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Analysing engineering students' information retrieval behaviour using online databases as information sources

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Abstract

Students at the tertiary education level need the information to complete their assignments at the university. Information retrieval behavior among university students is interesting to study because it shows the ability of search techniques and the diversity of information needed. The researcher has extensively researched information-seeking behavior at this level of education. However, more needs to be explicitly performed on the information retrieval process conducted by engineering students. The purpose of the present study was to reveal engineering students' information retrieval behavior process when using information sources from online database websites through analysis the types of online database websites the students used as primary information sources, why the students used these websites, and identified the challenges in information seeking using online database websites. For this study, data were collected using an internet-based questionnaire distributed among students at the Department of Urban and Regional Planning, ITS. The study results indicated that engineering students used search engines as the primary information source due to their richness and flexibility. In this case, we have found additional results regarding the patterns of presentation and the interactivity necessary to optimize the function of online database websites. Also, the study has found the challenges faced by students in retrieving information and how they overcome the situation by using different keywords.

Keywords**:** Information-seeking behaviour; Information retrieval; Information source; Online database websites

Analisis perilaku temu-kembali informasi mahasiswa teknik menggunakan sumber informasi database daring

Abstrak

Mahasiswa membutuhkan informasi untuk menyelesaikan tugasnya di perguruan tinggi. Perilaku temu kembali informasi pada mahasiswa perguruan tinggi menarik diteliti karena memperlihatkan kemampuan teknik mencari dan ragam informasi yang dibutuhkan. Kajian mengenai perilaku penemuan informasi di kalangan mahasiswa telah banyak dilakukan. Namun, penelitian yang mengkaji perilaku temu kembali informasi yang dilakukan oleh mahasiswa teknik masih sedikit. Tujuan penelitian ini adalah mengetahui proses perilaku temu kembali informasi mahasiswa dalam menggunakan sumber informasi dari laman database *daring melalui analisis jenis situs* website *database* online *yang digunakan mahasiswa sebagai sumber informasi utama, alasan penggunaan situs* website *tersebut, dan identifikasi kendala dalam penelusuran informasi dalam laman* database *daring. Metode penelitian ini menggunakan pendekatan deskriptif kuantitatif. Data untuk penelitian ini dihimpun melalui kuesioner daring yang didistribusikan ke pada mahasiswa di Departemen Perencanaan Wilayah dan Kota ITS. Hasil penelitian mengungkap bahwa mahasiswa telah menggunakan mesin pencari sebagai sumber informasi utama karena kelengkapan dan fleksibilitas. Mahasiswa telah menggunakan kata kunci umum yang relevan dengan topik yang mereka telusuri dan tidak menggunakan teknik* truncation*. Simpulan penelitian adalah mahasiswa masih terkendala aksesibilitas dikarenakan adanya* paywall*, informasi yang ditulis masih dalam bahasa asing, dan reliabilitas sumber informasi. Untuk mengatasi hal ini, mahasiswa mengganti kata kunci yang mereka gunakan, atau beralih ke sumber informasi lainnya.*

Kata Kunci: Perilaku pencarian informasi; Temu kembali informasi; Sumber informasi; Laman database daring

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INTRODUCTION

Information-seeking is seeking or searching for information through certain information carriers because of particular needs or goals (Diwanji et al., 2020; Puspitasari, 2020; Zimmerman, 2020). Individuals will engage in information-seeking behavior when they feel that their knowledge is insufficient to support their daily activities (Gurusinga, 2019). The information gap creates information needs that anyone can meet by engaging with various sources of information.

The information-seeking process consists of several stages. The first stage is the stage of one's awareness of the need for information. At this stage, information seekers try to assess their current situation with their information-seeking experiences. In the next stage, information seekers will consider the information found with various criteria, such as personal interests, requirements in the tasks to be completed, available sources of information, and time availability. At this stage, information seekers begin to select information more systematically. After going through the selection stage, information seekers may need clarification about the information they receive. This is due to a discrepancy between the information seeker's mind concepts with the information they find. The fourth stage of the information-seeking process is the focus formulation stage. In this stage, information seekers have more confidence in the information they gather. As a result, they shift their minds to selecting relevant ideas and shaping the topic they are working on. Then, information seekers enter the information collection stage, where the interaction between information seekers and the information retrieval system reaches the most effective and efficient point. Activities at this stage include linking the information collected with the information seekers' needs and selecting relevant information. The final stage in the information-seeking process is closure. This stage is the peak of the information-seeking process. There are two possible outcomes to closure: the information-seeker is satisfied, or vice versa.

