionnaire also provided an opportunity for those wishing to participate in phase 2 of the study. A section was included to provide contact details and select timeslots for the computer-based search task, allowing students to select the most convenient timeslot to attend, if they agreed to participate in the study. If a student indicated an interest in participating in phase 2, a second participant information sheet was emailed to them, outlining details of the online search task associated with the second stage. A pilot study was also conducted to test the measurement instruments for stage 1 as well as the practicalities of the online search task used in stage 2. The survey was made available digitally via SurveyMonkey for both the pilot test and the final study.

The second phase of the study also made use of non-probability purposive sampling, together with convenience sampling, to obtain the required number of psychology students needed to conduct the practical online search task (Terre Blanche *et al.*, 2006). There were two possible incentives for participation – students registered for first-year level psychology courses received course credit for completing phase 1, the survey; and students participating in phase 2 were given additional course credit and were also entered into a prize draw to win a Proline seven-inch Android tablet at the conclusion of the study. The aforementioned procedures yielded a total of 131 participants for phase 1, of which 119 completed the full questionnaire. Phase 2 had a total of 17 participants, with a participant being defined as one who completed both levels of the study – the questionnaire, and the computer-based search task.

2.2 Participants

2.2.1 Stage 1: Demographics

Students registered at the University of the Witwatersrand and enrolled for first-year level psychology courses volunteered to partake in the study. For phase 1, the final sample comprised of one hundred and nineteen individuals, with a mean age of 19. 73.1% were female (n=87), 24.2% were male (n=29), while three participants did not reveal their sex. 58.8% of the participants identified themselves as Black (n=70), followed by 19.3% White (n=23), 9.2% Indian (n=11), and 8.4% Coloured (n=10). The remaining 4.2% comprised participants who selected the option ‘other’ or preferred not to disclose their race (n=5). The gender are race breakdowns discussed

above would be considered equivalent with those found in a typical Psychology 1 (PSYC1009) class.

The majority of participants did not have IT as a school subject (61.3%, n=73), while 36.9% of them did (n=44). Two participants did not answer this question. The majority attended a public (former Model C) high school (36.1%, n=43), 33.6% (n=40) attended a private school, 24.4% (n=29) a public (former DET) high school, and of the remaining 5.9%, four participants attended an independent school or did not complete the answer (n=3). The language breakdown is as follows: the majority (44%, n=50) listed English as their home language, 19.3% selected isiZulu (n=23), 10% selected Setswana (n=12), 9.2% selected Sesotho sa Leboa (n=11), 4.2% chose Xitsonga and 4.2% Sesotho (n=5 respectively), the remaining 10.9% (n=13) selected isiXhosa (n=4) , siSwati (n=3), isiNdebele (n=1), Tshivenda (n=1), Afrikaans (n=1) and 'other' (n=3).

2.2.2 Stage 2: Demographics

Registered undergraduate students at the University of the Witwatersrand enrolled in first-year psychology courses volunteered to partake in Stage 2 of this study. The final sample comprised seventeen individuals, with a mean age of 19. 76.47% were female (n=13), 23.52% male (n=4). 70.58% of the participants were Black (n=12), followed by 23.52% White (n=4), and 5.88% Indian (n=1). Of the 17 participants, 23.52% attended public school (former DET) (n=4), 47.05% attended public school (former Model C) (n=8), 23.52% attended private school (n=4), and one participant did not complete this question (n=1). 29.41% took IT as a subject in school (n=5), 64.70% did not (n=11) and 5.88% did not complete this question (n=1). Only 5.88% indicated that they had a disability (n=1), all participants (n=17) were registered for first-year level psychology courses and had enrolled in 2015. 64.70% were completing BA degrees (n=11), the other 35.29% were doing a Bachelor of Social work (n=6).

2.3 Measures

2.3.1 Stage 1: Online questionnaire

Measures of critical components of Digital Information and Search Literacy (DISL)

The first phase of the project used a questionnaire (see appendix A) designed to measure the critical cognitive components of Digital Information and Search Literacy (DISL) using three self-report instruments. The three scales were, the Self-Directed Learning Readiness Scale (SDLRS) (Guglielmino, 1977), the Epistemic and Ontological Cognition Questionnaire (EOCQ) (Greene,

Torney-Purta, & Azevedo, 2010) and finally the Psychology-Specific Epistemological Belief (Psych-SEBS) (Renken, McMahan, & Nitkova, 2015) scale.

Self-directed learning belief measures

The assessment of readiness for self-directed learning, Guglielminos' (1977) Self-Directed Learning Readiness Scale (SDLRS) was placed after the demographic and financial questions. The SDLRS version used in this study was a 38 item self-report questionnaire with three subscales (self-management, desire for learning and self-control). The scale is designed to measure the multifarious attitudes, abilities and individualities that comprise a student's level of willingness to manage their success at learning (Guglielmino, 1977). A few sample items include, 'I am looking forward to learning as long as I'm living', 'I am logical', 'I prefer to plan my own learning' and 'I don't work very well on my own'. The item response scale ranged from 1 (almost never true of me) to 5 (almost always true of me).

Justification belief measures

To assess beliefs about justification for knowing, 13 items were used from the Epistemic and Ontological Cognition Questionnaire (EOCQ) developed by Greene, Torney-Purta, and Azevedo, (2010). The Epistemic and Ontological Cognition Questionnaire (EOCQ; Greene, *et al.*, 2010) is a quantitative measure of a model of epistemic and ontological cognition (EOC). This model specifies associations between developmental positions and systems of belief along with the dimensional aspects of epistemic and ontological cognition, derived from philosophical epistemology. The item response scale ranged from 1 (completely disagree) to 6 (completely agree).

Items were originally developed based on Greene's (2010) epistemic and ontological cognitive development (EOCD) model, which describes the profile of individuals' beliefs along three dimensions: (1) Simple and certain knowledge; (2) Justification by authority; and (3) Personal justification. The original EOCQ contains two sets of 13 items each, one pertaining to mathematics and the other pertaining to history. This scale was adapted to use psychology-specific language in order to make it applicable to the sample used in this particular study. The original scale referred to math / history, hence, all these items were replaced with psychology as the key subject matter.

Simple and certain knowledge were measured using five items (sample items: 'In psychology the truth means different things to different people' and "In psychology, what is a fact today will be a

fact tomorrow'). Beliefs about justification by authority were measured with four items focusing on the reliability of statements or claims, based on scientific research and conveyed by teachers, textbooks and scientists (sample item: 'When I read something about psychology that is based on scientific investigations, then I believe that it is correct'). The higher the scores on this measure, the more students can be assumed to believe that knowledge claims can be justified by appealing to an authoritative external source or evidence derived from scientific research (Greene, Torney-Purta, & Azevedo, 2010). Beliefs about personal justification for knowing were assessed with four items concerning the extent to which students considered it appropriate to evaluate knowledge claims in the field of psychology on the basis of personal views or opinions (sample item: 'What is a fact in psychology depends on one's personal views'). The higher the scores on this measure, the more students can be assumed to believe that knowledge claims can be justified by appealing to subjective, internal means of justification. All items included in the three justification belief measures that were used are displayed in Appendix A. All the item response scales ranged from 1 (completely disagree) to 6 (completely agree).

The reliability estimates (Cronbach's α) for scores on the Simple and Certain Knowledge, Justification by Authority, and Personal Justification measures were, 0.72, 0.81 and 0.63 respectively. The original EOCQ also includes seven demographic items, bringing the total number of items on the instrument to 33. As a demographic section was already included in the questionnaire used, these items were also removed.

Psychology-specific epistemological belief measures

Thirdly, the Psychology-Specific Epistemological Belief (Psych-SEBS) Scale (Renken, McMahan, & Nitkova, 2015) was also included in the final online questionnaire to measure individual differences in identifying sources of scientific knowledge. This 12-item instrument and its three subscales, namely, significance of psychology research (SEBS-SI), subjective nature of psychology knowledge (SEBS-SN), and predictability of human behaviour (SEBS-PH) is designed to measure psychology-specific epistemological beliefs (Ebs). The SEBS-SI subscale contained 5 items, (sample item: 'Carefully controlled research is not likely to be useful in solving psychological problems'), the SEBS-SN also contained five items, (sample item: 'Some psychological knowledge proposed earlier is opposite to the contemporary knowledge'). Finally, the SEBS-PH subscale comprised of two items, (sample item: 'Psychological research can enable us to anticipate people's behaviour with a high degree of accuracy'). The item response scale ranged from 1 (completely disagree) to 6 (completely agree). Psychology-specific EBs are

believed to influence students' approach to, and performance in, psychology courses and impact students' knowledge acquisition within this field (Renken, McMahan, & Nitkova, 2015).

Conducting online searches

The final section of the questionnaire included an 8 item scale developed for this research project to assess students' general internet skills and online search behaviours (OSB). The item response scale ranged from 1 (not at all) to 6 (not sure), the maximum frequency option was to rate 5 (very frequently). One item related to general internet-specific epistemic beliefs, e.g. 'Do you consider information found online to be potentially biased?' other items concerned search engine preferences – 'Is Google your starting point when searching for information?' and 'Do you use the Wits library website to conduct searches?' Finally, general online search skills items were included, such as 'Are you able to open multiple tabs when searching?' and 'Have you ever received formal training on how to conduct an academic literature search online?' The questionnaire was administered to students using SurveyMonkey. It took approximately 25 minutes to complete and students were able to complete it in their own time on campus or at home.

Section 1: Demographic information, 11 questions.
Section 2: Current Financial circumstances, 5 questions.
Section 3: Self-Directed Learning Readiness Scale, 38 questions in total.
Section 4: Epistemic cognition and epistemic beliefs, 2 parts with 25 questions in total.
Section 5: Searching for information online, 8 questions.
Section 6: Option to participate in phase 2 of the study.

On the final page of the questionnaire they were redirected to a separate survey where they entered their details to gain course credit and indicate if they were willing to participate in further research. If they choose to participate in the second phase of this study, there was a section to provide their contact details and indicate which times (from a set of options available for the researcher) their timetable and other commitments would make data collection convenient for them. The full version of the online questionnaire used in this study is available in Appendix A.

Pilot Study

Careful pre-testing of the measurement instrument was undertaken to ensure reliability of the research instrument in collecting data with a South African undergraduate student sample. An online pilot exercise was conducted to identify potential problem areas and deficiencies in the

various instruments with three undergraduate psychology students. A space to indicate if the question was comprehensible and appropriate was made next to each item. At the end of the questionnaire, there was a section to provide general feedback and to confirm if the items were well defined, clearly understood and presented in a consistent manner. The main goal of the pilot study was to obtain qualitative data to ascertain how students were interpreting the questionnaire items. Their responses and comments were noted and any necessary modifications were made prior to emailing the link to the final version of the questionnaire on SurveyMonkey via SAKAI. A pilot study was also conducted to test the methods and procedures intended for Task 2. The same three participants conducted the online search task and completed the written report with their responses and ratings of the internet academic sources. Based on these trials, it was then decided to limit the search task period to 15-minutes, to all sufficient time to complete the full procedure in under 60 minutes.

Reliability and validity

The reliability scores of the SDLRS scale came from a population of 3,150 individuals from America and Canada, using a split-half Pearson product moment correlation with a Spearman-Brown correction. The study produced a reliability coefficient of 0.94 (Guglielmino & Guglielmino, Expanding your readiness for self-directed learning: A workbook for the Learning Preference Assessment, 1991). The majority of studies published working with samples above the age of twenty, report similar reliability, falling within a range of 0.72 - 0.96. The scale is somewhat outdated (it was designed in 1977), therefore a more current review of the SDLRS by Delahaye and Choy (2000) was consulted. The findings from the literature suggest that there is still conclusive support for the scale as an accurate and valuable instrument for measuring readiness for self-directed learning. Delahaye and Choy (2000) conclude that the SDLRS can be used with satisfactory assurance as a reliable measure of readiness for self-directed learning. In the current study, the Cronbach's alpha for the 32-item SDLRS scale was .89. This is considered adequate for research purposes. All items were examined individually using the questionnaire item-total statistics and it was justified to include all the items, as removal would not increase the alpha value obtained. Therefore, all items where included in subsequent analysis.

Psych-SEBS subscales have been found to be acceptable for the significance and subjective subscales (α.70 and .71, respectively), with lower internal consistency observed for the inherent predictability of the human behaviour subscale (α .60). Internal consistency of the composite Psych-SEBS in previous studies was acceptable (α .76) (Renken, McMahan, & Nitkova, 2015). In the current study Cronbach's alpha for the 12-item scale was .698. As this was not considered

adequate for research purposes, a closer examination of the questionnaire item-total statistics indicated that alpha would increase to .703 if item 1 was removed. The item asked whether 'carefully controlled research is not likely to be useful in solving psychological problems'. The negative phrasing (not likely) of the question may have caused contradictory interpretations of this statement amongst the student sample. Consequently, this item was dropped from the questionnaire, and all subsequent analyses are based on participants' responses to the remaining 11 items.

Appropriateness of the data

Questionnaire measures are useful in this research context as they allow for the collection of data from relatively large sample sizes. This makes it possible to conduct a quantitative analysis and then potentially generalise the findings to a larger population group (Hargittai, 2005). The questionnaire items focused on self-reported assessment of students' self-directed learning (SDL) and epistemic cognition (EC) skills and their general online search behaviours. However, as discussed earlier, there are several potential weaknesses when using self-reported questionnaires (Veenman, 2007). To account for these limitations, students' readiness for self-directed learning (SDL) and their epistemic cognition (EC) were also measured using video capture data, transcribed audio recordings and written reports of the practical search task. These data were coded using an analytic procedure developed by Greene and Azevedo (2009) and Braasch, Bråten, Helge, Anmarkrud, and Ferguson (2013).

2.3.2 Stage 2: Practical online search task

Measuring SDL and EC

The measurement of the cognitive components of digital literacy was based on theoretical work done by Azevedo (2005) and Greene *et al*. (2014). A scheme developed by Azevedo, Greene and their colleagues (Greene & Azevedo, 2009) was used to guide the analysis of the transcriptions and video capture data. The transcribed data was divided into codable segments of text that served as evidence of students' cognitive and metacognitive processing. For example, when a participant states, 'so I thought while it was loading the pages, let me open the document in the meantime… so I can save some time' – Participant 1, this segment can be coded as *time management* (TM). In addition, the codes developed by Greene and Azevedo were expanded on by adding 31 codes (see Appendix D) derived from the online search data. As an example – 'most of the time I use Google Scholar because it has does have peer reviewed sources' – Participant 4 was coded as *Expectation of Credibility Content (Plus)*. Each coding was done by hand and then tallied in MS Excel before being exported to SPSS (Version 23.0 for Windows 10). for further analysis. It was believed that

this data would capture students' SDL and EC processes that were engaged during an online search.

Rank-order Justification Scoring

Regarding the analysis of the rank-order justification responses that students provided in the written task, each justification was coded according to several features (Braasch, Bråten, Helge, Anmarkrud, & Ferguson, 2013; Bråten, Ferguson, Strømsø, & Anmarkrud, 2014). In alignment with the focus of the online search task, and in testing RQ4, rank-order justifications were coded according to one of the nine provided source features from the literature review. Namely, author (credentials), relevance to the task, explanation quality, personal justification, justification by authority, argument quality, venue, document type, and date (see Table 3 for definitions and examples from the written reports). Each justification could be coded as mentioning 0, 1, or several source features of the webpage. For example, a rank-order justification of 'I ranked this the most reliable source because it had statements and opinions of qualified people such as psychologists and doctors and there was a full reference list at the end of the article' would receive codes for type and author, as well as an additional code for author credentials (Braasch, Bråten, Helge, Anmarkrud, & Ferguson, 2013).

Table 3. Source Attributes (features) used in the rank-order justifications for Task 2
Coding categories, definitions, and quoted examples from the Task 2 participants.

Source feature-based coding categories	**Definitions**	**Examples from the video transcripts and written task (Phase 2)**
Author (credentials)	An evaluative decision about a rank based on a reader's consideration of the author that wrote the document. (An additional code was given if the justification indicated a consideration of the author's credentials.)	'This source is ranked the least credible ,based on the fact that this [site] is edited by the general public and therefore would only be a source used to exhibit general opinion within the population (i.e., the view of the man on the street).'
Relevance to the task	An evaluative decision about a rank based on a reader's assessment of the relevance of the content information in a document with respect to the task, research question, reading goal or topic of inquiry	'Source item no. 6 – it does not necessarily show the reliability and inaccuracies, it just explains how it is used.'
Explanation quality	An evaluative decision about a rank based on a reader's assessment of the quality of the explanation provided in the content information within the document	'I rated it 1 because this source explains more information about the polygraph test and it provides a clear and in-depth explanation about the validity of the polygraph test.'

Source feature-based coding categories	Definitions	Examples from the video transcripts and written task (Phase 2)
Personal justification (academically credited)	An evaluative decision about a rank based on their own reasoning or the use of prior knowledge	'In my opinion, source 3 is the least credible – the site has an informal display to it and does not seem to be academically accredited, and it illustrates a more general factual basis of information.'
Justification by authority (multiple sources)	An evaluative decision about a rank based on whether the content is referenced or peer reviewed. This is an internet-specific epistemic belief concerning justification by multiple sources.	'I always check the citation on the page, cause I feel if it's referenced, if it's cited then the person has gone over and above just putting in their own opinion.'
Format / style	An evaluative decision about a rank based on a reader's assessment of the format or style of the content information provided in the document	'This decision is based on the style of writing (i.e., academic), the references cited and the fact that it is a result of a published book, meaning it has been peer-reviewed.'
Argument quality	An evaluative decision about a rank based on a reader's assessment of the quality of the argument, claim, evidence, or support provided in the content information within the document	'Secondly, along with making a claim on the polygraph's validity, it also provides case studies and examples to support its claim, the case of Frye for instance.'
Venue	An evaluative decision about a rank based on a reader's consideration of the body that published the document or the particular search engine it was obtained from	'Source 4 is the most credible, firstly because it is a peer-reviewed journal and therefore more reliable as a source in an academic essay.'
Type	An evaluative decision about a rank based on a reader's consideration of the document's type of publication	'I ranked source 3 the least credible. I got it from a blog, which has no guarantee that it is peer-reviewed and therefore no assurance that it is accurate.'
Date	An evaluative decision about a rank based on a reader's consideration of a document's date of publication	'Perhaps source 4, because of the age of the document – how long ago the research was done.'

