A Sense-Making Approach for Engineering Undergraduates to Retrieve Environmental Management Information on Bolgoda Ecosystem

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ABSTRACT

The use of methodologies, practices, and activities are encouraged in engineering education to solve real-world problems for which knowledge generation and information transfer is vital. For this purpose, it is essential to have access to authoritative information as much as possible. Dervin's sense-making framework involves a process of seeking, encountering and using the information to address an information need with respect to ambiguous and complex real-world situations. Retrieving information on Bolgoda Ecosystem for the purpose of environmental management was an activity with engineering undergraduate library orientation during the pre-academic term. Accordingly, the students have engaged in a guided literature search to retrieve information from nine resources on a topic of interest from six categories of the Bolgoda Ecosystem. This individual exercise comprising 13 hands-on sessions was designed in line with the sense-making framework and created in MS Form. The results were manually analyzed and evaluated for information retrieval productivity with respect to relevance and document type. The results from 1169 search records revealed that 98.3% have selected a topic relevant to a complex situation and they were able to retrieve 89.5% of appropriate document categories that included 89.9% for books/reports, 90.3% for articles and 87.1% for conference papers. It was also observed that Google Books, ScienceDirect database and the Institutional Repository of Moratuwa University have been mostly accessed for document retrieval. The productive use of sense-making theory for information retrieval during a library orientation is evident from this study. Also, it can be recommended as a tool to educate library users on effective information systems and designing new information systems.
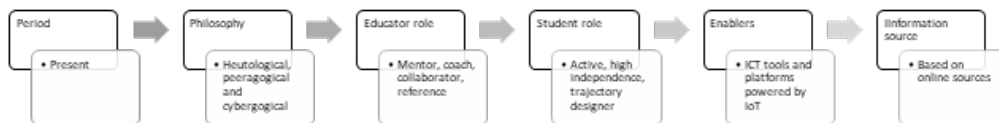
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This enabled the fresh engineering undergraduates to engage in evidence-based decision-making and rational thinking to develop environmental awareness on a sensitive ecosystem.

Keywords : Literature Search, Sense-Making Theory, Library Orientation, Ecosystem

Introduction

Education 4.0 - comprises the fourth industrial revolution, technologies, innovative pedagogical procedures and best practices - allows higher education institutes to combine new learning methods, management tools, and smart sustainable infrastructure to develop knowledge generation and transfer using novel information and communication technologies. Education 4.0 invites engineering undergraduates to develop technical, technological and analytical skills where knowledge can be applied to solve real-world problems (Miranda et al., 2021). Figure 1 depicts some components of Education 4.0. and the requirement of information from online sources where information technology tools and platforms are powered by the Internet of Things. Hence, skills in information retrieval will be mandatory.

Figure 1: Some Components of Education 4.0 [source: Miranda et al. 2021]

Sense-making theories of information retrieval illustrate how individuals interact with information and make decisions regarding information retrieval. Dervin's sense-making framework involves a process of seeking, encountering and using information to address information needs with respect to ambiguous and complex situations (Dervin, 1998). It consists of five stages namely: pre-encounter; encounter; construing; comprehending and using. Later, this has been developed into a multi-faceted sense-making theory with nine components (Turner et al., 2023).

The protection and sustainability of sensitive environments such as Bolgoda require widespread awareness and knowledge, especially about the issues and remedial measures. Even though the information retrieval is crucial for

environmental management, it could be challenging due to the dynamic nature of information sources (Baylissa & Beyer, 2015). Among the handful of studies conducted to assess environmental awareness in particularly by Sri Lankan undergraduates (Sachitra & Kaluarachchi, 2018), only a limited attempts have been made to evaluate and reveal the effective use of library resources and facilities for the environmental awareness across the domains of undergraduate education (Seneviratne & Jayawardena 2022). Hence, a novel approach of sense-making approach for engineering undergraduates to retrieve environmental management information is a requirement to facilitate the future decision-makers while complimenting the sustainable development goals.

Objective

The main objective is to evaluate the performance of engineering undergraduates to retrieve information in terms of relevance and type of document, complying to the Dervin's sense-making framework.

Methodology

Environmental management information requirement on the largest freshwater body in Sri Lanka [Bolgoda ecosystem] was considered as a complex situation. The six specific topics of interest in which the information is required were: 1) Biodiversity of Bolgoda is in risk: Impact of water pollution; 2) Economic benefits of developing water sports in Bolgoda lake; 3) Environmental impact of waste dumping near Bolgoda lake; 4) Management of flood risk with special reference to Bolgoda wetland; 5) Ferry service for Bolgoda lake: cost-benefit analysis, and 6) Illegal encroachment and landfilling in Bolgoda environment protection area. The activity was facilitated with a lecture on "First steps in research" highlighting the importance of literature review in research followed by an introductory situational awareness of the Bolgoda ecosystem. There were 13 in-person hands-on sessions during March-April 2023 for the exercise, which was embedded to the library orientation, where 496 engineering undergraduates in pre-academic term participated.