Diwanji et al. (2020) revealed four categories of information-seeking behavior. The first behavior is Passive Attention or receiving information such as listening to the radio or watching television. The second category is Passive Search, where information seekers find relevant information to their needs. Next, Active Search, the third category, is where information seekers actively seek information. The final category is On-going Search, where information seekers engage in active, structured information-seeking. The information-seeking activity's structures can be based on predetermined ideas, beliefs, and values. This type of information-seeking behavior can be developed systematically through the continuous expansion of the search framework.

Septian, Narendra, and Hermawan, (2021) demonstrated another information-seeking model. Their study reveals that students do not seek information randomly but systematically, following Ellis's Model of starting, chaining, browsing, differentiating, monitoring, and extracting. According to Faturrahman (2016) psychological factors, professional factors, and information needs affect information-seeking behavior. Gurusinga (2019) argues that people pursuing higher education need more information than others.

Students in higher education institutions need quality information to

complete assignments, seek out course references, and look for references to support their extracurricular activities (Hanum, 2017; Heriyanto, 2018). Therefore, students will engage in information-seeking activities to meet their information needs (Hanum, 2017). However, according to Heriyanto (2018) the complexity of student activities in finding information for completing assignments is caused by the scope of work, the requirements for coverage and forms of references, and the student's capacity to use information sources.

Furthermore, according to Fitri and Prasetyawan (2020) current diploma and undergraduate students are predominantly digital natives. Therefore, they have ample information about their assignments and research topics. Sometimes, students receive information and references from their lecturers or academic supervisors. However, they often need help deciding which information is relevant when seeking it independently.

The ability to search for information independently is a fundamental skill that students must possess (Heriyanto, 2018). Research on information discovery behavior is a branch of library science and readership studies (Diwanji et al., 2020; Mishra, Allen, & Pearman, 2015). It developed into other scientific disciplines such as marketing (Tanusha & Rupasi, 2019), organizational communication (Hsu & Reid, 2021; Pool & Koopman, 2019), health (Barnes, Khojasteh, & Wheeler, 2017; Hartoonian, Ormseth, Hanson, Bantum, & Owen, 2014; Paek, Choi, & Hove, 2017) urban and regional planning (Afida, Idrus, & Hashim, 2017) and disaster risk management (Piltch-Loeb, Merdjanoff, & Abramson, 2018; (Rahmi, Joho, & Shirai, 2019; Ryan, 2013; (Steelman, McCaffrey, Velez, & Briefel, 2015). There is numerous research on information-seeking behavior among higher education students.

However, there are few studies on information-seeking behavior among engineering students. Alhusna (2019) observed the information discovery behavior of undergraduate students enrolled in the Library Sciences program using the Empowering 8 Information Literacy Model and found that demographic characteristics affect information literacy. Whereas Andina (2020) revealed a positive correlation between cognitive symptoms on student information retrieval using the Wilson Search Model. Furthermore, Gurusinga (2019) analyzed information-seeking behavior among Library Sciences students using a descriptive approach. He discovered that students rarely formulate keywords before searching for information on the web.

Besides, Heriyanto (2018) observed students' interaction with academic databases, students' experience with libraries (Heriyanto, 2019), and students' information source preferences (Heriyanto, 2020). Puspitasari (2020) studied information-seeking and information-retrieval behavior among shopaholic students. Moreover, Safitry (2019) examined the information-seeking behavior of PGMI students at the Faculty of Tarbiyah Sciences and Teaching using the Seven Pillars Standard. In addition, Shobirin, Roekhan and Safii (2020) examined the information-seeking behavior of high-achieving students using a qualitative approach. Nurfadillah and Ardiansah (2021) observed the changes in the information-seeking behavior of Library and Information Sciences students before and after the Covid-19 pandemic.