Notes: Codes derived from studies by Braasch, Bråten, Helge, Anmarkrud, & Ferguson (2013) and Bråten, Ferguson, Strømsø, and Anmarkrud (2014), examples provided from data obtained in the current study.

2.4 Design and Procedure

Table 4. Research questions and data collection methods

Research Questions	Data collection method			
	Questionnaire	Video capture	Post search interview	Search task written feedback
RQ1: What general levels of readiness for self-directed learning and epistemic cognition are self-reported in an undergraduate student sample?	O	#	#	X
RQ2: What do undergraduate university students in South Africa self-report on the following epistemic cognition and digital literacy issues? - What self-directed learning behaviours are evident in the sample - What psychology-specific epistemic cognitions are evident in the sample - What are their internet-specific epistemic beliefs regarding information sources found online - What is their general level of exposure to formal digital literacy and IT training	O	#	#	X
RQ3: What are the actual behaviour based digital literacy components of SDL and EC that students demonstrate when performing an online search task?	O	X	O	O
RQ4: Do the self-reported measures of SDL and EC and the actual behaviour based SDL and EC scores of students associate with constructive online search behaviours (OSB)?	O	X	X	O
RQ5: Which search engines, online libraries and databases do students consider reliable when conducting academic literature based searches on psychology specific topics?	O	X	X	O
RQ6: Which epistemic cognitions and source attributes associate with post-search evaluations and the perceived credibility of internet based information sources?	#	#	O	O

Note: 0: Useful X: Somewhat useful #: Not useful.

2.4.1 Stage 1: Online questionnaire

In order to gain access to students, consent was first obtained from the ethics committee, then the course coordinator, Ms Enid Schutte. Once the course coordinator's permission was obtained, a formal request was sent to distribute the questionnaire via SAKAI. The questionnaire was then made available online using SurveyMonkey. (www.surveymonkey.com/r/digital_literacy). The link to the questionnaire was sent from SAKAI to all first-year level psychology course students registered for the 2015 academic year. The Participant Information Sheet was sent as an attachment, along with details of how to access the online questionnaire via email. Questionnaire data was captured using SurveyMonkey and then later exported into MS Excel for further analysis using SPSS (Version 23).

2.4.2 Stage 2: Practical online search task

Before the commencement of the practical task, a pilot study was conducted with three psychology students as soon as ethical clearance had been obtained. This was to ensure the data collection methods and data analysis procedure (Greene & Azevedo, 2009) proposed were feasible. Both the pilot study and the online practical search task were conducted on campus in an appropriate venue, with internet access, during the lunch period or breaks between lectures, depending on the preference and availability of the students. All students were given additional credit for participating in the practical search task and, as an additional incentive, the 17 students who volunteered to participate in the online study were eligible to win a seven-inch Android tablet. All data was collected by the end of September 2015 and the winner of the tablet was notified in October 2015.

As previously mentioned, students that completed the online questionnaire were given the option to be involved in the second phase of this study. A unique identifier was created using their initials and the last 4 digits of their student number. Those students who volunteered were contacted via email and SMS and asked to attend an individual 50 to 60 minute face-to-face session. Five minutes was allocated to explaining the task and for responding to any questions the participants had. They were asked to complete an online search in order to answer a hypothetical essay style question (i.e., Critically evaluate the following statement: The polygraph test is an accurate means of detecting lies); while their actions were recorded using Video Capture Software for Windows 8. The researcher checked if the student was familiar with opening multiple tabs in a browser before they began the task, and they were told to ask for assistance if they had any difficulty using the computer in general. The instructions were read out loud and a printed copy was placed next to the computer monitor for the duration of the search task. Students were allowed to choose among

three web browsers and given full access to the internet during the search task. They were also permitted to take notes.

They were given additional time to use the online resources they found to answer a series of questions (see Appendix B). One of the tasks was to rate the 6 to10 web sources they had found on a 4-point Likert type scale (ranging from highly credible to not at all credible). After completing the task, the video capture screens were replayed and participants were asked to verbalise, but not explain, their thinking to account for the steps they took to complete the given task. There was a 5 minute debriefing period after completion of the interview, where they were asked if they experienced any difficulties during the search task and if they had any general comments about their overall experience.

2.5 Ethical considerations

Stage 1: Questionnaire

As a learner-centred study seeking active partnerships with participants, strict ethical guidelines were adhered to in order to uphold the rights to privacy, dignity and confidentiality (Terre Blanche *et al*., 2006). Participation was strictly voluntary and participants were informed of their right to withdraw at any time and without any negative consequences (Terre Blanche *et al*., 2006). For the online questionnaire, participants remained anonymous as no personal identifying information was required. A special coding system was used to create a unique identifier for those willing to participate in the second task. The data collected was kept confidential at all times using a password protected file system on the researcher's personal computer. All participants were given a Participant Information Sheet that stated the voluntary and confidentiality clauses as well as the required time commitments, description of how their data would be handled, and an open assessment of both the benefits and potential risks (Terre Blanche *et al*., 2006). It was stated that consent was given by means of completion and submission of the online questionnaire and that there were no negative consequences if they choose not to participate.

The Participant Information Sheet also stated that, because the online questionnaire provided anonymity and confidentiality, no individual feedback could be given. General feedback in the form of a summary sheet was provided to one participant upon request. Participants were informed that they could email the researcher should they require additional information or feedback, or decide to withdraw after completing the questionnaire. Contact details were provided on the Participant Information Sheet. The participants were informed that their data would be used

to determine students' use of cognitive skills when searching online and that it would be conveyed in the research report in an aggregated form. They were also informed that their data could also be used in conference presentations and journal articles and would be securely stored for future research purposes.

Stage 2: Online Search Task

For the data obtained during the online search task, the following was taken into consideration: the researcher informed the participants of the purpose, nature, data collection methods, and extent of the research prior to the commencement of the study. In addition, the researcher explained the typical roles the participant would be undertaking in completing the online search task and answering the 7 questions, all of which was audio recorded with a digital recorder and later transcribed, taking approximately 50 - 60 minutes to complete. Participants were given Participant Information Sheets as well as a separate certificates of consent. Informed consent was obtained in writing from the participants prior to commencement of the practical online search task (Terre Blanche *et al*., 2006). Due to the nature of the data collection methods, participants were given the option on the consent form as to when and how they agree for the audio recordings to be played (in public lectures, classroom settings, etc.). The audio and video screen capture recordings will be kept indefinitely in a locked storage area, and electronic copies are stored on secure, password-protected computers. Only the researcher and her supervisor will have access to them, and only for research or educational purposes. Participants were informed that in the final report, complete confidentially of their data, responses and personal details would be ensured by using pseudonyms during the coding of transcriptions.

The researcher ensured that no participant was placed in a situation where they might be harmed as a result having partaken in the study, either physically or psychologically (Stiles, 1993). The participants held the power to discontinue the audio recording at any point, or to remove any portion of the recording, if they deemed it necessary. All 17 participants that volunteered to take part in the practical task received additional course credit and stood an equal chance of winning a seven-inch Android tablet, regardless of whether or not they completed the online search task. Participating for credit may influence the study's external validity so participants were reminded again verbally, before reading the participant information sheet and starting the online search task, that they could withdraw at any point without fear of losing their extra credit. As they may or may not win the prize, their participation remained voluntary. Further justice principles included the power to choose a preference for the time and day for the interview (Terre Blanche *et al*., 2006).

Referrals were provided for free campus based resources that students can access to further develop their digital literacy.

2.6. Preparation of the data for analysis

Stage 1: Response data from the online questionnaire was exported to MS Excel format, where it was cleaned. This data cleaning procedure included the deletion of fields deemed unnecessary to the purpose of the study. Only the demographic information, subscale responses for each cognitive component of digital literacy and their self-reported online search behaviour responses, thereby remained. All responses from the questionnaire sample were coded and transcribed in MS Excel before being added to the SPSS (Version 23) database for further statistical analysis.

Stage 2: The video and audio data obtained during the post-search interview task was transcribed using VCL Media player and MS Word. The transcribed recordings were then imported into MS Excel so they could be coded into the various macro-level self-directed learning, epistemic cognition and online search behaviour categories that the students verbalised during the search task. Each frequency count of the aforementioned behaviours was summed to provide overall micro-level scores on each variable for all 17 participants. For example, if they refined their search criteria five times during the 15-minute search task they would obtain a score of '5' for the micro-level variable, refine search criteria (RSC) which would then be categorised under online search behaviour (OSB plus). The summed macro-level self-directed learning and epistemic cognition scores, including the various micro-level subscales, were then added to the SPSS data file for further analysis.

2.7 Data analysis

2.7.1 Stage 1: Analysis of questionnaire data

The IBM SPSS Statistics 23 software was used to carry out the statistical analysis. Descriptive statistics of demographic and financial variables was done using SPSS. The mean, standard deviation, range, skewness and kurtosis for the five categories of questionnaire items were calculated. Descriptive statistics were also used to analyse the macro-level self-directed learning (SDL) and epistemic cognition (EC) variables. For SDL, the items were categorised under three factors, namely, Self-management (13 items); Desire for learning (11 items); and Self-control (14 items) (Fisher & King, 2010). For EC, the items were categorised under beliefs about knowledge, justification, source evaluation and epistemic aims (Greene *et al*., 2014). For data that was normally distributed, Pearson Product Moment Correlation Coefficient was calculated; and for

data that was not normally distributed, Spearman's Correlation Coefficient was calculated.

2.7.2 Stage 2: Analysis of online search task data

Analysing transcribed verbal description data to understand digital literacy phenomena

First approach: Summarising micro-level cognitive processes into macro-level variables

Due to the nature of the data collection procedure, the kind and frequency of behaviours demonstrated during the online search task may vary from individual to individual (Greene & Azevedo, 2009). Greene and Azevedo (2009) have proposed that aggregated data can be coded from micro-level self-directed learning (SDL) processes (e.g., content evaluation of learning) into macro-level SDL variables (e.g., monitoring). They claim that distinguishing these two levels better captures the relevant variance regarding the degree to which students self-direct their engagement with complex materials. Furthermore, Greene and Azevedo (2009) argue that macro-level analyses provide better control for idiosyncratic differences in the specific actions that learners choose to enact (e.g., taking notes versus summarising). It may, therefore, be advantageous to evaluate the extent to which participants are engaging in macro-level SDL processing, such as planning, monitoring and strategy use, as opposed to focusing on whether students are enacting particular examples of those macro-level SDL processes (on the micro-level, such as setting a sub-goal versus accessing prior knowledge) (Greene & Azevedo, 2009).

From the analysis self-directed learning, epistemic cognition and online search behaviours codes were created (see Appendix D for a full list of all codes used). Although a similar method to the Greene *et al*. (2014) framework for data analysis was used in this study, it was also considered that within this specific research context, only certain micro-level SDL and EC behaviours might associate with online search strategies. Some of the key differences between the Greene *et al*. (2014) study and this project is that their focus was on measuring learning gains, they also worked with talk aloud protocols which would have produced different types of data. Therefore whilst Greene and Azevedo's (2009) general framework was initially used, if new codes emerged from the data they were first categorised as micro-level processes (such as changing the search criteria several times or using multiple search engines) and then later summed into a single macro-level variable, for example, constructive online search behaviour (OSB plus).

Second approach: Data-driven coding of transcripts

Using the theoretical framework provided by Azevedo (2005) and Greene *et al*. (2014), the transcribed data was coded and then organised into micro-level SDL and EC categories for further

statistical analysis. In light of the potential problems (Greene et.al, 2014) with simply summing up all micro-level cognitive variables into macro-level variables, the micro-level processes, which occurred more frequently during the online search, were focused on. This more data driven approach eliminated micro-level processes that did not demonstrate strong associations with the critical assessment of online resources. Correlations between each macro-level code for both self-directed learning (SDL) and epistemic cognition (EC) were calculated and compared with the SDL and EC scores obtained on the questionnaire from Stage 1. The micro-level codes were clustered into macro-level variables to account for the individual differences that might affect specific SDL and EC processes that occur while students search online for academic content (Greene *et al*., 2014; Guglielmino, 1977).

Chapter Three
Results

3.1 Stage 1 and 2: Overall demographics

Table 5 provides a detailed summary of the sample's (n=119) financial, schooling and language demographic features for the Task 1 participants. The majority of the students attended either a Public (former DET school), 35.8% (n=43) or a Private school, 33.3% (n=40). This would indicate a greater likelihood of them having developed digital skills through their educational institutions or social support (skills access), as well as possession of a computer (material access) or other types of technology and therefore more frequent usage opportunities (usage access) (Van Dijk & Hacker, 2003).

Table 5. Financial, schooling and language demographics of the questionnaire sample (n=119)

Home language	***f***	**(%)**	**Type of High School**	***f***	**(%)**
Afrikaans	1	(0.8%)	Public (former DET school)	29	(24.2%)
English	50	(41.7%)	Public (former model C school)	43	(35.8%)
isiNdebele	1	(0.8%)	Private	40	(33.3%)
isiXhosa	4	(3.3%)	Independent	3	(2.5%)
isiZulu	23	(19.2%)	Other	1	(0.8%)
Sesotho sa Leboa	11	(9.2%)	Total	116	(96.7%)
Sesotho	5	(4.2%)	Not answered	4	(3.3%%)
Setswana	12	(10.0%)			
siSwati	3	(2.5%)			
Tshivenda	1	(0.8%)			
Xitsonga	5	(4.2%)			
Other	3	(2.5%)			
Total	119	(99.2%)			
Not answered	1	(0.8%)			

Total household income	***f***	**(%)**	**Funding studies**	***f***	**(%)**	**Personal Financial position**	***f***	**(%)**
No income	4	(3.3%)	Bursary / Loan scheme	31	(25.8%)	Not enough money for basics	8	(6.7%)
Under R5000	14	(11.7%)	Student loan	11	(9.2%)	Have enough for food but short on everything else	21	(17.5%)
Under R10 000	5	(4.2%)	Scholarship	11	(9.2%)	I have most of the important things like food and clothes. but few luxury goods	48	(40.0%)
Under R15 000	10	(8.3%)	Parent / Family / Personal sponsor	60	(50.0%)	I have most of the important things like food and clothes and luxury goods	30	(25.0%)

Total household income	***f***	**(%)**	**Funding studies**	***f***	**(%)**	**Personal Financial position**	***f***	**(%)**
Under R30 000	15	(12.5%)	Personal Savings	1	(0.8%)	Enough money for extra things such as going away for holidays and luxury goods	12	(10.0%)
Under R50 000	17	(14.2%)	Part-time or full time work	1	(0.8%)	Total	119	(99.2%)
Under R100 000	7	(5.8%)	Other	1	(0.8%)	Not answered	1	(0.8%)
Under R150 000	6	(5.0%)	Not answered	4	(3.3%)			
Under R300 000	15	(12.5%)						
Under R600 000	6	(5.0%)						
R600 000 +	10	(8.3%)						
Not sure / Don't feel comfortable discussing	8	(6.7%)						
Total	117	(97.5%)						
Not answered	3	(2.5%)						

Note. N = 119

f, frequency count.

Demographics for the Stage 2 participants

The majority (52.94%) of the Stage 2 participants were born in urban areas, such as Johannesburg, Cape Town and Durban (n=9). Outside of South Africa, 17.65% were born in Zimbabwe, (n=3), 5.88% in Gaborone (n=1) and 5.88% in Lesotho (n=1). With the remaining 17.65% coming from townships or smaller towns within South Africa (n=3).

