Relationship between Demographic Factors and Metacognition in Digital Library Interaction

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Abstract: This paper aims to investigate the relationships between the university students' demographic factors and their metacognition in digital library interaction. To achieve the objectives of this study, the demographic factors were divided into six variables (i.e., gender, age, qualification, academic backgrounds, searching skills, and experience with the digital library) and the metacognition was classified into nine variables (i.e., schema-training, planning, monitoring, evaluation, transfer, memory, comprehension, task, technology). A total of 112 students participated in the online questionnaire. The collected data were analyzed using SPSS version 26, and a significant correlation between demographic elements and metacognition was found in digital library interactions. Interestingly, the experience with digital libraries has shown the strongest factor to be considered as the most important variable in the design of digital library interactions.

1 INTRODUCTION

Over the years, the storage and preservation of physical materials and notable books have been the hallmark of a conventional library. Users would have to go to the library to learn and search for detailed information. This trend gradually changed with the introduction of computers in the processing and searching of information some decades ago. The rapid development of Information Communication and Technology (ICT) has brought about unprecedented changes. Present developments in ICT have brought positive change to how we store, generate, access, and use information (Chowdhury and Chowdhury, 2003). Due to the role of ICT, libraries are undergoing fundamental changes from the traditional library to the digital library. Digital library searches become faster than traditional libraries and provide easy access, fast-tracking, and many electronic resources, although one can't neglect the feel of holding books which means we can't denigrate the importance of traditional libraries. (Case, 2002) describes information searching as a deliberate endeavor to obtain information to eliminate a deficiency of knowledge or meet a knowledge demand. However, due to the significant changes in the libraries, studies show that during information searching in the digital library, users experience less optimal search results or suffer cognitive overhead. This is due to a lack of information tailored to the users' interests, preferences, needs, and context. For instance, users in traditional libraries can learn how to find information from librarians if assistance is needed.

However, that may not be the case in the modern digital library, where information professionals' help is not always available, and users are left alone to access, search, and use information. Generally, when students looking for information, they prefer to information, students prefer to look at online sources rather than practice in a methodical and organized manner, making learning information sources in the digital library difficult. In this regard, one could argue that self-knowledge may drive successful information searching in the digital library environment with the help of "metacognition." The term metacognition is most commonly connected with (Flavell, 1976), who is credited as being the first scholar to use the notion of metacognition, a term he coined from the word "metamemory" and first used in his early 1970s publications. According to (Flavell, 1979), metacognition is the act of a thinker reflecting on their mental process. It involves people comprehending both them-

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selves and the nature of the activity and understanding the specification of the task.

Metacognition is defined by (Swanson, 1990) as an individual awareness of their ability to monitor, regulate and manage their learning activities. Metacognition refers to higher-level planning for handling a learning activity and mechanisms for observing and evaluating comprehension. At times, individuals utilize the expression "going meta" when discussing metacognition, alluding to the interaction of reviewing a sort of flashback to see what you are doing, as though you were another person noticing it. Sternberg refers to these executive processes as meta-components in his triarchic theory of intelligence (Sternberg, 1984). According to (Sternberg, 1986) meta-components are in charge of "determining how to perform a certain task or set of activities, and then ensuring that the job or set of tasks is completed correctly and the ability to organize cognitive resources effectively, such as selecting how and when a task should be completed is centered to intelligence. Metacognition is a fundamental human trait (Muhali, 2018) that is defined as thinking about thinking by going through a process of review (McCormick, 2003).

Having metacognition awareness assists individuals in taking a more active role in planning, analyzing, evaluating, and monitoring their learning processes (Akyol and Garrison, 2011). Individuals' metacognition awareness is assumed to play an essential part in the online information searching process by structuring the searching process, monitoring, and assessing much as it is in the learning process. Resources on the relationship between metacognition and the search process and its applications are needed (Bowler, 2009). So much research has been done in the academic field, but much research has not been done in the digital library interaction regarding metacognitive skills.