Several studies have shown comparisons between various digital information sources. For example, Ali and Gul (2016) analyzed search engine effectiveness by comparing two popular search engines, Google.com dan Yahoo.com. Their research revealed that search engines present relevant and accurate information. Gusenbauer (2019) looked at 28 academic databases, including Google Scholar, PubMed, and Web of Science. Gusenbauer and Haddaway (2020) indicated that each database has its characteristics. Therefore, the degree of usefulness and effectiveness varies. Reflecting on Ali and Gul (2016) and Gusenbauer and Haddaway (2020), the recommended sources of information in searching for information are internet search engines such as Google, DuckDuckGo, Bing, and scientific databases such as EBSCOHost, ProQuest, Gale, Google Scholar, dan the like. Earlier studies compared internet search engines with online library database systems (Gusenbauer, 2019; Gusenbauer & Haddaway, 2020). These studies show that internet search engines are preferred because of their ease of access and broad scope. On the other hand, online library databases are favored for better quality results. This research is built on previous studies by Gusenbauer (2019), Gusenbauer and Haddaway (2020) to achieve the research aim.

While extensive research has been conducted on information-seeking behavior, the present study sees that the overall information retrieval process is another interesting study area to address. Hence, this study focuses on how information-seeking behavior leads to the information retrieval process in the context of engineering students when engaging with various digital information sources from internet search engines, digital libraries, and online repositories. Roshdi and Roohparvar (2015) adopted the basic principle of information retrieval, which posits that information retrieval concerns the representation, storage, and access of information. In this case, information retrieval deals with how engineering students in tertiary education organize and retrieve information from sizeable online database collections.

Another approach used in this research is the study of the presentation of information on online websites. Internet websites have hyper textuality that enables readers to access broader information from a single line of text (Fairclough, 2013). Interestingly, several linguistic studies show the importance of understanding online pages as a unit of meaning that can be understood semiotically. In particular, Adami (2015) argued that online pages need interactivity to be used optimally. The information organized on a page is not simply represented as inert material; however, the page requires specific actions to use its features. He suggests that the interactivity on the page includes three things that users should pay attention to, namely form, action and effect.

The form on online pages refers to the various forms that appear on the screen when a visitor opens a web page. These include text, icons, images, or a combination thereof. These things are visible, and the user can use them to access the page's content. The user can do actions with the shapes described earlier, for example, 1) click or tap, 2) type and click, and 3) move the cursor. While effects are consequences resulting from the actions carried out earlier, for example, 1) accessing new text, 2) providing text, and 3) transferring text to another place.

The present study investigated tertiary students' information retrieval process when using online database websites. More specifically, this research sought to fulfill the following objectives. First, this study aimed to reveal the online database pages used by students as the primary source of information and why, including knowing how the presentation patterns of these pages and the interactivity needed to optimize the online database pages' function. Second, this study sought to identify obstacles in searching for information on online database pages that students often face. Finally, with these various obstacles, this research would reveal the student's solution behavior in assessing the relevance and quality of the information obtained from the information source. This study contributes to library and information sciences by presenting a perspective on information-seeking behavior and information literacy among students, especially engineering students. In addition, the results from this study can also be of interest to library managers in providing information services for students in higher education institutes, such as a university.

RESEARCH METHODS

This research used the basic principles of descriptive quantitative research. Research results were the results of data analysis which were discussed in depth descriptively. As a descriptive study, this study seeks to systematically describe facts about the object of research (Mudjiyanto, 2018). In this case, the subject of this research is engineering students.

The study was conducted at the Institut Teknologi Sepuluh Nopember (henceforth ITS), Surabaya. The research object was undergraduate (S1) students of the Regular Program and the International Undergraduate Program (IUP) within the Department of Urban and Regional Planning (henceforth DPWK), Faculty of Civil, Planning, and Geo-engineering (FTSPK). At the time of writing, there were 550 active students in the DPWK. Since this research was conducted in the odd semester of 2020/2021, students in semesters one, three, five, and seven were involved. A random sampling technique was employed to recruit potential respondents.

Questionnaires were distributed at the semester's beginning and end of the lecture sessions. The author delivered the links on the subjects taught, Introduction to Urban and Regional Planning, presented in the first semester. Next, Land Use and City Design, and Theory and City Morphology in the third semester. Then, Urban Design Practice in the fifth semester, and Seminar (writing thesis proposals) in the seventh semester.

Respondent recruitment was carried out randomly using the Google Form questionnaire. Based on their demographic characteristics, the study population has high computer literacy. Questionnaires for this study were distributed and filled out electronically using various devices accessible to participants. In the end, data collected from 43 respondents were deemed eligible for analysis.