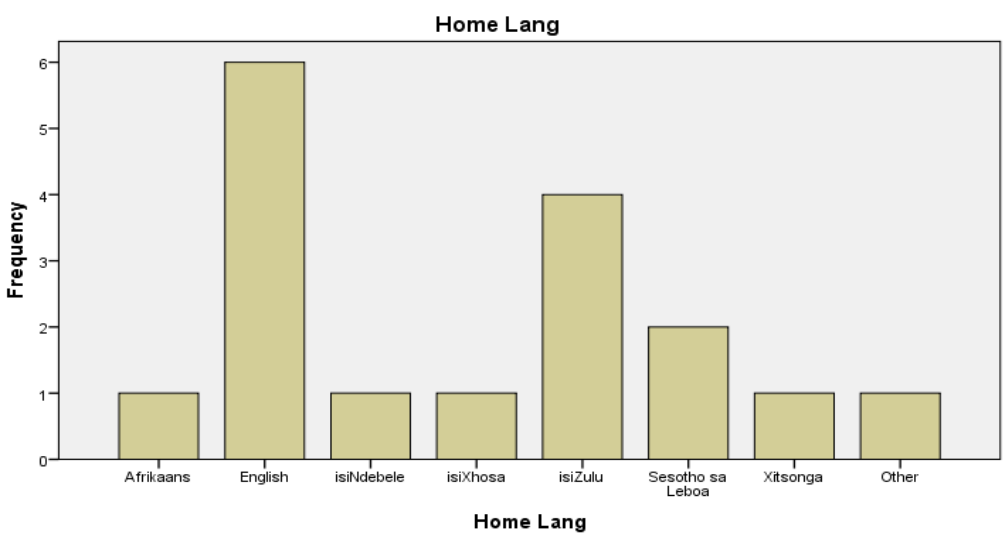


Figure 2: Demographics for Stage 2 participants only- Home language

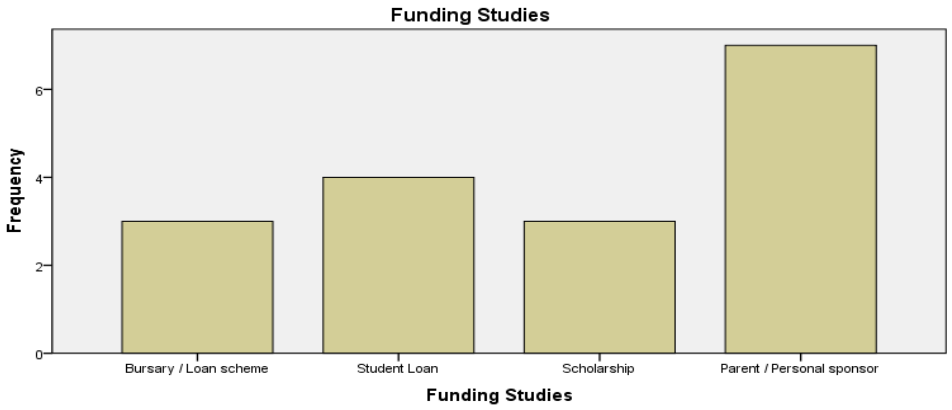


Figure 3: Demographics for Stage 2 participants- Funding studies

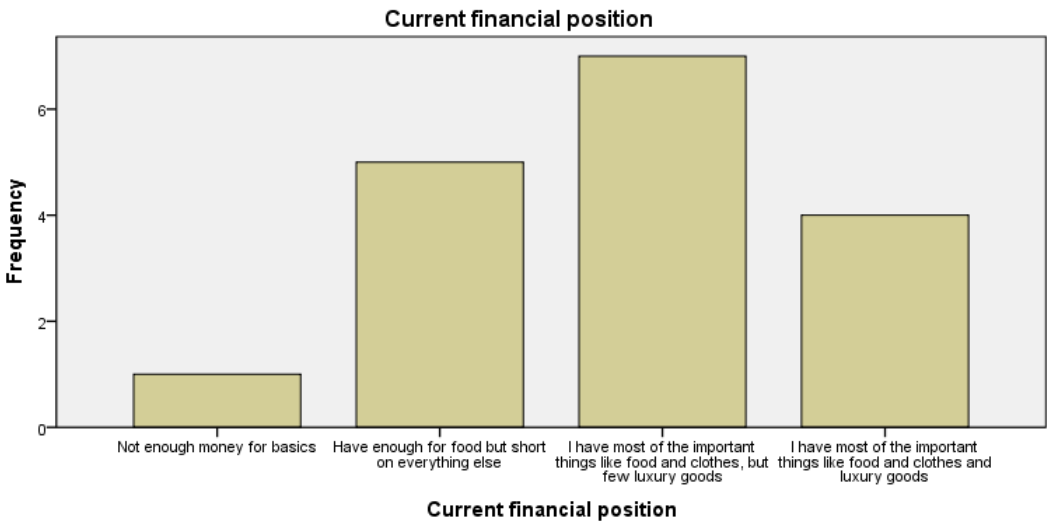


Figure 4: Demographics for Stage 2 participants- Current financial position

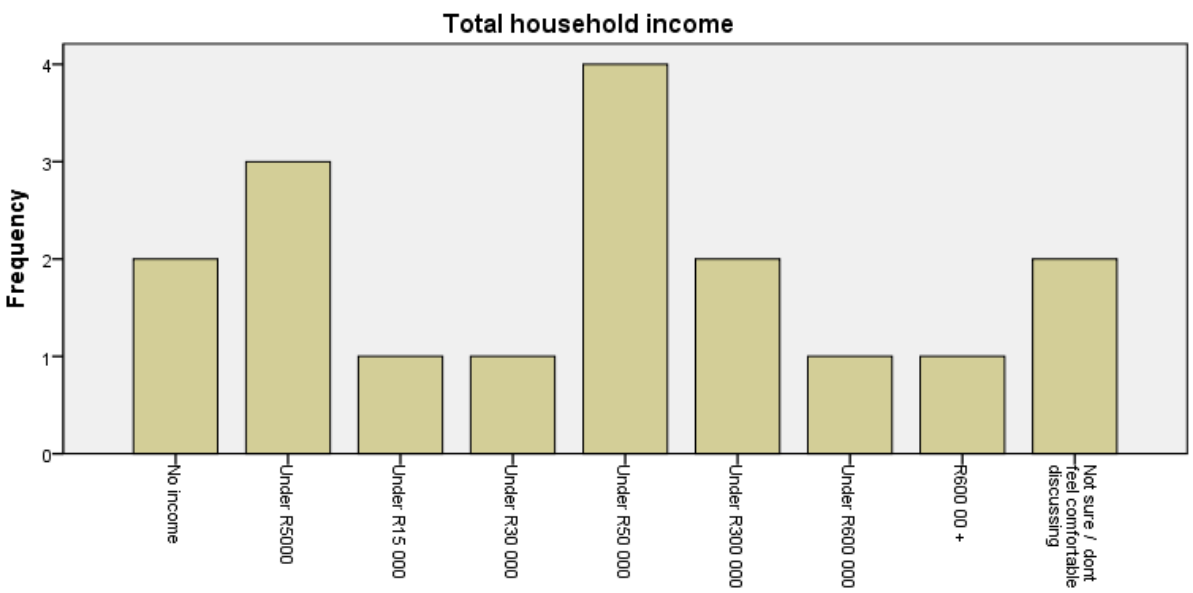


Figure 5: Demographics for Stage 2 participants- Total household income

3.2 Stage 1: Self-directed learning and Epistemic Cognition Questionnaire (SDLECQ)

Research Question 1: What general levels of readiness for self-directed learning and epistemic cognition are self-reported in an undergraduate student sample?

Each student's SDLRS, EOCQ and Psych-SEBS responses to the questionnaire were scored using their responses to the Likert-type scales. Each item was grouped on the various subscales for each main scale (e.g. desire for learning under SDLRS) and then summed to create final total scores for each scale (See Table 6). The EOCQ scale assesses students' beliefs about the nature of psychological knowledge. The *justification by authority* scores indicate students' views regarding experts in the field of psychology, classroom learning, textbooks and lecturers (Greene, 2007). The score indicated the degree (ranging from 1, completely disagree, to 6, completely agree) of trust that students place on authority figures and if they accept claims made by them without question. The items also assessed if students considered textbooks to be authoritative sources of knowledge. The scores for the *personal justification* assesses students' personal beliefs in content areas and whether those beliefs can be disproved. One of the reverse-coded items measured whether students had the ability to justify knowledge as being knowledge at all (Greene, 2007). The Psych-SEBS subscale scores are considered significant predictors of students' psychological knowledge and general interest (Renken, McMahan, & Nitkova, 2015). The higher scores on these items indicate a greater belief in the significance of psychological research (Renken, McMahan, & Nitkova, 2015).

Table 6. Descriptive Statistics for the Self-Directed Learning (SDLRS), Epistemic and Ontological Cognition Questionnaire (EOCQ) and the Psychology-Specific Epistemological Belief Scale (Psych-SEBS)

Variable	Mean	(SD)	Min	Max	Skewness	(SE)	Kurtosis (SE)	
Desire for learning (DL)	3.667	(.443)	2	4	-.630	(.228)	.867	(.453)
Self-management (SM)	3.774	(.447)	2	4	-.506	(.228)	.396	(.453)
Self-control (SC)	4.101	(.518)	2	5	-.213	(.229)	-.395	(.455)
Total SDLRS	11.324	(1.124)	7	14	-. 578	(.240)	. 736	(.476)
Raw score SDLRS	133.19	(12.88)	86	162	-.632	(.239)	.844	(.474)
Simple and Certain Knowledge Terms	2.95	(.688)	1	4	-.485	(.225)	.394	(.446)
Justification by Authority	3.46	(.916)	2	6	.280	(.229)	.132	(.455)
Personal Justification	3.73	(.788)	2	5	-.380	(.226)	-.137	(.447)
Total EOCQ	10.132	(1.346)	7	14	.623	(.230)	.751	(.457)

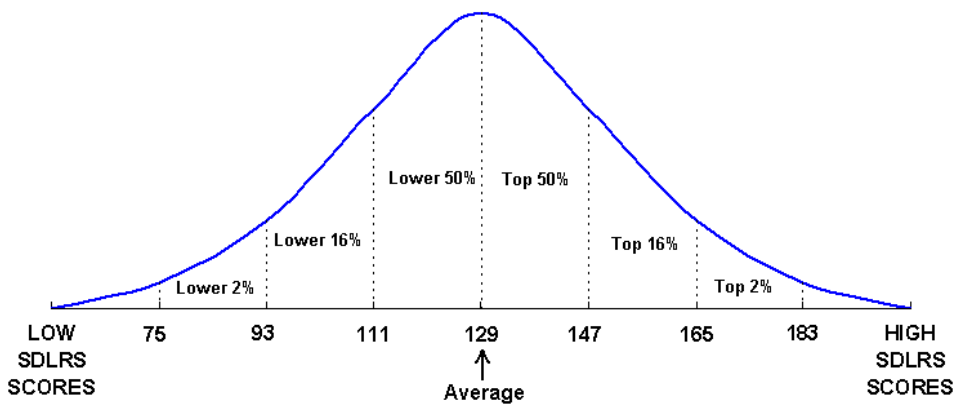
Variable	Mean	(SD)	Min	Max	Skewness	(SE)	Kurtosis (SE)	Variable
Significance of psychological research	2.929	(.882)	1	6	.744	(.233)	1.107	(.461)
Subjective nature of psychological knowledge	4.521	(.759)	2	6	-.536	(.234)	.550	(.463)
Predictability of human behaviour	4.400	(.881)	2	6	-.413	(.229)	-.014	(.455)
Total Psych-SEBS	11.857	(1.736)	6	18	-.055	(.236)	2.353	(.467)
Essay Mark Average	68.77	(8.447)	39	85	-.891	.236)	1.324	(.467)

Note. N = 119. Raw scores SDLRS, was derived from the summed scores on the SDLRS scale across all participants

Self-directed learning behaviours evident in the sample and interpretation of the *SDLRS* scores of the Stage 1 and 2 participants.

The SDLRS score is a measure of a student's current level of Self-Directed Learning Readiness (Delahaye & Choy, 2000). Students who score between 34 - 119 are considered 'below average', if they score between 120 and 138 they are categorised as 'average', and between 139-170 as 'above average' (Delahaye & Choy, 2000).

Figure 6: Normed averaged scores on the Self-Directed Learning Readiness Scale (SDLRS)



The summary data in figure 6 was taken from studies done by Delahaye and Choy (2000).

The raw score average for the questionnaire sample on the SDLRS scale was 133.13 (SD=12.88), this would place the Wits undergraduate sample in the top 50% percentile above the average of 129 (Delahaye & Choy, 2000).

Research Question 2: What do undergraduate university students in South Africa self-report on the following self-directed learning behaviours, epistemic cognition and digital search literacy issues?

Self-directed learning behaviours evident in the sample.

The questionnaire responses for the SDLRS scale were examined for factors that may relate to the skills needed to complete an online academic search. One item required them to rate themselves on their 'ability to search out information'. Out of the 118 respondents, 55.08% (n=65) rated themselves as confident in their ability to search out information (4, usually or 5, almost always true of me) and 42.38% (n=50) rated themselves as less confident in their ability to search out information (2, sometimes or 3, not often true of me). An item measuring 'time management' skills showed that 23.93% self-reported that they managed their time well (n=28), they rated themselves 4 or 5 (usually or almost always true of me) on the scale, whilst 6.41% (n=74) stated they were not able to manage their time well (either 2 or 3, sometimes or not often). In terms of behaviours that might hinder their ability to search online, one item asked them if 'understanding what they read is a problem for them'. Out of the 119 respondents 18.48% (n=22) rated themselves as unable to understand what they have read (either 4 or 5; usually or almost always true of me) while most of them 69.75% (n=83) were confident in their ability to understand what they had read (rated themselves 2 or 3; sometimes or not often true of me).

3.2.1 Psychology-specific epistemic beliefs that emerged from the sample

The questionnaire responses for the EOCQ scale were examined for factors that may relate to the epistemic beliefs students may have regarding the nature of psychological knowledge. One item required them to rate their belief that 'psychological knowledge of the facts about human behaviour does not change'. Out of the 116 respondents, 10.35% (n=12) said they believed psychological knowledge of the facts about human behaviour does not change (rated either a 5 or 6, mostly or completely agree), 14.66% (n=17) were less confident that facts regarding behaviour did not change (rated it 4, somewhat agree), and 60.34% (n=70) believed that psychological knowledge of the facts about human behaviour did in fact change (rated 2 or 3; mostly or somewhat disagree). Another item asked if they agreed with the statement, 'if a psychologist says something is a fact, I believe it'. Out of the 115 respondents, 9.57% (n=11) believed that what a psychologist stated as a fact was indeed so (rated either a 5 or 6, mostly or completely agree), 24.35% (n=28) were less confident but also agreed that a psychologist could make factual claims (rated 4, somewhat agree), and 52.18% (n=60) did not believe that a psychologist's claims were necessarily fact based (rated 2 or 3, mostly or somewhat disagree). An additional item required them to rate their belief that 'things written in psychology textbooks are true'. Out of the 115 respondents, 26.09% (n=30) believed that psychology textbooks are accurate (rated it either 5 or 6, mostly or completely agree), 34.78% (n=40) also believed they are accurate but to a lesser degree

(rated 4, somewhat agree), and 37.4% (n=43) did not agree that things written in psychology text books are necessarily true (rated 2 or 3, mostly or somewhat disagree).

3.2.2 Students self-reported internet-specific epistemic beliefs regarding information sources found online

In terms of internet-specific epistemic cognition, 110 responded in the final section of the questionnaire to the statement, how often 'do you consider information found online to be potentially biased'. The majority, 50% (n=55), agreed that on occasion online information could be considered biased (rated 3, occasionally). 21.82% (n=24) stated that bias occurs more frequently (rated 4 or 5, frequently or very frequently) and only 14.55% (n=16) disagreed that online information might regularly contain bias (rated it 1 or 2, never or very seldom). The Psych-SEBS items assessed students' psychological knowledge and general interest in the field. One item asked if 'currently acceptable psychological knowledge may be changed or totally discarded in future'. One hundred and ten students responded to this statement, out of which 45.46% (n=50) believed that currently accepted psychological knowledge would most likely change in future (rated 5 or 6, mostly or completely agree). 35.45% (n=39) stated it was possible it would change (rated 4, somewhat agree), and 16.36 (n=18) did not agree that psychological knowledge was likely to change or be discarded (rated 2 or 3, mostly or somewhat disagree). This item related to whether students might check the date stamps or comment on the *currency* (whether the content is current or outdated) of online content during the actual search task (Meola, 2004).

3.2.3 Students self-reported general level of exposure to formal digital literacy and IT training

Students self-reported having taken information technology (IT) as a school subject. There were 130 responses in total, of which, 39.23% (n=51) said yes, and 60.77% (n=79) said no. In section 5, they were asked if they had ever received formal training on how to conduct an academic literature search. There were 109 responses in total, of which, 38.53% said they had never received any formal training (n=42), 17.43% said it was seldom that they had been exposed to formal training (n=19), 20.18% said only occasionally (n=22), and only 18.38% had received regular online training (n=20). Six participants (5.5%) said they were unsure if they had received training or not.

3.2.4 Self-reported general online search behaviours (OSBs)

The final section of the questionnaire comprised 8 items, which measured the frequency with which students engaged in certain online behaviours. The items were rated on a 6-point Likert

type scale. The ordinal scale was reduced to a categorical scale by coding all ratings of 1 to 2 (never and very seldom) as 'no' and ratings of 3 to 5 (occasionally to frequently) as 'yes'. The questionnaire category remained as 'not sure' for all ratings of 6 and if students did not respond to the question they were placed in the 'not answered' category.

Table 7. Self-reported online search behaviours for the questionnaire participants

Response	Received formal training on conducing an online search	Uses e-Journals / databases	Uses the Wits library portal	Can open multiple tabs when searching	Google is my starting point
Yes	87 (72.5%)	42 (35.0%)	20 (16.7%)	76 (63.3%)	74 (61.7%)
No	7 (5.8%)	61 (50.8%)	84 (70.0%)	29 (24.2%)	35 (29.2%)
Not sure	14 (11.7%)	6 (5.0%)	6 (5.0%)	4 (3.3%)	1 (0.8%)
Not answered	11(9.24%)	10 (8.4%)	9 (7.56%)	10 (8.4%)	9 (7.56%)

Note. N = 119

Table 7 summarises the results of the Task 1 participants' (n=119) responses to the final section of the online questionnaire, *conducting online searches*. The general trends found in the Stage 1 self-reported data seemed to follow through for the Stage 2 online search task sample (n=17). Of the 17 participants, 88.2% (n=15) had received some form of formal training on how to conduct an academic literature search online. In terms of internet-specific epistemic cognition, 64.7% (n=11) stated that online information was potentially biased, while only 17.6% (n=3) did not consider it to be biased. Three participants from Stage 2 (17.6%) stated they were not sure if online information was biased or not. In Stage 2, 64.7% (n= 11) self-reported that they used Google as their starting point for finding information, while 17.6% (n=3) claimed to make use of the Wits Library Catalogue to conduct searches.