This research examines the relationship between demographic factors and metacognition in digital library interaction. The study conducted for this purpose attempts to find answers to the following questions below:

(a) Is there a significant relationship between demographic factors and metacognition when interacting with digital libraries?

(b) What metacognitive skills do students have when interacting with digital libraries?

2 RELATED WORK

Through the reviewing the previous research, we understood how various techniques of analysis have specific strengths and weaknesses. (Gorrell et al., 2009) conducted a research on metacognitively aware IR systems. They classified metacognitive components into five categories: schema-training, planning, monitoring, evaluation, and transfer. They used metacognition information Likert-based knowledge generator, so called MILK, to offer the coverage of the subareas in the taxonomy. They found that metacognitive uses vary greatly depending on gender, age, and academic discipline and that older adults, in particular, use metacognitive skills more than younger adults.

(Madden et al., 2012) revealed whether the application of user evaluation standards provides Metacognitive evidence for web reliability, a total of 48 graduate students from various disciplines participated in the study. It was observed that some students encountered some difficulties because of an overly simplistic approach to assessing sites. The students were given different evaluation criteria such as websites (name, description, appearance, references) and contents such as authorship, quality of writing, evidence of research, and contacts. According to the findings, some participants reported dissatisfaction with the lack of information about the author's identity. It was also noted that the students in the study appeared to have received little formal assistance on the evaluation, which provides the most direct indication of metacognition behavior, according to (Bonds et al., 1992), will not only hold information in ways that vary depending on the task. In this study, some volunteers engaged in such conduct.

(Cadamuro et al., 2019) investigated the relationship between metacognition and information and communication technology (ICT) in undergraduate students. Metacognitive reflection during an online course was found to build advanced epistemic agency in students and increase decision-making skills through metacognitive tips in the e-learning environment. Another observation during the research is that metacognition self-regulation and organization predicted students' performance and information searching behavior. The ICT and Metacognition are likely in a bi-directional relationship. On the other hand, working in technology-mediated contexts supports the development of metacognitive skills, leading to better learning outcomes. However, metacognitive skills are necessary to take advantage of web-based training. The use of metacognitive skills In ICT has contributed to creating powerful learning and information search.

Another previous research is the think-aloud procedure focusing on comparing the use of these strategies by people with different levels of critical thinking in searching behavior; participants were asked to

think aloud everything they thought of when completing the task that attracted favorable attention. (Ericsson and Simon, 1984) argue that it reflects the thinking process more directly than other oral reports that require participants to express their ideas in words during the task. It is also considered to be a straightforward method to gain insight into human knowledge and techniques of problem-solving," similarly to (Crain-Thoreson et al., 1997). The study examines think-aloud procedures to check the reading comprehension process and found that only the conversion response represents after modifying the coding scheme. The variance in comprehension score accounted for by the usage of comprehension strategy increased from 20% to 40% after adjusting the coding system to include only transformed responses that demonstrated active and correct integration of passage content.

(Reisoğlu et al., 2020) analyzed 20 university students on online information searching and metacognitive abilities during argumentation activities, focusing on three phenomena: argumentation activities, metacognitive skills, and the link between them. By examining screen recordings and the online information searching strategy inventory (OISSI) created by (Tsai, 2009), different results were obtained in terms of metacognition awareness and online information searching methods. The findings of the interviews demonstrated a link between participants' online information searching tactics used in argumentation activities and all dimensions of metacognition. Furthermore, the data shows that metacognition skills are frequently linked to multiple sub-dimensions in (Tsai, 2009) framework and might readily encompass a variety of techniques. Again, online argumentation activities can be argued to allow for extensive use of metacognitive abilities in planning, monitoring the information gathering process, and applying appropriate strategies. According to (van Geel et al., 2015) metacognition is essential in solving complicated information problems.