The undergraduates had to perform a guided literature search created in Microsoft Form to retrieve information from nine information resources (Online catalogues of University of Moratuwa Library; National Library and Documentation Services Board; Google Books; ScienceDirect; Google Scholar; Directory of Open Access Journals; and the Institutional

Repositories of University of Moratuwa; University of Kelaniya; and University of Sri Jayewardenepura) for the selected topic of interest out of the given six specific areas. The three document categories were considered as Books/Reports, Articles, and Conference papers. The recorded results from the literature search were manually evaluated for terms of relevance and type of document.

Results and Discussion

The majority of the participants (38.1%) selected the research topic 'Biodiversity of Bolgoda is in risk: Impact of water pollution". The least preference (1.01%) was for the topic "Illegal encroachment and landfilling in Bolgoda environment protection area". The topic selection count of the 469 participants and the corresponding percentages are indicated in Table 1.

Table 1: Specific topics of interest in the complex situation – retrieving environmental management information related to Bolgoda ecosystem

Topic	No. Selected	%
1. Biodiversity of Bolgoda is in risk: Impact of water pollution	189	38.10
2. Economic benefits of developing water sports in Bolgoda lake	131	26.41
3. Environmental impact of waste dumping near Bolgoda lake	116	23.39
4. Management of flood risk with special reference to Bolgoda wetland	39	7.86
5. Ferry service for Bolgoda lake: cost-benefit analysis	16	3.23
6. Investigation of illegal encroachment and landfilling in Bolgoda environment protection area.	5	1.01
Total	**496**	**100.00**

From the total (1169) of search results recorded by the undergraduates, 98.3% selections were relevant to the complex situation, which means the search activity has been successful to obtain the required and most relevant information for the purpose of interest. In the context of type of the document, more than 99% records retrieved belonged to the Books/Reports category. The second highest selection, which was 93.6%, was for the conference

papers. The document type "articles" was the least selected, possibly due to the ambiguities on relevance and variety of its presentation methods. Nevertheless, the undergraduates were able to retrieve 89.5% of correct document category with an individual record percentage of 89.9 for Books/Reports, 90.3 for articles and 87.1 for conference papers. This result reflects that majority of the undergraduates have demonstrated a clear understanding of the document type and how to accurately identify their category out of the given options. This is a positive observation in the context of a literature search where accurate and valid information to be used for knowledge creation.

It was observed that the Google Books (71.5%) have been the mostly preferred online resource to find Books/Reports from the given resources, amidst the availability of online public access catalogues of University of Moratuwa (26.4%) and National Library and Documentation Services Board (2.1%). In the search for research articles, ScienceDirect (52%) and Google Scholar (45.3%) has been the choice over Directory of Open Access Journals (2.7%). The institutional Repository of the University of Moratuwa was accessed to retrieve 73.4% of Conference Papers when compared to the access of institutional repositories of the University of Sri Jayewardenepura and the University of Kelaniya which has recorded as 15.7% and 10.9% respectively. The Table 2 presents this information with the relevant percentages corresponding to the retrieved records.

Table 2: Search preferences with respect to the information resources

Document Category	Information Resource		
Book/Report	Google Books (308) (71.5%)	OPAC, UoM (114) (26.4%)	OPAC, NatLib (9) (2.1%)
Journal Article	ScienceDirect (194) (52%)	Google Scholar (169) (45.3%)	DOAJ (10) (2.7%)
Conference Paper	UoM DL (243) (73.4%)	USJP DL (52) (15.7%)	UoK DL (36) (10.9%)

Conclusion

Considering the results of the study it can be concluded that students have performed well in the given exercise of information retrieval regarding the Bolgoda Ecosystem. Hence, they have demonstrated sufficient skills to conduct a literature search using online resources within a guided environment and possess the capability of differentiating the document types. Since the deployed approach during the library orientation was user-centered, contextual and iterative facilitated by the Dervin's sense-making framework the developed skilled by the undergraduates through this exercise could be efficiently utilized to integrate and apply to retrieve information for real world instances that they would be facing in future. Furthermore, "Sense-making theory" could be effectively used by the libraries to educate their users on the availability of information systems and extracting the required information from them. Additionally, based on the student feedback the engineering uundergraduates of the University of Moratuwa had an opportunity to develop awareness on a sensitive environment in the neighborhood and its knowledge domain with respect to the published literature.

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