The questionnaire's content used as a data collection tool consisted of two parts. In the first part, questions were structured to investigate students' information-seeking behavior. In this section, the questionnaire collected data regarding the choice of online database pages as a source of information. Then, respondents were asked to state their reasons for choosing the primary source of information to obtain the

necessary information to support the reference collection for the task at hand. In the next section, the questions in the questionnaire were structured to investigate and identify the obstacles experienced by students in searching for information. This section collected respondents' strategies when they could not find the required information. Finally, this section ended with questions about the respondents' methods in determining the relevance and quality of the information found.

The validity of the electronic survey in this study has been confirmed. Each participant stated their agreement in filling out the questionnaire according to the situation and conditions they experienced as students using various sources and online information pages to support multiple coursework assignments. The validity of online surveys conducted through the internet is related to their capacity to reach a large number of participants in a relatively short time (Ansolabehere & Schaffner, 2014). Furthermore, the researcher stated that internet surveys could recruit respondents who objected to face-to-face interviews and were more practical for respondents. In this study, from the total number of samples, 43 responses from participants were eligible to be used as data for the analysis.

Data analysis was then performed to achieve the research objectives stated in the previous section. The data analysis procedure was carried out in two stages. First, the data collected were analyzed using a descriptive statistic approach. At this stage, the data source was obtained from the annotated online survey as informed by the respondents via the Google Form questionnaire. In the next step, data analysis was explicitly carried out to find a description of the interactivity. With information about various types of online information resource pages used by participants, an analysis of interactivity was performed using the framework from Adami (2015), which consisted of forms, actions, and interactivity effects in the online websites. The overall analysis results from these stages were presented descriptively, connecting the analysis results according to the teaching and learning situations and conditions experienced by participants at DPWK ITS.

RESULTS AND DISCUSSION

The description of the results of this study was divided into two parts according to the research objectives. The first part described the results of data analysis from the research instrument. This section also explained the presentation pattern of online database pages and their interactivity. The second part of this section presented the interpretation of the results of the data analysis about students' information-seeking behavior on online database pages.

The report on the study results was obtained based on data collected using an electronic questionnaire which was summarized from 43 DPWK students. The number of respondents was quite far from the total number of active students in ITS DPWK, which was 550. However, the total number of participants screened for less than ten percent for this questionnaire can be categorized as a representative number. Since the researcher also analyzed the detailed responses that respondents filled in, in the form of descriptions for several questions in the questionnaire. This number reflects the findings of several other studies that mention low response rates as a drawback of internet surveys (Evans & Mathur, 2018; O'Callaghan et al.,

2020; Sahu, 2012; Saleh & Bista, 2017). As a by-product of the primary research objective, the data collection process in this study showed that the online questionnaire was proven to be quite effective.

Statistics from the questionnaires showed that when the survey was conducted, most of the respondents who filled out the survey were in the third semester (62.79%) and the first semester (25.58%). The rests are respondents in the fifth semester (6.98%) and seventh semester (4.65%). This demographic structure was relevant to the odd semester in the DPWK of ITS when data collection was carried out. See Figure 1.

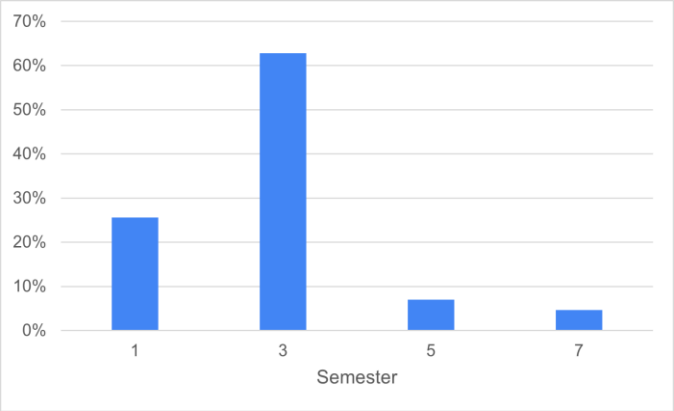

Figure 1. Number of respondents
Source: Survey results, 2020

The students who were the respondents in this study were between 19 and 21 years old. The study also noted the involvement of male and female student respondents. Though this factor was not included in the data analysis, it was noteworthy that respondents from both genders within this age range could be categorized as digital natives. This aligns with a concept introduced by Prensky (Kirschner & De Bruyckere, 2017) to refer to the demographic generation born and raised in the digital era. As digital natives, this age group is a group that is familiar with and easy to adapt to the use and development of technology. This research had a prerequisite underlying the assumption that the respondent's age range was considered to be able to efficiently operate information retrieval using online databases from various digital platforms.