However, given that information search is a problem-solving process, metacognition has always been a missing piece in the puzzle to understanding users better. The current study used a metacognitive paradigm from educational psychology to illuminate the research problem. However, further research is needed to categorize users' difficulties during information searching through digital libraries and develop adequate taxonomy, which are five core metacognition skills to address these challenges.

3 METHODOLOGY

This section will present the study design, instrument, participants, and data analysis information.

3.1 Research Design

The quantitative research approach was employed to identify the demographic differences in metacognition in digital library interaction. This strategy was used to gather data on the subject and contribute to a more comprehensive understanding.

3.2 Participants

The study was conducted to gather adequate information from Kyungpook National University students (Koreans and international students) and Nigerian university students. This research tends to employ a simple random sampling technique in selecting one hundred and twelve (112) respondents for this research. This includes 20 Knu-Korea students,35 Knu-International students, and 57 Nigeria university students. The bulk of the 112 participants was male (57%) and female (43%) respectively. The participant's ages range from 18 to 43 years above. Participants have different qualifications ranging from bachelor's degrees, master's degrees, doctorate degrees (Ph.D.), and post-doc.

3.3 Metacognition Components

The existing concept of five metacognitive skills used in the study Schema-training, planning, monitoring, evaluation, and transfer were developed by (Brown, 1975). Schema-training: This involves the development of cognitive structures that provides a conceptual framework for comprehension (Gordon and Braijn, 1985). Planning: This refers to carefully evaluating the current situation in order to determine potential causes of action to implement solutions to achieve results and make efficient use of the time and resources (Erenler and Cetin, 2019). Monitoring: This is about the person's awareness of how she performed in relation to the process that was planned. (Schraw, 1998) Evaluation: This refers to how the person evaluates both the organization process and the outcomes of her own learning (Schraw and Moshman, 1995) Transfer: It refers to the process of moving one's skills and knowledge from one problem-solving scenario to another. The low and high-road theory on learning transfer, developed by (Perkins et al., 1992) However, (Wallace and Kupperman, 1997), who also explores web searching,

Table 1: Metacognition components.

	Memory	Comprehension	Task	Technology
Schema-training	[S-M]	[S-C]	[S-Ta]	[S-Te]
Planning	[P-M]	[P-C]	[P-Ta]	[P-Te]
Monitoring	[M-M]	[M-C]	[M-Ta]	[M-Te]
Evaluation	[E-M]	[E-C]	[E-Ta]	[E-Te]
Transfer	[T-M]	[T-C]	[T-Ta]	[T-Te]

recommends breaking down the rest of the required skills into two parts task and technology. In addition, metamemory and meta-comprehension are subareas of Metacognition (Brown, 1975). All these make it four elements applied to five components of the task. As shown in Table 1, there are twenty subareas.

Based on the subareas of Table 1, a 32-item questionnaire was developed by the researcher using the Google forms feature. The questionnaire aims to cover all the domains outlined in the taxonomy and explore participants' perceptions of their usage of selected metacognitive skills while searching on the web and digital libraries. The measurement used is a 5-point Likert type scale range and was set out and scored in the following way 5= Strongly agreed, 4= Agree, 3=Neutral, 2= Disagree, 1= Strongly disagree.

3.4 Data Analysis

The data collected was coded organized and processed by the researcher using the statistical package for the social sciences (SPSS version 26). Descriptive statistics of frequency count were used to provide information on the number of males and females that participated in the research. It was also used to analyze the age, qualification, academic background, searching skills, and experience with a digital library.

The mean and standard deviation were used to analyze the research question to determine the metacognitive skills possessed when searching through the digital library. Bivariate correlation was used to analyze the relationships between demographics and metacognition awareness.