3.2.5 Multivariate analysis of variance (MANOVA) to compare the Stage 1 and Stage 2 participants

The Stage 1 questionnaire totals were also used to attain baseline scores for students' self-reported self-directed learning and epistemic cognition behaviours. The scores of the Phase 2 participants were then compared to the general questionnaire group from Phase 1 to ascertain if they were indeed a representative sample, or if any significant differences emerged. A multivariate analysis of variance (MANOVA) was used to compare the questionnaire scores for the Stage 1 (n=103) and Stage 2 (n=17) participants. Before conducting the MANOVA, the data was examined using SPSS (Version 23) software to ensure all of its underlying assumptions were met. Univariate normality was assessed with Shapiro-Wilk tests and boxplots, and could be assumed. Analysis of

the dependent variables individually showed statistically non-significant results for the epistemic cognition scores; SEBS Total, F(1)=.576, p=.450, partial $\eta^2 = .007$, EOCQ Total, F(1)= 1.422, p= .237, partial $\eta^2 = .017$ and the first term essay marks, F(1)= .073, p=.788 partial $\eta^2 = .001$ indicating the absence of any meaningful group differences on the variables measured.
The SDLRS score, however, was statistically significant F(1)= 10.731, p= .002, partial $\eta^2 = .117$, indicating a difference between the Stage 1 and Stage 2 groups. The difference (M= 133.19, SD=12,88) between the questionnaire group and that of the Stage 2 sample (M= 139.33, SD=15,24) indicates that those participating in Stage 2 had somewhat higher SDL scores than the general group. Adults with high SDL scores are usually are more successful in recognising their learning needs and can often plan and implement individual learning projects (Guglielmino & Guglielmino, Expanding your readiness for self-directed learning: A workbook for the Learning Preference Assessment, 1991). This characteristic of high SDL scorers may account for their volunteer behaviour and interest in participating further in psychological research. Group means (and standard deviations) for each dependent variable are presented in Table 8 and 9.

3.3 Stage 2: Questionnaire results for the online search task sample

3.3.1 Self-directed learning (SDLRS) questionnaire scores for Stage 2 participants (n=17)

Table 8. Descriptive Statistics for macro-level SDL and essay mark variables

Variable	Mean	(SD)	Minimum	Maximum	Skewness	(SE)	Kurtosis	(SE)
Desire for learning (DL)	3.73	(.460)	3	5	-.199	(.550)	-.362	(1.063)
Self-management (SM)	3.35	(.406)	3	4	.286	(.550)	-.661	(1.063)
Self-control (SC)	4.30	(.533)	3	5	.714	(.550)	.069	(1.063)
Total SDLRS	3.79	(.426)	3	5	.417	(.550)	.129	(1.063)
Raw total SDLRS	139.33	(15.262)	113	170	.304	(.550)	-.036	(1.063)
Average Essay Mark	68.74	(9.010)	50	85	-.323	(.550)	-.098	(1.063)

Note. N = 17. SDLRS, Self-directed learning Readiness Scale

The average score for all the students (n = 119), who completed the *SDLRS* questionnaire, was *133.19* and the standard deviation was 12.88. The *SDLRS* measures the current level of readiness for self-directed learning (Guglielmino, 1977). Those with high SDLRS scores generally prefer to self-regulate their learning requirements and develop their own strategies and implementation of their own learning. This should not be interpreted as being unwilling to participate in more structured learning environments. They could easily select traditional academic

courses or workshops as a part of a learning design (Guglielmino & Guglielmino, Expanding your readiness for self-directed learning: A workbook for the Learning Preference Assessment, 1991). Persons with average *SDLRS* scores may be more successful in independent situations, but are not completely content with managing the entire process of recognising their learning needs and planning and implementing learning goals (Guglielmino & Guglielmino, Expanding your readiness for self-directed learning: A workbook for the Learning Preference Assessment, 1991). Those with below average *SDLRS* scores generally prefer very structured learning options such as lectures or schoolroom settings (Guglielmino & Guglielmino, Expanding your readiness for self-directed learning: A workbook for the Learning Preference Assessment, 1991).

One of the research goals was to assess the current levels of epistemic cognition in the undergraduate student sample. Table 9 summarises the mean scores for the questionnaire sample (n=119) on the two measures of epistemic cognition, the EOQC and the Psych-SEBS as well as their respective subscales. The mean scores for each of the subscales on the EOCQ subscales was approximately 3, which would indicate some disagreement with that particular item. For the Psych-SEBS subscales, the average was 4, which would indicate agreement with those items.

3.3.2 Epistemic and Ontological Cognition Questionnaire (EOCQ) and Psychology-Specific Epistemological Belief Scale (Psych-SEBS)

Table 9. Descriptive Statistics for the Stage 2 sample's macro-level EC variables and totals

Variable	Mean	(SD)	Minimum	Maximum	Skewness	(SE)	Kurtosis	(SE)
Simple and Certain Knowledge	3.18	(.591)	2	4	-.199	(.550)	-1.540	(1.063)
Justification by Authority	3.60	(.940)	2	5	-.253	(.550)	-1.020	(1.063)
Personal Justification	3.65	(.707)	3	5	.645	(.550)	.354	(1.063)
EOCQ TOTAL	3.475	(.434)	2.80	4.33	.631	(.550)	-.271	(1.063)
Significance of psychology research	3.0323	(.531)	2.20	4.20	.592	(.550)	.422	(1.063)
Subjective nature of psychological knowledge	4.5368	(.615)	2.80	5.40	-1.150	(.550)	3.068	(1.063)
Predictability of human behaviour	4.7941	(.771)	3.50	6.00	-.130	(.550)	-.726	(1.063)
Psych-SEBS TOTAL	4.1211	(.399)	3.20	4.67	-.535	(.550)	.051	(1.063)

Note. N = 17. EOCQ, Epistemic and Ontological Cognition Scale; Psych-SEBS, Psychology-Specific Epistemological Belief Scale

3.3.3 Online search task results: Exploring the relations between measures of digital literacy and online search behaviours

Research Question 3: **What are the actual behaviour based digital literacy components of SDL and EC that students demonstrate when performing an online search task?**

The general trends observed in the online search task sample (n=17) are summarised in Table 10, which compares the number of sources found, which search engines or databases they made use of, their initial search criteria and any additional tools used for each participant. The table also summarises which sources they rated the most and least credible and the codes used during the analysis of the post-search credibility judgements data.

Table 10. Overview of the online search behaviour (OSB) and search strategies engaged: results from the Stage 2 video capture and interview transcription data

ID	No. of Sources	First search tool	First search term	Additional search tools	Additional search terms/ strategies	Most credible source (title & details)	Least credible source (title & details)	Primary bases for credibility judgements
1	9	Google Scholar (https://scholar.google.co.za)	'Polygraph Test definition'	Wiley Online library – (http://onlinelibrary.wiley.com/) University of Portsmouth (http://www.port.ac.uk/library/infores/libcat/)	'Accuracy of polygraph tests' 'Definition of polygraph tests' 'William Moulton Marson' Inventor search Hyperlinked content Citation link (Wonder Woman) 'Wonder Woman cartoon superhero' 'Origins of Wonder Woman cartoon superhero' 'Detecting lies' 'Consequences of lying' 'infallible detector of the truth' Total: 8	Title: The reliability of polygraph examiner diagnosis of truth and deception. Type / Category: The Journal of Criminal Law, Criminology, and Police Science, 276-281. Authors and year: Horvath, F. S., & Reid, J. E. (1971).	Title: A critical review of the control questions test (CQT). Type / Category: Handbook of polygraph testing, 103-126. Authors and year: Ben-Shakhar, G. (2002).	Personal justification Type Argument quality
2	7	Google (www.google.co.za)	'Is a polygraph test an accurate means of detecting lies?'	n/a	n/a Total: 0	Title: The Truth About Lie Detectors (aka Polygraph Tests) Type / Category: American Psychological Association, August 5, 2004	Title: Vaughan Bell: the truth about lie detectors Type / Category: Guardian News and Media	Author (credentials) Justification by authority
3	10	Google (www.google.co.za)	'Polygraph tests'	Youtube (www.youtube.com)	'Reliability of polygraph tests' 'The psychology behind a polygraph' 'Detecting lies' 'Definition of a lie' 'How to tell is someone is lying'- typed but not entered / searched changed it to 'Reasons polygraph tests are used' 'Origination of the polygraph' 'Youtube- How a polygraph is done'	Title: Uses of Polygraph Tests Type / Category: Educational institution	Title: How to Detect Lies Type / Category: Blifaloo.com is 'temporary boredom relief & knowledge for the curious mind'	Type Justification by authority

ID	No. of Sources	First search tool	First search term	Additional search tools	Additional search terms/ strategies	Most credible source (title & details)	Least credible source (title & details)	Primary bases for credibility judgements
					'How often people fool lie detector tests' 'Statistics on beating a lie detector test' Total: 10			
4	10	Google (www.google.co.za)	'The Polygraph Test is an Accurate Means of Detecting Lies'	Google Scholar (https://scholar.google.co.za) Wikipedia (https://en.wikipedia.org/wiki/Main_Page) Google News	Google Scholar: 'The Polygraph Test is an Accurate Means of Detecting Lies' 'Polygraph Test' 'Polygraph Test social effect' 'Polygraph Test criminal effect' Total: 4	Title: Effects of mental countermeasures on psychophysiological detection in the guilty knowledge test Type / Category: International Journal of Psychophysiology	Title: Polygraph Type / Category: From Wikipedia, a free online encyclopedia	Format / Style Type Personal justification Justification by authority
5	7	Google (www.google.co.za)	'What is a polygraph test'	Google Scholar (https://scholar.google.co.za)	Google Scholar: 'Research on polygraph test's accuracy' 'Can blood pressure be highly related to lying' 'can blood pressure changes be highly related to lying' Google: 'can blood pressure changes be relevant to lying dictators' Total: 4	Title: The Truth About Lie Detectors (aka Polygraph Tests) Type / Category: American Psychological Association, August 5, 2004	Title: LIE Detection by Inducing Cognitive Load Eye Movements and Other Cues to the False Answers of 'Witnesses' to Crimes Type / Category: Sage journal, Criminal Justice and Behaviour	Explanation quality
6	6	Google (www.google.co.za)	'Polygraph test accuracy'	e-Wits Library Database (https://www.wits.ac.za/library/find-e-resources-and-library-catalogue-/) Electronic Databases: EBSCO*host* Google Scholar	EBSCO*host*: 'polygraph test accuracy' Total: 1	Title: How accurate is a polygraph? Type / Category: Commercial Web site (San Gabriel, Pomona, and Big Bear Valley for Lie Detector Tests)	Title: The one thing you need to know to pass a polygraph test Type / Category: Commercial Web site (Business Insider Inc)	Personal justification

ID	No. of Sources	First search tool	First search term	Additional search tools	Additional search terms/ strategies	Most credible source (title & details)	Least credible source (title & details)	Primary bases for credibility judgements
				(https://scholar.google.co.za)				
7	6 (in 20 mins)	Google Scholar (https://scholar.google.co.za)	'lie detector William Marston'	n/a	'lie detector science' Total: 1	Title: Brain Activity during Simulated Deception: An Event-Related Functional Magnetic Resonance Study Type / Category: Online Journal (NeuroImage 15, 727–732 (2002)	Title: Psychology and the lie detector industry Type / Category: Report – PDF document (University of Minnesota , 1974)	Personal justification Explanation quality
8	8	Google Scholar (https://scholar.google.co.za)	'the polygraph test'	e-Wits Library Catalogue (https://www.wits.ac.za/library/469/researc_resources.html) Google (www.google.co.za) Oxford university online (https://www.conted.ox.ac.uk/research/index.php)	'the polygraph test is an accurate means of detecting lies book' e-Wits Catalogue: 'polygraph test' Google: 'is the polygraph test an accurate means of detecting lies' Google: 'a book on polygraph test' Google: 'a book on polygraph test google scholar' Google: 'william moulton marston' Google: 'william moulton marston on the lie detector machine' Oxford university online: 'polygraph test' Google: 'polygraph test book' Total: 9	Title: Polygraph.com Type / Category: Fundraising website (a documentary about my crusade against the fraudulent and abusive polygraph 'lie detector' industry.)	Title: Lie detection and the polygraph: A historical review Type / Category: Online Journal (The Journal of Forensic Psychiatry & Psychology)	Argument quality Format / style
9	8	Google Scholar (https://scholar.google.co.za)	'Accuracy of a polygraph test'	Google (www.google.co.za) Bing (www.bing.com) Wiley Online Library (onlinelibrary.wiley.com)	Google: 'polygraph test accuracy' Bing: 'accuracy of the polygraph test results' Google Scholar: 'Accuracy of lie detectors' Total: 3	Title: The Truth About Lie Detectors (aka Polygraph Tests) Category / type: American Psychological Association, August 5, 2004	Title: How accurate is a polygraph? Type / Category: Commercial Web site (San Gabriel, Pomona, and Big Bear Valley for Lie Detector Tests)	Type Venue Personal justification

ID	No. of Sources	First search tool	First search term	Additional search tools	Additional search terms/ strategies	Most credible source (title & details)	Least credible source (title & details)	Primary bases for credibility judgements
10	6	Google Scholar (https://scholar.google.co.za)	'Polygraph Test definition'	Wiley Online library – (http://onlinelibrary.wiley.com/) University of Portsmouth (http://www.port.ac.uk/library/infores/libcat/)	'Accuracy of polygraph tests' 'Definition of polygraph tests' 'William Moulton Marson' Inventor search 'Detecting lies' 'Consequences of lying' 'infallible detector of the truth' Total: 6	Title: The validity of polygraph testing: Scientific analysis and public controversy. Type / Category: Online Journal (American Psychological Associations; American Psychologist, Vol 40(3), Mar 1985, 355-366.)	Title: Polygraph Tests, Urine Tests: A Debate: The validity of test Type / Category: Online Journal Author: David T. Lykken	Venue
11	5	Google (www.google.co.za)	'Polygraph tests'	Google Scholar (https://scholar.google.co.za) e-Wits Library Catalogue (https://www.wits.ac.za/library)	'Accuracy of polygraph tests' Google Scholar' 'Polygraph Test' Google Scholar' 'accuracy of Polygraph Test' Google Scholar' 'are polygraph tests accurate' Google: 'are polygraph tests accurate pdf' Wits library: 'Polygraph Test' e-Wits Catalogue: 'Accuracy of Polygraph Tests' Google: 'Accuracy rate of Polygraph tests' Google: 'Accuracy of Polygraph tests' Total: 9	Title: A review of the current scientific status and fields of application of Polygraphic Deception Detection: Type / Category: Online Report (Final report (6 October 2004) from the BPS Working Party) Authors: Professor Ray Bull (Chair); Dr Helen Baron; Professor Gisli Gudjonsson; Professor Sarah Hampson; Professor Gina Rippon; Professor Aldert Vrij	Title: Mental and Physical Countermeasures Reduce the Accuracy of Polygraph Tests Type / Category: Online Journal (Journal of Applied Psychology 1994, Vol. 79, No. 2,252-259) Authors: Charles R. Honts, David C. Raskin, and John C. Kircher	Explanation quality
ID	**No. of Sources**	**First search tool**	**First search term**	**Additional search tools**	**Additional search terms/ strategies**	**Most credible source (title & details)**	**Least credible source (title & details)**	**Primary bases for credibility judgements**
12	8	Google (www.google.co.za)	'The Polygraph Test is an	Wits Intranet Ask South Africa (http://za.ask.com)	Wits intranet: 'Do Lie Detectors Work?' Google: 'Do Lie Detectors Work?'	Title: The Truth About Lie Detectors (aka Polygraph Tests)	Title: How to Cheat a Polygraph Test (Lie Detector)	Justification by authority

ID	No. of Sources	First search tool	First search term	Additional search tools	Additional search terms/ strategies	Most credible source (title & details)	Least credible source (title & details)	Primary bases for credibility judgements
			Accurate Means of Detecting Lies'		Google: 'how accurate are lie detectors' Google: 'William Moulton Marston' Google: 'william moulton marston in psychology' Google: 'is the Polygraph Test an Accurate Means of Detecting Lies' Google: 'is the Polygraph Test not Accurate as Means of Detecting Lies' Google: 'polygraph test journal' Google: 'polygraph test accuracy' Google: 'are lie detectors reliable' Google: 'how effective are polygraph tests' Ask SA: 'polygraph testing accuracy' Total: 12	Category / type: American Psychological Association, August 5, 2004	Category / type: Wikhow (an online wiki-style community consisting of an extensive database of how-to guides)	
13	5	Google (www.google.co.za)	'Findings about the lie detector test is it accurate or not'	n/a	'How do people pass lie detector tests and what does this say bout detector tests' 'are lie detector tests still used to measure if a person is lying or not' 'to what extent are polygraphs accurate' Total: 3	Title: The Truth About Lie Detectors (aka Polygraph Tests) Category / type: American Psychological Association, August 5, 2004	Title: How to Pass a Lie Detector Test (Whether You're Lying or Not) Category / type: Commercial Web site (Our renowned brands offer content designed to educate, inspire, and trigger buying decisions across an array of tech-related product and service categories.)	Justification by authority Venue
14	8	Google Scholar (https://scholar.google.co.za)	'Polygraph Test'	Google Books (http://books.google.co.za)	Google Books: 'Polygraph Test' Google Scholar: 'What are the means of detecting lies beside Polygraph'	Title: What Is the Current Truth About Polygraph Lie Detection? Category / type: Online Journal (Basic and Applied Social	Title: Polygraph and Interview Validation of Self-Reported Deviant Behaviour	Date Venue

ID	No. of Sources	First search tool	First search term	Additional search tools	Additional search terms/ strategies	Most credible source (title & details)	Least credible source (title & details)	Primary bases for credibility judgements
					Google Scholar: 'Polygraph Test' (repeated) Google Scholar: 'how accurate is a poly graph for detecting lies' Total: 4	Psychology Volume 24, Issue 4, 2002)	Category / type: Online Journal (Published by: American Sociological Association)	
15	10	Google (www.google.co.za)	'how accurate is a polygraph test'	Google Scholar (https://scholar.google.co.za) Jstor (www.jstor.org)	'is a polygraph test an accurate means of detecting lies?' Google Scholar: 'polygraph tests' Google Scholar: 'are polygraph tests accurate' Google Scholar: 'can lie detector tests detect lies' Jstor: 'polygraph' Total: 5	Title: To Catch a Liar: Challenges for Research in Lie Detection Training Category / type: Online Journal (Journal of Applied Communication Research Volume 31, Issue 1, 2003)	Title: Lie detection Category / type: From Wikipedia, a free online encyclopedia	Type
16	6	Google Scholar (https://scholar.google.co.za)	'polygraph test accuracy' (misspelled polygraph)	n/a	'how accurate is a lie detector' 'can a lie detector really detect lies?' 'can a polygraph test really detect lies?' 'how accurate is a polygraph test' Total: 4	Title: The validity of polygraph testing: Scientific analysis and public controversy. Category / type: American Psychological Association (American Psychologist, Vol 40(3), Mar 1985, 355-366.)	Title: Thermal image analysis for polygraph testing Category / type: Digital Library (A not-for-profit organization, IEEE is the world's largest professional association for the advancement of technology.)	Argument quality
17	6	Google (www.google.co.za)	'validity of a polygraph test'	Google Scholar (https://scholar.google.co.za)	Google Scholar: 'William moulton Marston's polygraph is it valid' Google Scholar: 'cases proving the validity of the polygraph' Google: 'validity of a polygraph test google scholar' Total: 3	Title: Controversy Over Polygraph Testing Validity Category / type: Online Book	Title: The Polygraph Test: Can Science Tell if You Are Lying? Category / type: Wordpress Blog	Venue Personal justification Justification by authority

The first method of analysis followed Greene and Azevedo's (2009) recommendation of summing all SDL and EC micro-level processes into their macro-level variables. During the analysis of the video data capture and audio transcripts, a third macro-level category emerged – online search behaviours (OSB). This macro-level variable comprised behaviours that assisted the search process. For example, refining the search criteria (RSC), navigating multiple tabs (TABS_OM), searching for definitions (S_DEF) if particular terminology in the topic was not clear, looking for a broader understanding (BU) of the topic by assessing different viewpoints such as the legal or biological standpoints on polygraph tests, and assessing if an adequate number of resources had been located (AANR). An illustration of the type of data that would have been coded as refining the search criteria (RSC), is taken from Participant no. 16. Their initial criteria was entered as follows, 'how accurate is a lie detector' it was then refined three times, first to: 'can a lie detector really detect lies?'; then 'can a polygraph test really detect lies?' and finally 'how accurate is a polygraph test' (Participant no. 16). These types of behaviours were then grouped into constructive online search behaviours (OSB plus).