In the context of teaching and learning activities in the ITS DPWK, the respondents were users of online database pages. The primary purpose was to support information retrieval activities to complete coursework (97.7%). Apart from these reasons, a small proportion of respondents reported that they also carried out other supporting activities. Complete information regarding the reasons for use is presented in Table 1.

Table 1
Information-seeking purpose

Purpose	Number of respondents
Coursework	34
Coursework and additional knowledge	3
Coursework and final assignments	6

Source: Survey results, 2020

The survey results indicate that the information-seeking behavior of the respondents belongs to the category of active search or continuous search (Diwanji et al., 2020). Students' behavior reflected the role of students during lectures in the odd semesters, namely as an activity to search for information repeatedly over time to meet their information needs in completing their coursework assignments. Their primary interest was finding sources of information from online websites as a supporting activity to be actively involved in their course activities.

Students in later semesters are more advanced than those in the first semester of their studies. Assignments for third-semester DPWK students include assignments in the following subjects: 1) Planning Analysis Method (3 credits); 2) Transportation System (3 credits); 3) Land Use (3 credits); 4) Urban Design Theory and Urban Morphology (3 credits); 5) Applied Planning Processes (4 credits); and 6) Planning Information System (3 credits). The assignments at the DPWK include compiling reports, essay preparation, and thesis manuscripts requiring quality information from credible sources. Therefore, the skills to search and identify relevant information from various sources are necessary.

Relevant to the respondent's profile, the survey results showed that most respondents searched for information to support coursework (79.07%). The results also indicated that despite the abundance of online options, search engines became respondents' primary source of information because of their ease of use (86%). The comparison between search engines and online databases as the primary source of information is shown in Table 2.

Table 2
The primary source of information

Primary source	Number of respondents
Search engine	40
Scientific database	3

Source: Survey results, 2020

Only three respondents reported that they used scientific databases. This result was surprising because the ITS library provided access to online scientific databases. So naturally, students were expected to be familiar with and be able to use online scientific databases.

In the questionnaire, the choice of information sources consisted of four categories: 1) Search engines such as Google, DuckDuckGo, Bing, and the like; 2) Scientific databases such as EBSCOHost, ProQuest, Gale, Google Scholar, and the like; 3) Online library services such as the ITS library and the National Library of the Republic of Indonesia (PNRI), and 4) the departmental reading room. Responses collected indicated that most respondents recognized and used scientific databases. However, most respondents fulfilled their information needs using search engines (93%) due to accessibility. Findings showed that less than ten percent of all respondents accessed scientific databases to meet their information needs, while no one accessed the library or its database network.

It is worth noting that the ITS library provides access to textbooks, scientific journals, and thesis repositories. In addition, the library also organizes

academic writing and citation technique training regularly. In addition, the departmental reading room also has a collection of textbooks and stores thesis manuscripts from DPWK students who have graduated. Therefore, there is a possibility that students prefer to access textbooks and thesis repositories from the reading room. However, the survey did not explore the use of reading rooms any further.

Additionally, the survey in the questionnaire also includes additional questions regarding the reasons for using these sources. For example, the main reason for using search engines as the primary information source is their ease of use and flexibility. In this case, this research justifies these reasons based on a theory about interactivity in online websites that depends on three things: form, action, and effect (Adami, 2015).

Per the data in this research survey, the interactivity in each information source page has similar characteristics. For example, in standard search engines such as Google, DuckDuckGo, and Bing, interactivity is indicated by a search bar with a magnifying glass icon. The user can type a keyword in the bar and click the magnifying glass icon. The effect is the emergence of a choice of information sources from the internet network according to the keywords entered. Likewise, the source of information in the form of scientific databases for searching academic journals such as EBSCOHost, ProQuest, Gale, and Google Scholar has the same form, action, and effect.

Two other sources of information, namely the ITS and PNRI libraries, also have online pages. Students also use these two sources of information as information sources. As online pages, these two sources are secondary sources that have many links to various other online information source pages. In general, the forms, actions, and effects in the ITS and PNRI libraries' online pages are the same as the two categories of online information sources previously described. However, the differentiating factor in using various online information pages depends on the student's skills in using the right keywords. This was a challenge for the respondents in this study. They only used general keywords according to research topics relevant to their task. Although there were no specific questions in the questionnaire regarding this matter, respondents did not use truncation techniques that could narrow search results with the right keywords.