4 RESULTS

The results of descriptive statistical analyses were used to determine the university student's metacognitive competence scores. The overall mean score is ($\bar{x} = 3.62$) and the criterion mean is 3.0 on a five-point scale of metacognitive skills which was divided into five dimensions namely: schema-training, planning, monitoring, evaluation, and transfer. The group means for each metacognitive skills dimension was also calculated. The result revealed that schema training ($\bar{x} = 3.48$), planning ($\bar{x} = 3.64$), monitoring ($\bar{x} = 3.63$), evaluation ($\bar{x} = 3.54$) and transfer ($\bar{x} = 3.81$). Full results are listed in Table 3.

Bivariate correlation analyses were conducted to discover relationships between demographic information (gender, age, qualification, discipline, searching skills, and experience with digital library) and scores for the various metacognitive components. A further correlation analysis sought relationships between demographic information and metacognition. The finding revealed the Pearson correlation analysis which shows that there is negative significant relationship between gender and task ($r = -0.265$, $p > 0.05$) as well as on schema ($r = -0.235$, $p > 0.05$) and planning ($r = -0.256$, $p > 0.05$). It also showed that there is negative significant relationship between age and comprehensive ($r = -0.190$, $p > 0.05$) as well as on schema ($r = -0.198$, $p > 0.05$). Furthermore, there is negative significant relationship between academic background and comprehensive ($r = -0.224$, $p > 0.05$) as well as on planning ($r = -0.270$, $p > 0.05$). Finally, there is negative significant relationship between experience with digital library and memory ($r = -0.249$, $p > 0.05$) as well as on comprehension ($r = -0.199$, $p > 0.05$), task ($r = -0.279$, $p > 0.05$), technology ($r = -0.234$, $p > 0.05$), schema ($r = -0.395$, $p > 0.05$) and planning ($r = -0.242$, $p > 0.05$).

5 DISCUSSION

Table 2 shows that there is a negative significant relationship between task, schema, and planning based on gender. This implies that males have a strong negative significance in the metacognitive skills in the main component of schema training p = 0.013 and planning p = 0.006 and subareas task p = 0.005 than females to a greater extent. Furthermore, age has a negative significance with older people having better metacognition skills in schema training p = 0.037 and comprehension p = 0.045. This implies that older

Table 2: Pearson correlation coefficient (Pearson's r) and p-value between Demographics and Metacognition awareness.

	Pearson's r (p-value)					
	Gender	Age	Qualification	Academic Background	Searching Skills	Experience with digital library
Schema	**-0.235*** (< 0.013)	**-0.198*** (< 0.037)	-0.021 (< 0.825)	-0.137 (< 0.149)	0.143 (< 0.133)	**-0.395**** (< 0.000)
Planning	**-0.256**** (< 0.006)	-0.112 (< 0.239)	-0.055 (< 0.563)	**-0.270**** (< 0.004)	0.063 (< 0.509)	**-0.242*** (< 0.010)
Monitoring	-0.032 (< 0.739)	-0.064 (< 0.501)	-0.012 (< 0.904)	-0.172 (< 0.070)	-0.031 (< 0.744)	-0.077 (< 0.419)
Evaluation	-0.089 (< 0.353)	-0.076 (< 0.426)	-0.134 (< 0.159)	0.169 (< 0.075)	0.017 (< 0.861)	-0.139 (< 0.143)
Transfer	-0.126 (< 0.186)	0.076 (< 0.424)	-0.062 (< 0.515)	0.044 (< 0.646)	0.095 (< 0.320)	-0.149 (< 0.116)
Memory	-0.146 (< 0.125)	-0.074 (< 0.437)	-0.070 (< 0.463)	0.064 (< 0.506)	0.119 (< 0.210)	**-0.249**** (< 0.008)
Comprehension	-0.111 (< 0.243)	**-0.190*** (< 0.045)	-0.080 (< 0.404)	**-0.224*** (< 0.018)	-0.009 (< 0.923)	**-0.199*** (< 0.036)
Task	**-0.265** ** (< 0.005)	-0.100 (< 0.296)	-0.040 (< 0.678)	-0.123 (< 0.198)	0.110 (< 0.248)	**-0.279**** (< 0.003)
Technology	-0.150 (< 0.114)	0.004 (< 0.967)	0.003 (< 0.975)	-0.033 (< 0.726)	-0.024 (< 0.798)	**-0.234*** (< 0.013)