The behaviours related to self-directed learning (SDL) were divided into two broad macro-level categories – monitoring and strategy use. These two codes were adopted from the Greene *et al*. (2014) framework. SDL monitoring comprised behaviours such as content evaluation (CE+ and CE-), expectations of the adequacy of the content located (EAC+ and EAC-), expectations of the credibility of the content (ECC+ and ECC-), as well as, time management (TM) and actively searching for different viewpoints (DV+ and DV-). For example, 'I went to different opinions, different views cause every field is going to have something different on the matter' –Participant 7. Regarding strategy use, the following micro-level variables were found in the data: directly referring to their own prior knowledge of the topic or using existing knowledge (KE), selecting new information sources (SNIS) by using hyperlinks or the back arrow, and finally controlling the playback of videos (CV). Table 11 provides the descriptive statistics for all the SDL and EC macro-level aggregated categories derived from the micro-level codes described above.

Table 11. Descriptive Statistics for Task 2 macro-level SDL and EC variables, and totals

Variable	Mean	SD	Range	Skewness (SE)		Kurtosis (SE)	
SDL Monitoring	1.70	(.790)	0-2.78	.251	(.550)	-.529	(1.063)
SDL Strategy Use	2.94	(.793)	0-2.67	.205	(.550)	-1.009	(1.063)
EC Source Evaluation	1.35	(1.086)	0-4.5	1.382	(.550)	3.393	(1.063)

Note. N = 17

3.3.4 Summarising of micro-level cognitive processes into macro-level scores

The second approach to analysis focused on the micro-level processes that the data suggested were more often used when conducting an online search. The following micro-level variables were coded: analysis of search query (AOSQ), refining the search criteria (RSC), changing the search criteria (CSC) and reading the abstract (RTA). In addition to searching for definitions of unknown terms (S_DEF), using multiple search engines (SE_M), developing a broader understanding of the topic (BU) and assessing whether an adequate number of resources have been found (AANR) – for example 'I realised, oh my gosh, I've only got like 3 websites. So then this caught my eye'- Participant 3 – were summed to create a new macro-level category variable, called positive search behaviours (OSB +). The variables that demonstrated sufficient variability to qualify as being measured on an interval scale were then summed to create a total OSB plus score for each of the 17 participants (see Table 12).

Table 12. Summed individual scores for the constructive online search behaviours (OSB+)

ID	CSC	S_DEF	SE_M	RTA	**OSB +**
1	7	0	2	0	**9**
2	0	1	0	3	**4**
3	10	2	0	2	**14**
4	4	1	2	4	**11**
5	4	1	1	2	**8**
6	1	0	3	2	**6**
7	1	0	0	6	**7**
8	9	1	3	0	**13**
9	3	0	3	5	**11**
10	8	2	2	4	**16**
11	9	1	2	0	**12**
12	12	0	1	0	**13**
13	3	1	0	1	**5**
14	4	2	1	3	**10**
15	4	2	2	1	**9**
16	4	0	0	3	**7**
17	3	0	1	0	**4**
Totals	86	14	23	36	**159**

Note. CSC, change search criteria; S_DEF, searching for a definition; SE_M, using multiple search engines and or databases; RTA, read the abstracts to determine if the information is relevant to the search topic; OSB +, constructive online search behaviour.

Research Question 4: Do the self-reported measures of SDL and EC and the actual behaviour based SDL and EC scores of students associate with constructive online search behaviours (OSB)?

In order to ascertain if the self-report measures for self-directed learning and epistemic cognition associated with the SDL and EC from the actual online task, a series of bivariate Pearson's product-moment correlations coefficients were calculated (see Table 13). The macro-level categories were derived from the total scores for Stage 1 participants on the three scales (SDLRS, Psych-SEBS and EOCQ). The same procedure described above to calculate the OSB plus scores for each individual participant was also used to calculate their total scores on SDL monitoring and strategy use and EC source evaluation variables.

Table 13. Correlations among online search behaviour (OSB) and SDL, and EC variables obtained from Stage 1 and 2

Variable	OSB +	Monitoring	Strategy use	Source evaluation	Total SEBS	Total EOCQ
Monitoring (SDL)	.494*					
Strategy use (SDL)	0,176	0,022				
Source evaluation (EC)	0,183	0,478	-0,084			
Total SEBS (EC)	-0,009	-0,007	-0,149	-0,090		
Total EOCQ (EC)	0,003	0,029	-0,107	-0,268	.310**	
Total SDLRS	0,225	0,090	0,225	-0,139	0,189	0,058

*p < .05. **p < .01 (2-tailed).

Note. OSB plus, constructive online search behaviours; Total SEBS, Psychology-Specific Epistemological Belief Scale; Total EOCQ, Epistemic and Ontological Cognition Questionnaire; Total SDLRS, Self-directed Learning Readiness Scale.

To assess the size and direction of the linear relationships between the constructive online search behaviour (OSB+) and the SDL and EC variables derived from the questionnaire and the Stage 2 data, a bivariate Pearson's product moment correlation coefficient (*r*) was calculated (see Table 13). The bivariate correlation between the following macro-level SDL variables and online search behaviours (OSB+) were positive and strong. SDL Monitoring and OSB plus, $r(15) = .49$, $p < .05$. From the Stage 1 questionnaire data, the following statistically significant bivariate correlations were positive and strong. Total Psych-SEBS scores, $r(117) = .31$, $p < .01$ and the Total EOCQ scores. The only significant correlation between constructive online search behaviour was with self-directed monitoring, coded and summed from the Stage 2 (n=17) online search task. However, larger sample sizes may have produced stronger correlations between the other macro-

level variables. Prior to calculating *r*, the assumptions of normality, linearity and homoscedasticity were assessed, and found to be supported. Specifically, a visual inspection of the normal Q-Q and detrended Q-Q plots for each variable confirmed that both were normally distributed. Similarly, visually inspecting the scatterplots confirmed that the relationships between the variables was linear and heteroscedastic. Due to the smaller samples sizes from Task 2, a Shapiro-Wilk test was also conducted. None of the Shapiro-Wilk (W) results were statistically significant, suggesting that the normality assumption was not violated.

Research Question 5: Which search engines, online libraries and databases do students consider reliable when conducting academic literature based searches on psychology specific topics?

Table 14 provides a list of 23 web pages, general domains, or PDF files that students located during the 15 minute search task. Only websites that were listed more than twice by different participants were included in the table below. In total, the highly credible rating was given 36 times (40.4%), moderately credible 26 times (29.3%), somewhat credible 20 times (22.5%) and not at all credible 7 times (7.8%).

The most frequently cited source was *The validity of polygraph testing: Scientific analysis and public controversy (*from http://psycnet.apa.org), which was rated highly credible by 53% of the participants (n=9), 11% rated it as moderately credible (n=2) and 5.8% rated it as somewhat credible (n=1).

Table 14. Summary of the most frequent resources found, web category and rating scale responses for the online search task

Tile of resource and URL	**Web page Category***	**Frequency Count**	**Rating given: frequency count (percent)**			
			1	***2***	***3***	***4***
The validity of polygraph testing: Scientific analysis and public controversy (http://psycnet.apa.org)	Information site	12 (52.1%)	9 (75.0%)	2 (16.6%)	1 (8.3%)	0 (0.0%)
The Truth About Lie Detectors (aka Polygraph Tests) (http://www.apa.org/research/action/polygraph.aspx)	Information site	11 (47.8%)	5 (45.4%)	5 (45.4%)	1 (9.0%)	0 (0.0%)
Polygraph Tests, Urine Tests: A Debate: THE VALIDITY OF TESTS: CAVEAT EMPTOR (www.jstor.org)	Search engine site	7 (30.4%)	4 (57.1%)	2 (28.5%)	0 (0.0%)	1 (14.2%)

Tile of resource and URL	Web page Category*	Frequency Count	Rating given: frequency count (percent)			
			1	*2*	*3*	*4*
Do Lie Detectors Work? Should you ever take a polygraph? Posted Mar 07, 2013 (www.psychologytoday.com/blog/the-human-beast/201303/do-lie-detectors-work)	Information and E-commerce site	7 (30.4%)	3 (42.8%)	3 (42.8%)	1 (14.2%)	0 (0.0%)
Lie Detector and Polygraph Tests: Are They Reliable? (http://www.nolo.com/legal-encyclopedia/lie-detector-tests-tell-truth-29637.html)	Information site	6 (26.0%)	0 (0%)	1 (0.16%)	4 (66,6%)	1 (0.16%)
To Catch a Liar: Challenges for Research in Lie Detection Training (www.tandfonline.com)	Information and search engine site	5 (21.7%)	2 (40.0%)	2 (40.0%)	1 (20.0%)	0 (0.0%)
Lie detection (https://en.wikipedia.org/wiki/)	Information site	4 (17.3%)	0 (0.0%)	1 (25.0%)	0 (0.0%)	3 (75.0%)
The Truth Will Out: Interrogative Polygraphy ('Lie Detection') With Event-Related Brain Potentials (onlinelibrary.wiley.com)	Information and search engine site	3 (13.0%)	3 (100.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Quantitative Assessment of Polygraph Test Accuracy (https://books.google.co.za/)	Search engine site	3 (13.0%)	2 (66.6%)	0 (0.0%)	1 (33.3%)	0 (0.0%)
The Polygraph Test: Can Science Tell if You Are Lying? (https://sciencebasedlife.wordpress.com/2011/09/15/the-polygraph-test-can-science-tell-if-you-are-lying/)	Information and Blog site	3 (13.0%)	0 (0.0%)	2 (66.6%)	1 (33.3%)	0 (0.0%)
Neuroscience-Based Lie Detection: the Urgent Need for Regulation (http://heinonline.org/HOL/Page?handle=hein.journals/amlmed33&div=22&g_sent=1&collection=journals)	Information (legal library) site	3 (13.0%)	1 (33.3%)	1 (33.3%)	1 (33.3%)	0 (0.0%)
How accurate is a polygraph? (www.truthorlie.com)	Information and E-commerce site	3 (13.0%)	0 (0.0%)	2 (66.6%)	1 (33.3%)	0 (0.0%)
The one thing you need to know to pass a polygraph test (www.businessinsider.com/how-to-pass-a-polygraph-test-2015-5)	News site	2 (8.69%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)
Vaughan Bell: the truth about lie detectors (www.theguardian.com/science/2012/apr/22/lie-detector-fallibility-criminal-psychology)	News and information site	2 (8.69%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)

Tile of resource and URL	Web page Category*	Frequency Count	Rating given: frequency count (percent)			
			1	*2*	*3*	*4*
How to Cheat a Polygraph Test (Lie Detector) (http://www.wikihow.com/Cheat-a-Polygraph-Test-Lie-Detector)	Information site	2 (8.69%)	1 (50.0%)	0 (0.0%)	0 (0.0%)	1 (50.0%)
Chapter 3, Controversy Over Polygraph Testing Validity (http://www.fas.org/sgp/othergov/polygraph/ota/contro.html)	Information site	2 (8.69%)	1 (50.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)
e-Wits Catalogue, University of the Witwatersrand Library (http://0-psycnet.apa.org.innopac.wits.ac.za)	Information site	2 (8.69%)	0 (0.0%)	0 (0.0%)	1 (50.0%)	1 (50.0%)
Scientific Validity of Polygraph Testing: A Research Review and Evaluation, November 1983 (https://antipolygraph.org/documents/ota-polygraph-report.pdf)	Information site / PDF document	2 (8.69%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)
How to Pass a Lie Detector Test (Whether You're Lying or Not) (www.livescience.com/33512-pass-lie-detector-polygraph.html)	Information site	2 (8.69%)	1 (50.0%)	1 (50.0%)	0 (0.0%)	0 (0.0%)
LIE Detection by Inducing Cognitive Load Eye Movements and Other Cues to the False Answers of 'Witnesses' to Crimes (http://cjb.sagepub.com/)	Search engine site	2 (8.69%)	0 (0.0%)	0 (0.0%)	2 (100.0%)	0 (0.0%)
Polygraphs Accurate But Not Foolproof By BRYAN ROBINSON July 14 (http://abcnews.go.com/US/story?id=92847)	News site	2 (8.69%)	0 (0.0%)	1 (50.0%)	1 (50.0%)	0 (0.0%)
The Polygraph and Forensic Psychiatry Don Grubin, MD (http://www.jaapl.org/content/38/4/446.full)	Information site (journal)	2 (8.69%)	1 (50.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)
The Validity of Polygraph Testing. Scientific Analysis and Public Controversy (www.researchgate.net/profile/Leonard_Saxe/publication)	Search engine site / PDF document	2 (8.69%)	1 (50.0%)	0 (0.0%)	1 (50.0%)	0 (0.0%)
Totals		89 (100%)	36 (40.4%)	26 (29.3%)	20 (22.5%)	7 (7.8%)

*Notes: The key for the rating scale is as follows, 1= highly credible, 2 = moderately credible, 3 = somewhat credible 4 = not credible at all.

Web sources are ordered by frequency and not in the order in which they were located.

Webpage classification or categorisation is the practice of allocating a webpage one or more category label. E.g., 'News', 'Sport', 'Business'. Web-specific features and algorithms are useful for webpage classification, generally sites are categorised according to function, purpose or a hybrid of both (Qi & Davison, 2009).

Participant no. 5 rated 'LIE Detection by Inducing Cognitive Load Eye Movements and Other Cues to the False Answers of "Witnesses" to Crimes', http://cjb.sagepub.com/content/39/7/887.full, as their least credible source. This resource was from

a Sage journal of criminal justice and behaviour. Their justification for this rating was as follows 'I say this because it does not give much information to me on how the lie detector can be inaccurate and detect false information on human beings since in my opinion; they can be able to manipulate their own biological reactions such as blood pressure, breathing rate and sweat by maintaining being calm.' This was one example of a standout result – in this case, the credibility seemed to be assessed based on lack of information and a general explanation of the topic only.

Based on their initial search 70.6% stated that the polygraph test was not an accurate means of detecting lies (n=12), and 29.4% claimed that it was accurate (n=5). The majority (64.7%, n=11) opted to close tabs while 35.29% kept their tabs open during the search (n=6). Students provided a broad range of justifications for closing tabs. Several key reasons that came from the data were: closing tabs once the source was referenced, 'Once I search a definition and understand it, I close the tab as I no longer need it for reference.'- Participant no. 3. Other students closed tabs if the information was no longer needed or relevant to their search topic, 'I also close a tab if I find the information irrelevant'- Participant no. 3; and 'Most of the tabs were closed because they offered the abstract of the paper instead of the full text… Other tabs were also closed as I did not view the information necessary [or] the hyperlink had already been obtained'- Participant no. 4. And, finally, one participant tried to use it, unsuccessfully, as a strategy to increase the speed of their search, 'As I was not using a browser I am familiar with I chose to close browsers in order to maximise speed. Although I found doing so to be ineffective, in terms of speed and in terms of being able to refer back to my chosen sources.'- Participant no. 7.

3.3.5 Analysis of the rating scales for the post-search evaluation data

Research Question 6: Which epistemic cognitions and source attributes associate with post-search evaluations and the perceived credibility of internet based information sources?

Several differences were noted regarding which source attributes students engaged more frequently when deciding which source was the most credible compared to the least credible (see Table 17). The most frequently occurring code for ranking the least credible source was *relevance to the task* (19.44%), with comments such as 'it lacked much information on the polygraph test weaknesses' and 'it illustrates a more general factual basis of information' being coded under this category. The relevance to task category did not feature at all in their justifications for the most credible rankings.