This study also noted several factors that caused the lack of information sources used in the form of departmental reading rooms available at DPWK ITS. One of them was the change in campus use policies during the pandemic. ITS switched to remote learning and imposed restrictions on offline activities in March 2020 due to the Covid-19 pandemic. Therefore, students could not freely access the campus. When writing this article, ITS extended the remote learning and working policy through a circulation letter no. T/37113/IT2.III/TU.00.08/2021. Another factor was the change in the policy regarding the departmental reading room. Since mid-2020, departmental reading rooms across ITS have been abolished to centralize library and information services in the ITS library.

In addition to these situations, there is an assumption about accessibility factors that might affect the use of library services (Heriyanto, 2019). When writing this article, remote access to the ITS library services required a Virtual Private Network (VPN). The VPN provides access to library

services and repositories, but users must renew their access rights periodically.

Another key finding from this study was the identification of the various obstacles students faced while seeking online information. However, these obstacles revealed students' strategies and solutions to assess information relevance and quality.

As previously mentioned, search engines were the primary source of information for the respondents because they were easy to use (86%) (Table 3). The rest of the respondents recruited used search engines because they did not know other information sources. This result is consistent with the findings of previous studies, for example, from Hanum (2017) and Heriyanto (2020), and confirms findings from Burger, Gochfeld, Jeitner, Pittfield and Donio (2013) that people tend to use the easiest-to-use information source to find the information they need.

Table 3
Reasons for using search engines

Reason	Number of respondents
Easy to use	37
I do not know of any other sources	6

Sumber: Survey results, 2020

Although search engines were easy to use, respondents reported that search engines were not very effective. More than half of the respondents admitted that the information they sought was only sometimes easy to find. These results support findings from a previous study by Gurusinga (2019), where information mismatch is a significant obstacle in information-seeking. More than a third of respondents said they almost always got the information they sought. However, nearly 10% said they seldom found the information they were looking for (Figure 2).

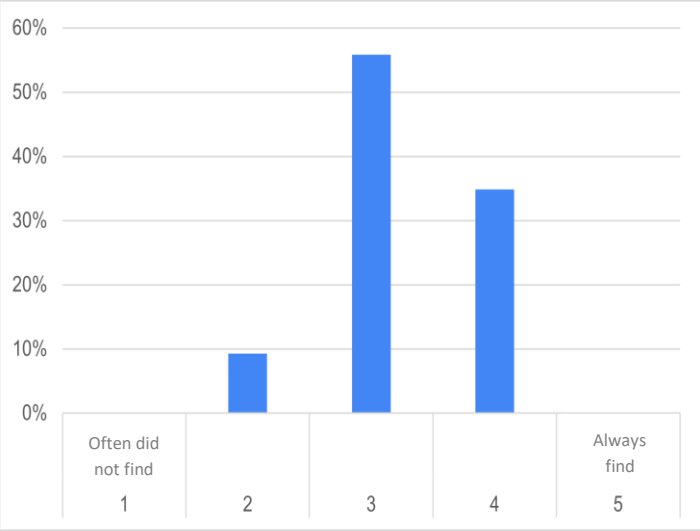

Figure 2. Information-seeking success rate
Source: Survey results, 2020

If respondents did not find the information they were looking for, most respondents (54.5%) stated they changed keywords to find the desired result. These results contradict Puspitasari (2020) findings, where information seekers will repeat their search using a different source of information. This finding also contradicts Gurusinga (2019) who states that students rarely formulate keywords before engaging in information-seeking.

Heriyanto (2020) reveals that keywords indicate a person's information literacy. A suitable information seeker may use the truncation technique, which is a technique to expand the search range by including certain specific elements such as the use of suffixes, accurate spelling, and various other punctuation marks. In this case, most of the respondents had information literacy and a reasonably good understanding of the search for information sources to carry out regional and urban planning-related assignments according to the location of this research. This sound knowledge was not surprising, considering that most respondents were sophomores.

Another exciting result of this study was that more than a quarter (27.3%) of informants turned to other sources and restarted the information search process if they could not find the information they needed. According to Heriyanto (2020), this behavior is due to the deterrent effect caused by not finding the required information. However, these results indicated that the respondents recruited had good information literacy. They knew other sources of information that they could use.