* Correlation is significant at the 0.05 level (2-tailed).
** Correlation is significant at the 0.01 level (2-tailed).

people have metacognitive accuracy for their capacity and older adults can accurately assess their ability to selectively remember high-value information. There is a negative significant relationship between the main component of planning $p = 0.004$ and sub-areas comprehension $p = 0.010$ based on the academic background which indicates that information technology students possessed high metacognition skills which comprise the highest percentage of students that participated in the research. Experience with the digital library is very much influenced and an important factor in both schema training, $p = 0.000$ planning, $p = 0.010$ memory, $p = 0.008$ comprehension $p = 0.036$ task, $p = 0.033$ technology $p = 0.013$. Therefore, gender, age, academic background, and experience with the digital are compelling factors that determine the level of the metacognitive skills of the students.

Table 3 shows that University students reported higher use of metacognition in general, with the highest score of ($\bar{x} = 3.81$) in transfer and in most of the subareas of metacognition skills. Under schema training majority of the students possessed high metacognitive skills in schema training-memory. This shows that a higher percentage of university students have a number of techniques at their disposal to help them remember what they learned and where they found it. It was observed that 52% of respondents lack techniques that can help them understand the information they find while using a digital library.

Under planning, it could be concluded that planning comprehension is significantly high, this shows that the majority of the students possessed skills in planning to summarize in order to monitor and improve their comprehension. While they lack plan search task strategies such as verifying how trustworthy the information from digital libraries is from different academic journals. Importantly, a lack of planning doesn't necessarily mean an ineffective search. In other words, the high potential in planning which in some cases inhibits efficient retrieval.

A higher percentage of students under monitoring show strong metacognition skills in the monitoring search task which indicates when using the digital library for a learning task, they ask themselves ques-

Table 3: Types of metacognitive skill.

S/n	Types of metacognitive skills	$\bar{x}$	σ
	Schema-Training		
[S-M]	I have techniques that help me remember any information I come across on digital library.	3.84	0.94
[S-C]	I have techniques that help me understand the information I find while using digital library.	3.21	1.19
[S-Ta]	I have developed ways of identifying the type of information I need for my learning tasks while using digital library.	3.33	1.24
[S-Te]	I am good at choosing keywords on user interface of digital library to get optimized feedback.	3.52	1.18
	Average mean	3.48	1.14
	Planning		
[P-M]	I plan ways to remember the information I find in the digital library.	3.88	0.84
[P-C]	I may use the digital library to start a search task to increase my understanding on a subject area.	3.87	1.02
[P-Ta]	I decide in advance exactly what type of information I am looking for on digital library.	3.17	1.33
[P-Te]	I tend to work out my search skills before using a digital library.	3.65	1.02
	Average mean	3.64	1.05
	Monitoring		
[M-M]	Sometimes when using the digital library, I am aware that I might for get the information I find.	3.68	1.01
[M-C]	Sometimes when using the digital library, I may have misunderstood information I read earlier in my search.	3.04	1.14
[M-Ta]	When using the digital library for a learning task, I find myself asking questions along the lines of: “Is this search providing the type of in formation I need?”.	3.94	0.80
[M-Te]	At times I am cautions as I search (e.g. the words I put into the search box) in the digital library.	3.85	0.91
	Average mean	3.63	0.97
	Evaluation		
[E-M]	It is clear to me when I am failing to remember what I learned in the digital library.	3.49	0.93
[E-C]	While using the digital libraries I get convinced that the feedback of my search is valid.	3.18	1.15
[E-Ta]	I spend a lot of time judging how well the information I find in digital libraries matches my learning needs.	3.70	1.02
[E-Te]	It is usually obvious to me whether I am using a good search strategy on a digital library or not.	3.80	0.92
	Average mean	3.54	1.01
	Transfer		
[T-M]	I use different approaches to recall the information that I learned in other domains of digital library.	3.77	0.96
[T-C]	My experience with different learning tasks has helped me monitor how well I am understanding what I read in the digital library.	3.79	0.83
[T-Ta]	My experience in other areas helps me to work out exactly what type of information I need for my learning task in the digital library.	3.99	0.93
[T-Te]	The skills I apply when using a digital library are useful in other areas of my information searching.	3.70	0.94
	Average mean	3.81	0.92
	Overall mean = 3.62		