However, *personal justification* and *justification by authority*, were commonly used for both types of rank orderings. Personal justification was almost equally represented (20.00% under most credible and 16.67% under the least credible ratings), with students commenting, ‘it wasn’t bias but gave both sides of the coin’ and ‘the source tells one how to pass the polygraph test and does not really take a stand as to whether it is accurate or not’ for justifying the most and least credible source respectively. For justification by authority, again, similar frequencies occurred (20.00% under most credible and 13.89% for the least credible assessment) with a ‘lack of references’, and ‘not academically credited’ being used as justification for a low rating score and stating ‘there was a full reference list at the end of the article’, it is ‘researched based’ and ‘it is a result of a published book meaning it has been peer reviewed’ when justifying a highest rating score.

Table 15.Source Attributes (features): summary values for attributions of trustworthiness to source features when completing rank-order justifications

	Most credible rank order		Least credible rank order	
Attribution categories	Frequency	(%)	Frequency	(%)
Author	1	3.33%	4	11.11%
Relevance to the task	0	0.00%	7	19.44%
Explanation quality	2	6.67%	0	0.00%
Personal justification	6	20.00%	6	16.67%
Justification by authority	6	20.00%	5	13.89%
Format / style	2	6.67%	6	16.67%
Argument quality	3	10.00%	1	2.78%
Venue	5	16.67%	2	5.56%
Type	5	16.67%	4	11.11%
Date	0	0.00%	1	2.78%
Total	30	100%	36	100%

Chapter Four

4.1 Discussion

Based on a review of the demographic data provided by the questionnaire participants, the sample (n=119) that took part in both stages of the study could be considered as representative of those found in a psychology first-year course cohort. General levels of readiness for self-directed learning, as self-reported in the undergraduate student sample, revealed that the mean score of the sample (M= 133.19, SD=12.88) placed them in the top 50% of the population mean (M =129, SD=18.0) (Delahaye & Choy, 2000). This would indicate, in general, undergraduate students might be more successful in independent learning situations, but would need some guidance to identify their learning needs, along with the planning and implementation of academic activities (Delahaye & Choy, 2000).

The questionnaire data was used to explore which general epistemic cognitions and digital literacy issues undergraduate university students in South Africa self-report. In terms of the samples, general level of exposure to formal digital literacy and information technology (IT) training, the majority (60.44%) had not taken IT as a school subject (n=79). Similarly, 55.96% of the students (n= 61) had not received any formal training on conducting literature searches online. An example of the possible impact of not having any formal training was that two of the participants had some difficulty using the MS Word programme, and asked the researcher for assistance with features like cutting and pasting their internet sources. This, in turn, would have impacted their SDL time management abilities, resulting in fewer sources being located in the 15 minute search period. However, the transcripts also revealed that students may have received some degree of informal training from their fellow students or possibly a lecturer; ‘I decided to go to jstore.org… Something a lecturer told me. Actually a friend told me and then the lecturer verified that it is good’- Participant 5.

One of the goals of the present research was to investigate the actual behaviour based on digital literacy components of SDL and EC that students demonstrate when searching the internet for information on an unfamiliar psychology subject. The findings showed that the most relevant macro-level processes for self-directed learning were monitoring and strategy use; and for epistemic cognition, source evaluation was the only category demonstrated during the search itself. Justification, the nature of knowledge and epistemic aims did not emerge from the post-interview transcript codes as they did in the Greene *et al*. (2014) study, which had post-search learning gains as its outcome variable. For the macro-level self-directed learning category, strategy use (M=2.94, SD=.79) behaviours were enacted more frequently than any other macro-

level process, followed by monitoring (M=1.7, SD=.79) and then finally source evaluation (M=1.35, SD=1.07) for epistemic cognition. This would make sense in this research context, where selecting new information sources, using digital controls and knowledge elaboration (i.e. self-directed strategy use variables) would be frequently executed. This was followed by monitoring behaviours, which would include content evaluation and time monitoring. In terms of epistemic cognition, students were required to rate their sources as either trustworthy or unreliable, with justifications for these assessments provided in the written task.

Another question asked in this report was whether the self-reported measures of SDL and EC and the actual behaviour based SDL and EC scores of students associate with constructive online search behaviours (OSB). The data (summarised in Table 10) also demonstrated which search engines, online libraries and databases students preferred to use when conducting academic literature searches on psychology specific topics. Data from the online survey reported that 64.7% (n=11) of the students that participated in Stage 2 used Google as the starting point for their search. This self-reported data was confirmed in the actual search task as 10 students began their search on Google (www.google.co.za). However, Google Scholar was also a popular choice as 12 out of the 17 participants made use of it, either on its own or in conjunction with Google. This is possibly due to the availability of academic journals on Google Scholar (Jacso´, 2005). In terms of understanding the motivations behind using multiple search engines, a student commented: ‘I usually get some stuff from the library, so I usually go straight to Scholar, but if I don’t really understand what I’m trying to answer I go to Google first, but I rely mainly on Google Scholar’ - Participant 6.

Six of the participants also made use of Google Books as a search engine, a feature that was added later to the Google Scholar offering (Jacso´, 2005). One student claimed they used it, ‘because it’s easier to get relevant information from Google Books, and you know it’s academically credible’ – Participant 13. However, only three students made use of the e-Wits Library Catalogue (https://www.wits.ac.za/library/find-e-resources-and-library-catalogue-/) and without much success at finding relevant information. One example of a student’s experience was: ‘I tried the Wits library where I tried to search but I couldn’t find any, then I had to return back again to Google Scholar’ - Participant 14; and another student commented ‘on the Wits library, I didn’t find anything here’- Participant 10. This supports Mostafa’s (2005) notion that the rise in use of popular search engines leads to a dismissal of any other sources of information, specifically of libraries and the formal information sources which they provide. Although not directly measured in this study, Computer Self-Efficacy (CSE) (Bandura, 1997), derived from Social Cognitive

Theory, may also account for the individual differences in the level of success students had in finding relevant online information. Studies have also found that internet experience and internet self-efficacy are positively related to the amount of effort users exert to verify the credibility of information they find online (Flanagin & Metzger, 2000).

In the digital world anyone is able to become a self-publisher, therefore the quality of online information varies considerably. Hence, when using the internet to find information about psychology-related topics, for example in finding resources to answer to academic essay topics, assessing the veracity of information found online and considering whose authority to accept are important evaluation processes (Hofer, 2004). Therefore, another goal for this report was to establish which epistemic cognitions and source attributes associate with post-search evaluations and the perceived credibility of internet based information sources. Previous research has provided first indications that sophisticated internet-specific beliefs are positively related to such processes (Bråten *et al*., 2005; Kammerer & Gerjets, 2012; Kammerer *et al*., 2013; Strømsø & Bråten, 2010). Bråten *et al*. (2005) asserts that general internet epistemology concerns the degree to which students believe the internet provides correct, expert and reliable information. The results from this study showed that students generally rated the websites they found as 'highly credible' more often than 'moderately' or 'somewhat credible'. Only 7.8% of the websites were rated not at all credible, suggesting that the students believed the internet sources they located were indeed trustworthy.

The final research goal was to describe which particular source attributes featured in students' post-search evaluation of web-based information. As discussed in the literature review, students should ideally employ the following five criteria in their assessments of the credibility of web-based sources. These are accuracy, authority, objectivity, currency and coverage or scope (Alexander & Tate, 1999; Fritch & Cromwell, 2001; Meola, 2004). In studies that actually examined what factors people *really do* use to determine credibility online, they found the following criteria were commonly used (Eysenbach & Kohler, 2002). Firstly, the main criteria for assigning credibility rested on whether the source was an official authority; secondly, whether the page cited scientific references; thirdly, whether the site was professionally designed and easy to use; and ,finally, whether it was written in language that they could understand (Eysenbach & Kohler, 2002). The students in this project made use of the following nine source attributes: personal justification, justification by authority, type, venue, argument quality, format/style, relevance to task, explanation quality and date (for example, 'But it was 1987 which might be a little outdated'- Participant 1).

As noted in the results section, when rating the least credible source, the most prevalent source feature was relevance to the task (19.44%), however, this feature was not used at all when rating the most credible source. In the present research, a distinction was made when analysing the data between beliefs concerning justification by multiple sources and beliefs concerning personal justification when coding the students' rating scale responses. The most commonly used source features to justify rank-order placement for both categories were personal justification (most credible rank, 20%; least credible rank, 16.64%) and justification by authority (most credible rank, 20%; least credible rank,13.89%). This finding, that internet-specific beliefs concerning justification by authority (i.e. multiple sources) are related to a higher credibility rating, supports the theoretical notion that justification for knowing beliefs play a role in source evaluation (Bråten *et al*., 2011).

Apart from the present results, based on the current literature review, empirically such a relation has been shown only twice, namely by Strømsø *et al*. (2011) for trustworthiness ratings of a science text and by Bråten *et al*. (2014) for source references included in essays. However, these studies did not assess navigation behaviour during a web search. Moreover, by differentiating between beliefs concerning justification by multiple sources and beliefs concerning personal justification, we followed a recent line of research that argues that justification for knowing should be more precisely defined including several separate dimensions (e.g., Bråten & Ferguson, 2014; Bråten *et al*., 2014; Ferguson *et al*., 2012; Greene *et al*., 2008). The results of the present study provide further evidence for the importance of this differentiation. They show that beliefs in the justification of internet-based knowledge claims, through the use of referenced and peer-reviewed webpages, are to be considered as highly facilitative in the context of web searches on an unfamiliar psychology issue. There were, however, several discrepancies between the source features used to rate the most credible source compared to the least credible. Explanation quality (7.69%) was only used when rating the most credible source, but not the least. When rating the least credible source, students made use of the date (2.78%) and relevance to the task (19.44%), yet neither of these attributes were used to justify the most credible source.

4.2 Limitations and Future Research

The following limitations are recognised in the present study. A potential problem with this study is that it relied on a relatively small, specific user population (undergraduate students) performing

a somewhat specialised search task. As a result, it may be difficult to generalise these findings to other internet users, age groups and student populations. With regards to the design, this was a non-experimental, correlational study, therefore causal inferences cannot be made. To conduct a fully comprehensive search in fifteen minutes may have been too short a time span, and there were many instances when the internet connection was slow or there was some difficulty connecting to the network. Thus, further research is needed to extend the findings of the present paper to more natural search situations, exploring topics outside the field of psychology, without time constraints, and with a high-speed internet connection to explore how these variables may influence self-directed learning behaviours.

Within these limitations, there are some concerns regarding the findings themselves. First, the measure used in Phase 1 of this study, the Self-directed learning and Epistemic Cognition Questionnaire (SDLECQ), used scales written at a broad, domain–general level, which may not specifically pertain to some of the digital literacy skills required to conduct online searches. Future studies could, therefore, include multiple instruments developed to measure internet-specific self-directed learning and epistemic cognition (Bråten *et al*., 2005). The types of data collection methods used in this project attempted to address certain validity issues and potential biases of self-reported data. However, the post search interview method also bears certain limitations. Some of the students were more confident and vocal in their descriptions thereby providing a richer, fully detailed account of their online search behaviour compared to those who required prompts to describe their actions. Some students required more direct guidance using verbal prompts, e.g., ‘what were you reading here?’ and stated that they were not clear on what was required of them, even though the same procedure was followed for all participants. One could also argue that the presence of the researcher primed the students to apply different search strategies to what they would use in a more natural context.

It should also be noted that selecting and reading commercial web pages is not necessarily an unfavourable navigation behaviour. If students are aware of the fact that these are commercial web pages and might provide one-sided or biased information, which was noted by several participants: ‘Wikipedia, normally they not credited scholars but they can give you a brief background’- Participant 4 and ‘for a social, for a more layman’s perspective because I like to base my articles on a layman’s perspective, and then I went to the news articles to see what well established newspapers would say’- Participant 13; then taking these information sources into account might be useful to acquire a comprehensive overview on the topic at hand.

4.3. Conclusion

Notwithstanding the above noted limitations, this study presents unique findings that have both potential theoretical and educational implications. The study attempted to address inherent weaknesses in relying solely on self-reported digital literacy data by examining the relationship between self-directed learning and epistemic beliefs and individuals' actual web navigation behaviour, as well as, the cognitive aspects involved in source evaluation by university students. In this study, it was found that specific SDL and EC processing were related to online search behaviour in a study of digital literacy, and that deriving codes from the data and organising them into micro- and macro-levels were a viable method of preparing, analysing and representing multiple data types regarding these phenomena. The results suggest we should consider the relationships between SDL and EC to online search behaviour and the vetting of online content as warrant for the inclusion of those phenomena in the definition of digital literacy, and for further investigation of these complex cognitive phenomena. Finally, it was demonstrated how combining multiple data collection methods and analysis can be successfully applied to the study of complex, learning behaviours when engaging psychological topics in the multimedia, hyperlinked contexts of the internet.

One of the goals of tertiary institutions is to ensure that students will go on to success in digital environment, where computers are part of almost every type of work environment. In classrooms and lecture based setting, technology can be used not only to nurture learning but as part of a comprehensive intervention. This comprises of providing students with the appropriate declarative knowledge, adaptive beliefs about learning and self-directed learning skills to successfully search and navigate online resources (Greene & Azevedo, 2009). In addition, technology can be used as a diagnostic tool. When students who have sufficient declarative knowledge fail to learn within online environments, it may indicate that these students have unsupportive internet-specific epistemic beliefs or lack sufficient SDL skills. Educationists can then endeavour to externalise these epistemic beliefs, or assist in developing self-directed learning skills, in addition to providing adequate support that fulfils these requirements.

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Appendices

Appendix A: Stage 1 Online Questionnaire

Self-directed learning and Epistemic Cognition Questionnaire (SDLECQ)

Section 1: Demographic Information

1. I identify my gender as?

□ Male □ Female □ Other □ Prefer not to disclose

2. Date of birth (DD/MM/YYY)

3. Place of birth

4. Home language (please choose only one)?

□ Afrikaans

□ English

□ isiNdebele

□ isiXhosa

□ isiZulu

□ Sesotho sa Leboa

□ Sesotho

□ Setswana

□ siSwati

□ Tshivenda

□ Xitsonga

□ Other (Please specify) _____

5. At what type of secondary / high school did you complete your matric?

□ Public (former DET school) □ Public (former Model C school) □ Private □ Independent

□ Other (Please specify) _____

6. When you were in secondary / high school, did you have Information Technology (IT) as a school subject?

□ Yes □ No

7. Race category? (For descriptive purposes only)

□ Black □ Coloured □ Indian □ Asian □ White □ Prefer not to disclose

□ Other (Please specify) _____

8. Do you have a disability?

□ Yes

□ No

9. In what year did you begin your current degree studies at Wits?

□ 2015 □ 2014 □ 2013 □ 2012 □ 2011 □ Before 2011

10. Which year / level of your degree are you currently enrolled for at Wits?

□ 1st year □ 2nd year □ 3rd year □ Other (Please specify) _____

11. Which degree are you currently registered for?

□ BA □ BSc □ BCom □ Bachelor of Social Work

□ Bachelor of Arts in Speech Pathology & Audiology □ Other professional BA

□ Occasional student □ Other (Please specify) _____

Section 2: Current Financial Circumstances

12. Please indicate how you are funding your current studies at Wits (you may choose as many options as necessary)?

13. □ Bursary / Loan scheme □ Student loan □ Scholarship □ Parent / Family / Personal sponsor

□ Personal savings □ Part-time or full-time work

14. □ Other (Please specify) _____

15. Please choose the option below that best describes your financial position:

□ Not enough money for basics

□ Have enough for food but short on everything else

□ I have most of the important things like food and clothes, but few luxury goods

□ I have most of the important things like food and clothes and luxury goods

□ Enough money for extra things such as going away for holidays and luxury goods

16. What is the total annual income for your household after tax?

□ No income □ Under R 5000 □ Under R10 000 □ Under R15 000

□ Under R 30 000 □ Under R 50 000 □ Under 100 000 □ Under R 150 000

□ Under R300 000 □ Under R 600 000 □ R 600 000 +

Section 3: SDLRS Self-directed learning

Instructions: This is a questionnaire designed to gather data on learning preferences and attitudes towards learning. After reading each item, please indicate the degree to which you feel that statement is true of you. There are no right or wrong answers. Please read each choice carefully and choose the response which best expresses your feeling.

There is no time limit for the questionnaire. Try not to spend too much time on any one item; however, your first reaction to the question will usually be the most accurate.

Responses

1 = Almost never true of me; I hardly ever feel this way.

2 = Not often true of me; I feel this way less than half the time.

3 = Sometimes true of me; I feel this way about half the time.

4 = Usually true of me; I feel this way more than half the time.

5 = Almost always true of me; there are very few times when I don't feel this way.