Students needed help finding the information they needed. The first obstacle was relevance. The information found was often irrelevant to their needs. The next obstacle was the completeness of the information. The information found was often fragmented. Other than that, accessibility often hindered information-seeking efforts. Access constraints were usually caused by paywalls or the requirement to register to access the required information. Sometimes, the information was only available to specific groups of people. For example, several students needed help finding Indonesian regional and urban planning knowledge references.

In addition, some of the references found in various online sources of information were usually provided in English. This means that respondents must have good English skills to use the information. The final obstacle was reliability. Sometimes, respondents found information from sources with a questionable reputation, such as non-academic pages or non-scientific journals but were individual or personal blogs.

The survey also found several examples of constraints, specifically from various descriptions from the respondents. For example, one respondent described a search constraint from online information sources as follows:

> "When searching for information, I still experience discrepancies between the information I want and the information available. In other words, there are still limited references, especially reading references in Indonesian (related to regional and urban planning). Therefore, getting the right information is still challenging, meaning it still takes effort to get the right information. So I spent more time just looking for the information I needed" (A. Syailendra, Interviewed, November 12, 2020).

The respondent's statement implied several other aspects that were not related to

technical aspects of information retrieval from online information sources but significantly influenced information search activities. These aspects were students' language skills and the time needed to search for information. In the context of DPWK ITS students, where lectures and assignments were delivered in Indonesian, journal articles in urban and regional planning science in Indonesian would undoubtedly be more relevant. If the article was available in English or other languages, students needed to make more effort to translate the paper. Furthermore, it also implied that the various obstacles in the search for information made the entire process of searching for information very time-consuming. This, of course, did not include the time of writing the task report itself.

This study investigated the student's solution behavior in addressing the above constraints. First, students decided if the information was relevant or could answer their questions. Second, students determined the information quality from its source. Official sources such as government agency websites or journals published by reputable publishers are considered quality information providers. For example, one respondent gave the following statement:

> "The information I get is considered quality if the information I get, for example, is from an accredited journal. Relevant information is when the information has the keywords I am looking for, and the discussion aligns with what I mean" (N. S. Arifin, Interviewed, November 24, 2020).

From this statement, respondents knew how to recognize accredited journals to determine their reliability. Another strategy to determine the quality and validity of the information obtained is data availability or a list of citations or references. Some students relied on external input to determine the quality and validity of the information they found. External parties asked for their opinions were friends, lecturers, or testimonials from other page visitors. Another strategy to determine the quality and validity of information is to compare the information found with other sources that provide similar information. The most interesting approach is to look at the search results consistency. One respondent who was in the first semester wrote:

> "The way I decide whether the information obtained is relevant or of quality is when you enter keywords, and many articles appear or whatever the definition or content is the same and almost the same" (I. U. Aldin, Interviewed, November 24, 2020).

This statement reflected a practical approach regarding the article's suitability with selected keywords that might be adapted to find sources of information for working on lecture assignments. Strategies to determine the relevance of information found by students in the DPWK environment were very diverse.

The approach taken by DPWK students is very different from that taken by Library and Information Science students; namely, students determine the relevance of information search results by reading abstracts after seeing the title of the publication (Nurfadillah & Ardiansah, 2021). Most of the analysis results regarding the obstacles experienced by students in finding sources of information are in line with the advice given by Øvern (2018). He suggests that to use search engines properly, users or, in this case, students must be given special training in understanding the factors that support the success of selecting

information sources from the internet or other digital forms of information sources.

CONCLUSION

Overall, the study results support the previous studies in the area, albeit with some minor differences. Information retrieval activities conducted by engineering students in tertiary education using online database sources are effective due to their ease of use and less complication in the process. Students also feel that these sources are convenient and reliable. They use the standard search engine on the internet as the source of information owing to the reach and accessibility, even though there is a risk of use whereby students do not use appropriate keywords. Engineering students tend to repeat a search query using different keywords if they fail to find what they were looking for in the first place. This tendency indicates a keyword formulation process prior to engaging in information-seeking activities. In addition, the study results also indicate that a search engine linked to an online library system is usually utilized for its higher accuracy of the resulting quality. The authors suggest further research that investigates the information discovery behavior of students from other disciplines to obtain a holistic picture of engineering students' information discovery behavior.

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