tions along the line if the search provides the type of information they need. It shows that 74% of the participants are aware of their progress towards completing the task and the reliability of the information they found. But possessed weak metacognition skills in monitoring comprehension which shows that when using a digital library they must have misunderstood information they read in the past when searching.

Under evaluation, it could be concluded that users possessed strong metacognition skills in evaluation technology which implies that it is usually obvious to the majority of university students whether they are using a good searching strategy in a digital library or not. It shows that participants critically evaluate their search method and use of technology and draw conclusions about the use. However, they lack evaluation comprehension skills while using digital libraries they get convinced if the feedback of their search is valid.

Under transfer, it shows that users possessed a higher level of metacognition skills in the transfer search task with 74% of participants who have experience from other areas helping them to work out precisely what type of information they need for their learning task. On the contrary, there is low metacognition awareness in transfer technology which indicates that the use of carrying learning from other tasks into their use of sources and technology is low.

6 CONCLUSION AND RECOMMENDATION

This study's findings imply that, regarding the issue with digital libraries, metacognition awareness is essential where it is lacking. Based on the conclusions of this paper, metacognitive skills were observed from different components and subareas of the taxonomy. The result shows that students demonstrated strong metacognition skills on transfer which is a result of metacognitive knowledge that helps them to select previously learned strategies to achieve searching goals or to deal with problems encountered during the task. According to (Groteluschen et al., 1990), if the chosen strategy is effective and searchers believe it improves learning quality and their specific strategy is stronger. The nature of this study cannot be considered indicative of the entire student body. Given the fact that there are 122 participants in the study, it seems reasonable that it doesn't cover larger numbers of students with different academic backgrounds. It is possible to argue that teaching students how to apply metacognitive methods improves their academic performance (1988). Students with advanced skills in metacognition may keep track of their own learning, express their opinions on it, keep up to speed on their knowledge, and develop and implement new learning procedures. Students that effectively use their metacognitive skills are more aware of their strengths and weakness and seek to develop their skills further than other students (Bransford et al., 2000). The results show improvement in planning which shows that majority of the students demonstrate the use of implementing metacognitive strategies that require careful planning and a better understanding of metacognitive skills should provide students with potential strategies to use when searching for information in digital libraries.

According to (Jones et al., 1995) the greater a student's understanding of metacognition, the greater his or her efficiency. In the twenty-first century, metacognition strategies are needed. This will allow students to successfully cope with new situations when searching, and school library media specialists to capitalize on their skills and gain access to a wealth of resources, fostering the development of good thinkers who are successfully problem-solvers, searching skills, and information retrieval experts. Additionally, students with good metacognitive skills are better critical thinkers, problem solvers, or decision-makers than students without metacognitive skills, and also metacognitive training can increase students' self-confidence and personal responsibility for their own development.

The implication is that metacognition skills help individuals process and retain information through self-recognition and reflection. Metacognition skills are essential because they help students understand their learning process and how they learn effectively, and it also assists users in learning to control their searching by defining search goals and tracking their progress towards them. The taxonomy used in this research to identify the metacognition awareness from different nationalities can be used for future research on information searching through a web search. Its feature can be used not just for digital libraries.

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