	Section 4.5: What I understand about the field of psychology	**Almost never true of me**	**Not often true of me**	**Sometime true of me**	**Usually true of me**	**Almost always true of me**
1	I'm looking forward to learning as long as I'm living.	1	2	3	4	5
2	I know what I want to learn.	1	2	3	4	5
3	When I see something that I don't understand, I stay away from it.	1	2	3	4	5
4	If there is something I want to learn, I can figure out a way to learn it.	1	2	3	4	5
5	I love to learn.	1	2	3	4	5
6	It takes me a while to get started on new projects.	1	2	3	4	5
7	In a classroom situation, I expect the instructor to tell all class members exactly what to do at all times.	1	2	3	4	5
8	I believe that thinking about who you are, where you are, and where you are going should be a major part of every person's education.	1	2	3	4	5
9	I don't work very well on my own.	1	2	3	4	5
10	If I discover a need for information that I don't have, I know where to go to get it.	1	2	3	4	5
11	I can learn things on my own better than most people.	1	2	3	4	5
12	Even if I have a great idea, I can't seem to develop a plan for making it work.	1	2	3	4	5
13	In a learning experience, I prefer to take part in deciding what will be learned and how.	1	2	3	4	5
14	Difficult study doesn't bother me if I'm interested in something.	1	2	3	4	5

15	No one but me is truly responsible for what I learn.	1	2	3	4	5
16	I can tell whether I'm learning something well or not.	1	2	3	4	5
17	There are so many things I want to learn that I wish there were more hours in a day.	1	2	3	4	5
18	If there is something I have decided to learn, I can find time for it, no matter how busy I am	1	2	3	4	5
19	Understanding what I read is a problem for me.	1	2	3	4	5
20	I manage my time well	1	2	3	4	5
21	I am confident in my ability to search out information	1	2	3	4	5
22	I prefer to plan my own learning	1	2	3	4	5
23	I critically evaluate new ideas	1	2	3	4	5
24	I learn from my mistakes	1	2	3	4	5
25	I need to know why	1	2	3	4	5
26	When presented with a problem I cannot solve I ask for assistance	1	2	3	4	5
27	I like to make decisions for myself	1	2	3	4	5
28	I have high personal standards	1	2	3	4	5
29	I prefer to set my own learning goals	1	2	3	4	5
30	I evaluate my own performance	1	2	3	4	5
31	I am responsible	1	2	3	4	5
32	I am logical	1	2	3	4	5
33	I have high personal expectations	1	2	3	4	5
34	I am able to focus on a problem	1	2	3	4	5
35	I am aware of my limitations	1	2	3	4	5
36	I can find out information for myself	1	2	3	4	5
37	I have high beliefs in my abilities	1	2	3	4	5
38	I prefer to set my own criteria on which to evaluate my performance	1	2	3	4	5

Section 4: Epistemic cognition and learning gains

Instructions: Please indicate your answers to the following statements.

Please try to respond to every statement if possible.

The following sections are adapted from the Epistemic and Ontological Cognition Questionnaire (Greene, Torney-Purta, & Azevedo, Epistemic and Ontological Cognition Questionnaire Database, 2010)**.** *In the final version uploaded to SurveyMonkey the questions were randomised and the sub sections merged into a single page and this note was removed.*

	Section 4.1:	**Completely disagree**	**Mostly Disagree**	**Somewhat disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely agree**
1	In psychology the truth means different things to different people.	1	2	3	4	5	6

2	To know psychology well, you need to memorize what you are taught.	1	2	3	4	5	6
3	In psychology, what is a fact today will be a fact tomorrow.	1	2	3	4	5	6
4	Psychological knowledge of the facts about human behaviour does not change.	1	2	3	4	5	6
5	The field of Psychology is so complex that humans will never really understand it.	1	2	3	4	5	6

	Section 4.2:	**Completely disagree**	**Mostly Disagree**	**Somewhat disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely agree**
6	If a psychologist says something is a fact, I believe it.	1	2	3	4	5	6
7	Things written in psychology textbooks are true.	1	2	3	4	5	6
8	I believe everything I learn in psychology class.	1	2	3	4	5	6
9	If a psychology LECTURER says something is a fact, I believe it.	1	2	3	4	5	6

	Section 4.3: What I understand about the field of psychology	**Completely disagree**	**Mostly Disagree**	**Somewhat disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely agree**
10	In psychology, everyone's knowledge can be different because there is no one absolutely right answer.	1	2	3	4	5	6
11	In psychology, if you believe something is a fact, no one can prove to you that you are wrong.	1	2	3	4	5	6
12	In psychology, what is a fact depends upon a person's point of view	1	2	3	4	5	6
13	Psychological knowledge is all factual and there are no opinions	1	2	3	4	5	6

* Psychology-Specific Epistemological Belief Scale (Psych-SEBS) (Renken, McMahan, & Nitkova, 2015)

	Section 4.4	**Completely disagree**	**Mostly Disagree**	**Somewhat disagree**	**Somewhat Agree**	**Mostly Agree**	**Completely agree**
1	Carefully controlled research is not likely to be useful in solving psychological problems	1	2	3	4	5	6
2	Students get little benefit from learning about procedures for conducting psychology experiments	1	2	3	4	5	6
3	Our ability as humans to behave in any way we choose makes our attempts to predict behaviour ineffective	1	2	3	4	5	6
4	Understanding psychology is important, but not for politicians	1	2	3	4	5	6

5	Courses in psychology place too much emphasis on research and experimentation	1	2	3	4	5	6
6	Some psychological knowledge proposed earlier is opposite to the contemporary knowledge	1	2	3	4	5	6
7	Psychologists in different eras may use different theories and methods to interpret the same natural phenomenon	1	2	3	4	5	6
8	When learning psychology, people can understand the material better if they relate it to their own ideas	1	2	3	4	5	6
9	Currently acceptable psychological knowledge may be changed or totally discarded in the future	1	2	3	4	5	6
10	Psychologists' research activities will be affected by their existing ideas, thoughts, and beliefs	1	2	3	4	5	6
11	Psychological research can enable us to anticipate people's behaviour with a high degree of accuracy	1	2	3	4	5	6
12	Even though each person is unique, it is possible for psychologists to find general laws explaining human behaviour	1	2	3	4	5	6

Section 5: Conducting online searches

Instructions: Select an option to reflect on how often you consider the following aspects when searching online. Please try to respond to every statement if possible.

	Section 5	**Not at all**	**Very seldom**	**Occasionally**	**Frequently**	**Very Frequently**	**Not Sure**
1	Do you consider information found online to be potentially biased?	1	2	3	4	5	6
2	Is Google your starting point when searching for information?	1	2	3	4	5	
3	Are you able to open multiple tabs when searching?	1	2	3	4	5	6
4	Do you use the Wits library website to conduct searches?	1	2	3	4	5	6
5	Do you search e-journals and / or electronic databases?	1	2	3	4	5	6
6	Are you comfortable organising information you have sourced online?	1	2	3	4	5	6
7	Do you use any referencing software, such as Endnotes or Zotero?	1	2	3	4	5	6
8	Have you ever received formal training on how to conduct an academic literature search online?	1	2	3	4	5	6

9. Please indicate your marks (%) on your first two essays / assignments in Psychology completed in the first term (i.e. first half of the year): Essay / Assignment 1: _____ Essay / Assignment 2: _____

Appendix B: Stage 2 Practical Online Search Task

Instructions to participant

Imagine a scenario in class where you are given the essay topic: **Critically evaluate the following statement: The Polygraph Test is an Accurate Means of Detecting Lies**

Have you ever told a lie? If you answered 'no,' you're lying. College students admit to lying in about one in every three social interactions and people in the community about one in every five interactions. Not surprisingly, investigators have long sought out fool proof means of detecting falsehoods. In the 1920s, psychologist William Moulton Marston invented the first polygraph or so-called 'lie detector' test, which measured systolic blood pressure to detect deception. He later created one of the first female cartoon superheroes, *Wonder Woman*, who could compel villains to tell the truth by ensnaring them in a magic lasso. For Marston, the polygraph was the equivalent of Wonder Woman's lasso: an infallible detector of the truth.

Please read and follow the instructions in each section very carefully. The intention behind the various tasks is for you to use electronic resources to assist you in answering the essay question. *Please note that you are NOT required to write the essay.* The task will only require you to find sources that could *in principle* assist you in completing the essay.

Once you have enough sources (10 sources maximum) to begin to formulate an answer to the question please stop and rate the credibility and reliability of the various sources of information where applicable. You are permitted to use any browser and search engine you wish and to make notes during your search.

Part 1: Online search Conduct an online search on the essay topic using any search engine and / or database of your choice. Find approximately 6- 10 references that relate to the essay question. You will have approximately 15 -20 minutes to conduct a preliminary search.

Please cut and paste your potential electronic sources below (the full URL / website address / PDF doc):

1. _____
2. _____
3. _____
4. _____
5. _____
6. _____
7. _____
8. _____
9. _____
10. _____

Part 2: Evaluate your sources (no time limit)

2.2 Please rate each of your sources according to how credible you believe it to be:

2.2. Source item number	**Highly credible**	**Moderately credible**	**Somewhat credible**	**Not at all credible**
1. Source item no 1	1	2	3	4
2. Source item no 2	1	2	3	4
3. Source item no 3	1	2	3	4
4. Source item no 4	1	2	3	4
5. Source item no 5	1	2	3	4
6. Source item no 6	1	2	3	4
7. Source item no 7	1	2	3	4
8. Source item no 8	1	2	3	4
9. Source item no 9	1	2	3	4
10. Source item no 10	1	2	3	4

1. Please name the source (**in your opinion**) you think is the MOST credible. Give your reasons why you think it is credible.

_____

_____

2. Which source (**in your opinion**) is the LEAST credible and why?

_____

_____

_____

3. Did you close any browser tabs while searching?

□ Yes □ No □ Not sure

4. If yes, what made you close the tab (i.e. did you consider the source to be irrelevant to your essay topic or not academically credible)?

_____

5. Based on your initial search do you think lie detectors are an accurate means of detecting lying?

□ Yes □ No □ Not sure

PLEASE ENTER YOUR **UNIQUE IDENTIFIER CODE**: _____

(Use the same one from the Digital Literacy Survey you completed online).

You are now ready to watch the video screen capture of your online search. Please notify the researcher so they can start the audio recording device. Describe your actions in detail (verbalise the various steps and processes you used to find sources you could use answer the essay question), you will be voice recorded only. This will be followed by a debriefing session which will then officially conclude the task. **Thank you for participating!**

Appendix C: Data from the search and ratings tasks

Individual Results from Evaluate your sources

Please note that all students responses have been left unedited, typos and spelling errors remain as originally typed in MS Word.

Participant no: S2_01

No of sources and time taken: Found 9 sources in 15 minutes

MOST Credible source:

Title: The reliability of polygraph examiner diagnosis of truth and deception.

URL: None provided (PDF file)

Type / Category: The Journal of Criminal Law, Criminology, and Police Science, 276-281.

Authors and year: Horvath, F. S., & Reid, J. E. (1971).

Justification: It is a Journal of Criminal Law which elaborates on the reliability of a Polygraph test and describes the practicality of its reliability which one can use in an essay to strengthen a argument.

LEAST Credible source:

Title: A critical review of the control questions test (CQT).

URL: None provided (PDF file)

Type / Category: Handbook of polygraph testing, 103-126.

Authors and year: Ben-Shakhar, G. (2002).

Justification: As it is a handbook and describes the topic from one view point, also does not carry enough weight for an academic essay.

Closed Tabs: No

Reasons Given: There were articles not credible that I came across but only shifted back to where I was previously.

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_02

No of sources and time taken: Found 7 sources (listed 8, but 1 was repeated) in 15 minutes

MOST Credible source:

Title: The Truth About Lie Detectors (aka Polygraph Tests)

URL: http://www.apa.org/research/action/polygraph.aspx

Type / Category: American Psychological Association, August 5, 2004

Justification: Source 1 because it had statements and opinions of qualified people such as psychologists and doctors and there was a full reference list at the end of the article

LEAST Credible source:

Title: Vaughan Bell: the truth about lie detectors

URL: http://www.theguardian.com/science/2012/apr/22/lie-detector-fallibility-criminal-psychology

Type / Category: Guardian News and Media

Justification: Source 4 because it is a blog with no references or proof of the statements the blogger is making. It is completely opinionated and not accredited.

Closed Tabs: Yes

Reasons Given: In clicking back the tab was closed, It was easier to go back than to keep typing in the same sentence over and over.

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_03

No of sources and time taken: Found 10 sources in 15 minutes

MOST Credible source:

Title: Uses of Polygraph Tests

URL: http://www.nap.edu/openbook.php?record_id=10420&page=178

Type / Category: Educational institution

Justification: I find source 6 to be most credible as it is a book written, edited and referenced by professionals that have contributed their time and done lengthy research to determine the use of polygraph testing and its accuracy.

LEAST Credible source:

Title: How to Detect Lies

URL: http://www.blifaloo.com/info/lies.php

Type / Category: Blifaloo.com is 'temporary boredom relief & knowledge for the curious mind'

Justification: I find source 4 to be least credible as it is a website resembling a blog. It is extremely opinionated and although it gives somewhat credible information it also is open to commentary and universal editing. It does not include credible references.

Closed Tabs: Yes

Reasons Given: Once I search a definition and understand it, I close the tab as I no longer need it for reference. I also close a table if I find the information irrelevant.

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_04

No of sources and time taken: Found 10 sources in 15 minutes

MOST Credible source:

Title: Effects of mental countermeasures on psychophysiological detection in the guilty knowledge test

URL: http://www.sciencedirect.com/science/article/pii/016787609190001E

Type / Category: International Journal of Psychophysiology

Justification: This decision is based on the style of writing (i.e. academic), the references sighted and the fact that it is a result of a published book meaning it has been peer reviewed.

LEAST Credible source:

Title: Polygraph

URL: https://en.wikipedia.org/wiki/Polygraph

Type / Category: From Wikipedia, a free online encyclopedia

Justification: This is based on the fact that this sight is edited by the general public and therefore would only be a source used to exhibit general opinion within the population (i.e. the view of the man on the street).

Closed Tabs: Yes

Reasons Given: Most of the tabs were closed because they offered the abstract of the sort paper instead of the full text. It is again advised to use full text as opposed to abstract as abstracts can be subjective. Other tabs were also closed as I did not view the information necessary of the hyperlink had already been obtained.

Conclusion- Are Lie Detectors reliable?: No

Additional Field Notes: Started at 2:05pm and found 10 sources in under 15 mins. Student opened multiple tabs and was very competent on the computer. They checked the pages when rating (as did student no 12 – but he was much slower (Trinity). In total they opened 12 tabs and closed several during the search task. They later commented that it usually took her 15 mins to do a search. Task completed by 3:05pm.

Participant no: S2_05

No of sources and time taken: Found 7 sources in 25 minutes

MOST Credible source:

Title: The Truth About Lie Detectors (aka Polygraph Tests)

URL: http://www.apa.org/research/action/polygraph.aspx

Type / Category: American Psychological Association, August 5, 2004

Justification: I say this because this source shows that a person can lie without showing any biological reactions when they train themselves, which later makes then to be safe.

LEAST Credible source:

Title: LIE Detection by Inducing Cognitive Load Eye Movements and Other Cues to the False Answers of ‘Witnesses’ to Crimes

URL: http://cjb.sagepub.com/content/39/7/887.full

Type / Category: Sage journal, Criminal Justice and Behavior

Justification: I say this because it does not give much information to me on how the lie dictator can be inaccurate and detect false information on human beings since in my opinion; they can be able to manipulate their own biological reactions such as blood pressure, breathing rate and sweat by maintaining being calm.

Closed Tabs: Yes

Reasons Given: I felt like the source was irrelevant because it only told me about what the polygraph test is about while I already have the information. The other tab did not give an article but just gave me irrelevant codes I did not understand.

Conclusion- Are Lie Detectors reliable?: Yes

Additional Field Notes: They needed an additional 10 minutes (over the allocated 15) as they only manged to locate 3 sources after 15 mins. They did make written notes but took them after completing the task.

Participant no: S2_06

No of sources and time taken: Found 6 sources in 15 minutes

MOST Credible source:

Title: How accurate is a polygraph?

URL: http://www.truthorlie.com/accurate.html

Type / Category: Commercial Web site (San Gabriel, Pomona, and Big Bear Valley for Lie Detector Tests)

Justification: Source 5, it wasn't bias but gave both sides of the coin

LEAST Credible source:

Title: The one thing you need to know to pass a polygraph test

URL: http://www.businessinsider.com/how-to-pass-a-polygraph-test-2015-5

Type / Category: Commercial Web site (Business Insider Inc)

Justification: Source3, it wasn't professionally written and the content of the article was based on cheating the polygraph test

Closed Tabs: No

Reasons Given: N/A

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_07

No of sources and time taken: Found 6 sources in 20 minutes

MOST Credible source:

Title: Brain Activity during Simulated Deception: An Event-Related Functional Magnetic Resonance Study

URL: http://web.missouri.edu/~segerti/1050H/docs/LanglebenGKT.pdf

Type / Category: Online Journal (NeuroImage 15, 727–732 (2002)

Authors: D. D. Langleben,1 L. Schroeder, J. A. Maldjian,* R. C. Gur, S. McDonald, J. D. Ragland, C. P. O'Brien, and A. R. Childress

Justification: I consider the second source to be most credible as it gives one scientific information concerning the subject matter/

LEAST Credible source:

Title: PSYCHOLOGY AND THE LIE DETECTOR INDUSTRY

URL: http://conservancy.umn.edu/bitstream/handle/11299/151572/PR-74-1.pdf?sequence=1

Type / Category: Report – PDF document (University of Minnesota , 1974)

Authors: David T. Lykken

Justification: I found source three to contain interesting information to add to the argument but not credible enough to base the argument on.

Closed Tabs: Yes

Reasons Given: As I was not using a browser I am familiar with I chose to close browsers in order to maximise speed. Although I found doing so to be ineffective, in terms of speed and in terms of being able to refer back to my chosen sources.

Conclusion- Are Lie Detectors reliable?: No

Additional Field Notes: The participant started rating before finishing the search task. An additional 5 minutes was given in order to find 6 sources. They read the sources in depth, and only chose PDF articles or looked for books whilst trying to find different angles on the topic. They did not work on a pc at home, so commented that the apps on her Mac were generally used to help search several university websites.

Participant no: S2_08

No of sources and time taken: Found 8 sources in 15 minutes

MOST Credible source:

Title: Polygraph.com

URL: http://polygraph.com/

Type / Category: Fundraising website (a documentary about my crusade against the fraudulent and abusive polygraph 'lie detector' industry.)

Justification: The online source found on the web; **polygraph.com**, this is because it provides a wide and complex critique of the use and the inaccuracy of lie detectors since the essay is also an argumentative one.

LEAST Credible source:

Title: Lie detection and the polygraph: A historical review

URL: http://www.tandfonline.com/doi/pdf/10.1080/14789940412331337353

Type / Category: Online Journal (The Journal of Forensic Psychiatry & Psychology)

Justification: was the least credible because it lacked much information on the polygraph test weaknesses but however provided an overview of what they are and how they operate

Closed Tabs: No

Reasons Given: N/A

Conclusion- Are Lie Detectors reliable?: No

Additional Field Notes: They found 8 sources in less than 15 minutes. The participant was searching mainly for books, but was not successful in locating them. Otherwise they were very confident and comfortable working with the computer. There were issues using my WITS login details, he then logged in with his own information and there were no further problems. He initially chose Firefox but was willing to use Chrome if we did not come right with the login. This was the only participant to make use of the WITS library website, however now successful results were returned so he Oxford university website. He knew they would be helpful but wasn't able to use them successfully.

Participant no: S2_09

No of sources and time taken: Found 8 sources in 15 minutes

MOST Credible source:

Title: The Truth About Lie Detectors (aka Polygraph Tests)

URL: http://www.apa.org/research/action/polygraph.aspx

Category / type: American Psychological Association, August 5, 2004

Justification: In my opinion Source 2 is the most credible, the site seems to be reputable as many articles are published on it and it is the publishing of the American Psychological Association. Which I feel makes it relevant to the research.

LEAST Credible source:

Title: How accurate is a polygraph?

URL: http://www.truthorlie.com/accurate.html

Type / Category: Commercial Web site (San Gabriel, Pomona, and Big Bear Valley for Lie Detector Tests)

Justification: In my opinion Source 3 is the least credible, the site has an informal display to it and does not seem to be academically accredited, it illustrates a more general factual basis of information.

Closed Tabs: Yes

Reasons Given: I closed the tab for Source 8, because I felt the information was irrelevant in terms of answering the original question.

Conclusion- Are Lie Detectors reliable?: Yes

Participant no: S2_10

No of sources and time taken: Found 6 sources in 15 minutes

MOST Credible source:

Title: The validity of polygraph testing: Scientific analysis and public controversy.

URL: http://psycnet.apa.org/psycinfo/1938-02915-000 / http://psycnet.apa.org/journals/amp/40/3/355/ http://psycnet.apa.org/journals/apl/79/2/252/

Type / Category: Online Journal (American Psychological Associations; American Psychologist, Vol 40(3), Mar 1985, 355-366.)

Justification: Source number 1, 2, 3 Credible because they are on psychnet – a respected resource library

LEAST Credible source:

Title: Polygraph Tests, Urine Tests: A Debate: THE VALIDITY OF TESTS: CAVEAT EMPTOR

URL: http://www.jstor.org/stable/29762017?seq=1#page_scan_tab_contents

Type / Category: Online Journal (Jurimetrics Vol. 27, No. 3 (Spring 1987), pp. 263-270)

Author: David T. Lykken

Justification: Perhaps source 4, because of the age of the document – how long ago the research was done.

Closed Tabs: Yes

Reasons Given: I only closed the source to save of how much bandwidth it was using. I felt it slowed down my searches on the other tabs

Conclusion- Are Lie Detectors reliable?: Yes

Participant no: S2_11

No of sources and time taken: Found 5 sources in 15 minutes

MOST Credible source:

Title: A review of the current scientific status and fields of application of Polygraphic Deception Detection:

URL: http://www.bps.org.uk/sites/default/files/documents/polygraphic_deception_detection_-_a_review_of_the_current_scientific_status_and_fields_of_application.pdf

Type / Category: Online Report (Final report (6 October 2004) from the BPS Working Party)

Authors: Professor Ray Bull (Chair); Dr Helen Baron; Professor Gisli Gudjonsson; Professor Sarah Hampson; Professor Gina Rippon; Professor Aldert Vrij

Justification: This source explains more information about the Polygraph test and it provides a clear and in-depth explanation about the validity of the polygraph test

LEAST Credible source: Mental and Physical Countermeasures Reduce the Accuracy of Polygraph Tests:

Title: Mental and Physical Countermeasures Reduce the Accuracy of Polygraph Tests

URL: http://0-psycnet.apa.org.innopac.wits.ac.za/journals/apl/79/2/252.pdf. (WITS login required to access)

Type / Category: Online Journal (Journal of Applied Psychology 1994, Vol. 79, No. 2,252-259)

Authors: Charles R. Honts, David C. Raskin, and John C. Kircher

Justification: This source only provides methods used to test whether polygraph tests are efficient or not. It provides what the mental and physical human reactions/behaviours have on the polygraph test and its outcome.

Closed Tabs: Yes

Reasons Given: The source was not useful

Conclusion- Are Lie Detectors reliable?: No

Additional Field Notes: There were serious issues during the last few minutes of the search task with no internet access. They were unable to open any of the links in the browser.

Participant no: S2_12

No of sources and time taken: Found 8 sources found in 15 minutes

MOST Credible source:

Title: The Truth About Lie Detectors (aka Polygraph Tests)

URL: http://www.apa.org/research/action/polygraph.aspx

Category / type: American Psychological Association, August 5, 2004

Justification: LOOKING AT THE SOURCE BEFORE EVEN READING IT, AT THE END IT HAD A REFERENCE LIST MEANING THE IS A POSSIBILITY THAT THE WORK IS FACTUAL AND THE OPINION OF SOMEONE

LEAST Credible source:

Title: How to Cheat a Polygraph Test (Lie Detector)

URL: http://www.wikihow.com/Cheat-a-Polygraph-Test-(Lie-Detector)

Category / type: From Wikhow (an online wiki-style community consisting of an extensive database of how-to guides)

Justification: BECAUSE ANYONE CAN POST ANYTHING ON WIKI, MEANING THE IS A POSSIBILTY THAT THE WORK IS JUST AN OPINION OF SOME AND NOT FACTUAL

Closed Tabs: Not sure

Reasons Given: N/A

Conclusion- Are Lie Detectors reliable?: Yes

Additional Field Notes: They only used the Google.com search engine and was the first participant to use the google suggested searches at the bottom of the page.

Participant no: S2_13

No of sources and time taken: Found 5 sources in 15 minutes

MOST Credible source:

Title: The Truth About Lie Detectors (aka Polygraph Tests)

URL: http://www.apa.org/research/action/polygraph.aspx

Category / type: American Psychological Association, August 5, 2004

Justification: This source is more credible than the others used for the research because the content has been researched by the reliable people and it is published by the American Psychological association.

LEAST Credible source:

Title: How to Pass a Lie Detector Test (Whether You're Lying or Not)

URL: http://www.livescience.com/33512-pass-lie-detector-polygraph.html

Category / type: Commercial Web site (Our renowned brands offer content designed to educate, inspire, and trigger buying decisions across an array of tech-related product and service categories.)

Justification: The source tells one how to pass the polygraph test and does not really take a stand as to whether it is accurate or no, also because the people who publish this content of information are not really reliable and their findings have not been really researched

Closed Tabs: Yes

Reasons Given: The source was not relevant to the task at hand and what I was suppose to find

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_14

No of sources and time taken: Found 8 sources in 15 minutes

MOST Credible source:

Title: What Is the Current Truth About Polygraph Lie Detection?

URL: http://www.tandfonline.com/doi/abs/10.1207/S15324834BASP2404_6#.VdXA-PnvOHs

Category / type: Online Journal (Basic and Applied Social Psychology Volume 24, Issue 4, 2002)

Justification: Sources Item number 4 is the most credible one for me because it's a recent journal from the APA and it provides the practical evaluations of the polygraph

LEAST Credible source:

Title: Polygraph and Interview Validation of Self-Reported Deviant Behavior

URL: http://www.jstor.org/stable/2090775?seq=1#page_scan_tab_contents

Category / type: Online Journal (Published by: American Sociological Association)

Authors: John P. Clark and Larry L. Tifft American Sociological Review Vol. 31, No. 4 (Aug., 1966), pp. 516-523

Justification: Source number 8 is the least credible because it's from google it's not a APA reviewed source

Closed Tabs: No

Reasons Given: N/A

Conclusion- Are Lie Detectors reliable?: Yes

Participant no: S2_15

No of sources and time taken: Found 10 sources in 15 minutes

MOST Credible source:

Title: To Catch a Liar: Challenges for Research in Lie Detection Training

URL: http://www.tandfonline.com/doi/abs/10.1080/00909880305377#.Vd7LQvnvOHs

Category / type: Online Journal (Journal of Applied Communication Research Volume 31, Issue 1, 2003)

Justification: It is directly from google scholar.

LEAST Credible source:

Title: Lie detection

URL: https://en.wikipedia.org/wiki/Lie_detection

Category / type: From Wikipedia, a free online encyclopedia

Justification: A lot of different people write for Wikipedia so you can never be sure if the person knows what they are writing about or not.

Closed Tabs: No

Reasons Given: N/A

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_16

No of sources and time taken: Found 6 sources in 15 minutes

MOST Credible source:

Title: The validity of polygraph testing: Scientific analysis and public controversy.

URL: http://psycnet.apa.org/journals/amp/40/3/355/

Category / type: American Psychological Association (American Psychologist, Vol 40(3), Mar 1985, 355-366.)

Justification: Source item no 5 it shows that as much as it can be used even in large institutions it can as such be inaccurate, which explains critical evaluation.

LEAST Credible source:

Title: Thermal image analysis for polygraph testing

URL: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1175139&tag=1

Category / type: Digital Library (A not-for-profit organization, IEEE is the world's largest professional association for the advancement of technology.)

Justification: Source item no 6 it does not necessarily show the reliability and inaccuracies, it just explains how it is used.

Closed Tabs: Yes

Reasons Given: It's not what I wanted to use.

Conclusion- Are Lie Detectors reliable?: No

Participant no: S2_17

No of sources and time taken: Found 6 sources in 15 minutes

MOST Credible source:

Title: Controversy Over Polygraph Testing Validity

URL: http://www.fas.org/sgp/othergov/polygraph/ota/contro.html

Category / type: Online Book (published by Federation of American Scientists)

Justification: Source 4 is the most credible, firstly because it is a peer-reviewed journal and therefore more reliable as a source in an academic essay. Secondly, along with making a claim on the polygraph's validity, it also provides case studies and examples to support its claim, the case of Frye for instance.

LEAST Credible source:

Title: The Polygraph Test: Can Science Tell if You Are Lying?

URL: https://sciencebasedlife.wordpress.com/2011/09/15/the-polygraph-test-can-science-tell-if-you-are-lying/

Category / type: Wordpress Blog (Science-Based Life ~ Add a Little Reason to Your Day)

Justification: Source 3. I got it from a blog, which has no guarantee that it is peer-reviewed and therefore no assurance that it is accurate. Anyone can put their opinions down as fact on a blog, so I'm a bit sceptical about it.

Closed Tabs: Yes

Reasons Given: The source was not relevant to the essay. Polygraph's are mentioned in reference to criminal law, so it didn't meet my focus.

Conclusion- Are Lie Detectors reliable?: No

Appendix D: Data Analysis: Coding scheme used for transcription analysis

Online search behaviour (OSB) coding scheme

OSB macro-level category: *search strategy (plus)*

Micro-level category	**Code**	**Description**
Analysis Of Search Query	AOSQ	Analysing the search criteria before starting the initial search task (e.g., 'Cause if you can just focus on the question, there a lot of things that are falling out of that question that can also be useful from that.')
Enter Search Criteria	ESC	Participants enters their initial search criteria into a search engine of their own choosing
Refine Search Criteria	RSC	Participant enters their initial search criteria with a few small changes or additions
Change Search Criteria	CSC	Participant continues to search on the same general topic but with a new search criteria to try and generate different search results.
Read The Abstract	RTA	Participant reads the abstract to determine if the web page will be relevant to their search topic
Broader Understanding	BU	Searching specifically for information to help understand the topic in general, not necessarily for use in an essay but for personal understanding, or general viewpoints
Search for a Definition	S_DEF	Searching for a definition of one of the key terms in an essay topic
Search Engine Identification	SE_ID	Identifying which search engine is used at that point in the search task (e.g., I used Google Scholar; I started in Google)
Multiple Search Engines	SE_M	Using multiple search engines either simultaneously during the course of a single search event.
Search engine evaluation	SE_E	Speed of the browser, e.g., Google is faster, clear layout, easier to navigate
Assessment Of Adequate No Of Resources	AANR	Assessing that enough resources have been located ('It was enough to get me started').

OSB macro-level category: *search strategy (minus)*

Single Search Engine	SE_S	Staying in only one search engine (E.g Google)
Unable To Locate Relevant Resources	UTLRR	Unable to successfully search for relevant content to answer the essay topic
Enter Search Criteria No Change	ESC_NC	Participants enters their initial search criteria without making any changes into a search engine of their own choosing

Unable To Access Desired Content	UADC	Blocked web sites (login required), PDFs that are not downloadable, Paid web site access, etc.

OSB macro-level category: *navigation*

Micro-level category	**Code**	**Description**
Browser Identification	BR_ID	Participant verbalised which browser they have chosen to work in
Multiple Browser Competence	BR_M	The participant can use multiple browsers (e.g., Firefox and Google Chrome).
Browser Evaluation (Plus)	BR_E +	Evaluating that the browser has some positive feature, e.g. 'I find Google Chrome to be much faster at this moment for me'
(Minus)	BR_E -	Evaluating that the browser has some positive feature, e.g.
(Neutral)	BR_E	Despite clearly evaluating the browser, no definitive claim is made regarding rating as compared to other web browsers.
Clicking Back	NAV_B	Using the back button feature on the web browser
Select Links In Order	NAV_SIO	Selecting links in order as they appear on the search page as opposed to looking for more specific criteria
Skipping Links	NAV_SK	Being more selective in which links are chosen, (e.g., skipped that link and went on to the third one).
Multiple Tabs	TAB_OM	Opening multiple tabs (e.g., I opened a third tab cause I was trying to get as many sources as possible)
Select Tabs	TABS_SO	Keeping selected tabs open (e.g., 'Whenever I keep a tab open it's just in case I need to refer to it again).
Not Closing Tabs	TABS_NC	Not closing any tabs for the duration of the search

Self-directed learning (SDL) coding scheme

SDL macro-level category: *monitoring*

Micro-level category	**Code**	**Description**
Content Evaluation (Plus)	CE +	Stating that any just-seen text, diagram, or video is relevant to learning or is good
Content Evaluation (Minus)	CE -	Stating that any just-seen text, diagram, video is irrelevant or not helpful to learning or to answering the search question
Content Evaluation (Neutral)	CE	Evaluating any just-seen text, diagram, or video without definitive conclusion regarding relevance to learning.
Expectation of Adequacy of Content (Plus)	EAC +	Expecting that a certain content (e.g., section of text, diagram, video) will be adequate given the current goal

Expectation of Adequacy of Content (Minus)	EAC -	Expecting that a certain content (e.g., section of text, diagram, video) will not be adequate given the current goal or that is it repeated information already found in a previous search
Expectation of Adequacy of Content (Neutral)	EAC	Evaluating adequacy of presented content given the current goal without definitive conclusion
Credible Content Evaluation (Plus)	CCE +	Content is considered credible due to it being referenced, cited or given some form of authority
Credible Content Evaluation (Minus)	CCE -	Content is not considered credible due to it not being referenced, cited or given some form of authority
Credible Content Evaluation (Neutral)	CCE	Evaluating any just-seen text, diagram, or video without definitive conclusion regarding relevance to learning.
Expectation of Credibility Content (Plus)	ECC +	Expecting that a certain content (e.g., section of text, diagram, video) will be credible given the current goal
Expectation of Credibility Content (Minus)	ECC -	Expecting that a certain content (e.g., section of text, diagram, video) will not be credible
Expectation of Credibility Content (Neutral)	ECC	Evaluating adequacy of presented content as credible given the current goal without definitive conclusion
Time Management	TM	Multi-tasking to save time (e.g., opening multiple tabs when the connection is slow) Participant refers to the number of minutes remaining or notes time limitations (e.g., This is wasting my time / No I didn't open any PDFs due to time constraints)
Different Viewpoints (Plus)	DV +	Actively searching for contradicting information or information from several disciplines, e.g., psychology, law and physiology fields ('I went for more from different perspectives and viewpoints').
Different Viewpoints (Minus)	DV -	Not actively searching for contradicting information or information from several disciplines, e.g., psychology, law and physiology fields, not searching for different viewpoints.

SDL macro-level category: *strategy use*

Micro-level category	**Code**	**Description**
Control Video	CV	Using pause, start, rewind, or other controls in the digital animation.

Evaluate Content as Answer to Question (Minus)	ECAQ -	Statement that what was just read and/or seen does not meet an experimenter posed question
Evaluate Content as Answer to Question	ECAQ	Statement that what was just read and/or seen meets an experimenter posed question
Knowledge Elaboration	KE	Elaborating on what was just read, seen, or heard with prior knowledge. Directly referring to their own prior knowledge of the topic or using existing knowledge of the topic in conjunction with new information found online. For example, 'I don't try to apply it only to psychology'.
Select New Informational Source	SNIS	Using features of the hypermedia environment to access a new representation and/or a new section of the environment (clicking on hyperlinks, items in Table of Contents, back arrow)

Epistemic cognition (EC) coding scheme and correlations with learning gain

EC macro-level category: *source evaluation*

Micro-level category	**Code**	**Description**
Source Evaluation (Plus)	SE +	Statements indicating that the participant is investigating the quality of the source of a knowledge claim. Statements indicate that the source in question can be considered trustworthy for providing knowledge claims whose veracity is high.
(Minus)	SE -	Statements indicating that the participant is investigating the quality of the source of a knowledge claim. Statements indicate that the source in question cannot be considered trustworthy for providing knowledge claims whose veracity is high.
(Neutral)	SE	Statements indicating that the participant is investigating the quality of the source of a knowledge claim. Despite clearly evaluating the source, no definitive claim is made regarding its trustworthiness for providing knowledge claims whose veracity is high.
Inferring Author Bias	IAB	Participant indicates a source of knowledge may be bias in some way.

* Several of these codes were adapted from the study conducted by Greene et.al (2014). A similar system was used for this study to generate new codes relating to online search skills, strategies and source evaluation.