JOURNAL OF THE UNIVERSITY LIBRARIANS ASSOCIATION OF SRI LANKA

Volume 29 Issue 1 **January 2026**

ISSN: 1391-4081

e-ISSN: 2579-2253

A publication of the
University Librarians Association (ULA) of Sri Lanka
(Web: www.ulasl.lk)

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Subscription Rate: SLR 500 or USD 50. The price includes the cost per copy and postage fees.

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Journal of the University Librarians Association of Sri Lanka, Vol. 29, Issue 1, January 2026, 1–24, DOI: https://doi.org/10.4038/jula.v29i1.8114

Patterns of Information Seeking and User Needs of Agricultural Scientists: A Case Study Based on Major Research Institutes in Sri Lanka's Plantation Sector

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ABSTRACT

Agricultural information plays a vital role in supporting agricultural education, research, development, and extension activities. This study aimed to explore the patterns of information seeking and the specific needs of agricultural scientists. A self-administered questionnaire was distributed among scientists at three main agricultural research institutes within Sri Lanka's plantation sector. The findings revealed that journal articles were the most frequently utilized information resource, with 100% of respondents indicating their use. Other sources such as interactions with professional colleagues (30%) and conference abstracts or proceedings (27.5%) held moderate significance. The primary motivations for seeking information were professional interest (85.71%) and agricultural promotional activities (72.73%). A significant majority (91.89%) of scientists preferred electronic information resources over printed materials (8.11%).

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Received: 02 May 2025, Accepted revised version: 30 December 2025.

Regarding library usage habits, most participants (85.71%) visited the library once or twice a month, while fewer visited more frequently, 2.38% more than twice a week and 4.76% once or twice a week. However, several challenges were identified in accessing scientific information, including the unavailability of subscribed online databases (51.35%), lack of current awareness sessions (40.54%), and infrequent updates of library materials (40.54%). Based on these findings, it is recommended that research institutes enhance their digital library systems by securing subscriptions to international agricultural research databases and improving internet connectivity. Additionally, regular workshops should be organized to boost digital literacy among scientists, focusing on search techniques and data management skills.

Keywords: *Agriculture-Scientist, Awareness, Online-Databases, Research-institutes, Sri Lanka*

Introduction

Agriculture continues to be an integral part of Sri Lanka's economy, contributing to national food security, employment generation, and rural development. Although its contribution to the Gross Domestic Product (GDP) has declined over time, the sector still provides livelihoods for nearly one-fourth of the country's population and remains an important source of foreign exchange through the export of tea, rubber, and coconut (Food and Agriculture Organization, 2022; Central Bank of Sri Lanka, 2023). Sri Lankan agriculture comprises two main sectors such as plantation and non-plantation sectors. Plantation agriculture which is mainly based on tea, rubber, and coconut cultivation is regarded as the backbone of the Sri Lankan economy as it generates 12.88% of export earnings and occupies nearly 10 per cent of employed persons of the country (Henegedara et al., 2024).

Mainly the agricultural research institutes and universities are the prime source of creation of agricultural knowledge and information in the country. The creation of information and knowledge management by these institutes begins with the identification of information and knowledge needs or gaps, and the capturing, storage, and sharing/dissemination of the knowledge to the users (UNDP, 2012).

Research and innovation are widely acknowledged as pivotal forces in the transformation of food and agriculture systems toward greater sustainability and productivity (Von Braun et al., 2023). Many institutions are involved in agricultural research, extension, and training activities in Sri Lanka. Apart from the universities, there are three main research institutes Tea research institute, Rubber research institute, and Coconut research institute. These institutions deal with research on these plantation crops in Sri Lanka (Weerarathne & Weerasinghe, 2009).

These institutes are mandatory to carry out relevant research on their production, processing, and marketing aspects. Agricultural research officers in these research institutions in Sri Lanka play a pivotal role in enhancing agricultural productivity and sustainability.

Different types of information are required by different kinds of users for different purposes. Scientists are likely to perform different work roles such as researcher, manager, administrator, educator, planner, supervisor, etc., simultaneously or at different stages of their careers.

In this context, understanding the information needs and seeking patterns of agriculture scientists working in Agriculture research institutes is crucial to ensure that they have access to the knowledge and resources required to drive progress in the field.

Agricultural scientists' main purpose in seeking information was to learn the latest developments in their fields and to support their current research work. Therefore, knowledge about the information seeking behavior and information use of individuals is crucial for effectively meeting their information needs. Agriculture scientists are professionals who are different in the sense that they are always conscious, and they are users of information as communicators to the agrarian society. Their information needs are vast and diversified as the work progresses and the time passes. For the satisfaction of their needs, they interact with many types of information systems and personal sources. This process is called information-seeking behavior (Majid et al., 1999).

Information needs and seeking activities are different from one profession to another. Thus, adequate knowledge of the information needs and seeking behavior of agricultural researchers was imperative for research institutes to support their research activity. Such an understanding would help agricultural research institutes to develop information systems and services that are more likely to satisfy users' information needs. Researchers and extension workers operate as facilitators and communicators helping farmers in their decision-making processes, ensuring that appropriate knowledge is applied in order to obtain the best results in terms of sustainable production and general rural development. The private sector (support and input services, traders) also helps harnessing knowledge and information from various sources for better farming and improved livelihoods (FAO, 2005).

In this regard, agriculture scientists from the three main research institutes in the plantation sector were selected to examine their information needs and seeking patterns for this study. This will help identify their needs and barriers when fulfilling their scientific information when they engage with research

work in these institutions. Finally, it would be productive, contributing to the development of the agriculture sector in Sri Lanka.

Problem Statement

In Sri Lanka, the Agriculture sector comprises two main sectors including plantation and non-plantation sector. The plantation sector is a significant contributor to the economy, requiring ongoing research and development to maintain productivity and sustainability. Agricultural research institutes are responsible for generating new knowledge and technologies to improve the productivity and sustainability of the agriculture sector. The role played by Agricultural scientists in these research institutes are pivotal in advancing sustainable practices and devising innovative solutions to overcome challenges in Sri Lanka's plantation sector. However, the information needs and seeking behaviors of agriculture scientists in this sector remain poorly understood. Further, Sidibé et al. (2021) revealed that limited access to agricultural information remains one of the serious barriers to sustainable agricultural development in developing countries. Despite the increasing availability of printed and digital information resources, gaps persist in accessing, utilizing, and sharing relevant information. These gaps can hinder effective decision-making, innovation, and dissemination of research findings critical to the sector's development. Furthermore, the lack of library services, awareness of relevant information sources and accessing methods of the scientist may affect the efficiency of information dissemination to the end users.

Therefore, this research seeks to explore the specific information needs and seeking patterns of agriculture scientists in major research institutes in Sri Lanka’s plantation sector. Identifying these patterns will provide insights

into improving information systems and services, thereby enhancing the productivity and impact of research in this vital sector.

Objectives of the Study

- To assess the level of awareness on available information resources among agriculture scientists
- To assess the level of usage of information resources by the agriculture scientists
- To examine the methods and sources used by the agriculture scientists to acquire required information
- To explore the practical issues encountered by agriculture scientists when seeking information
- To recommend possible ways of improving the information seeking patterns among agriculture scientists

Literature Review

Information Needs of Agricultural Scientists

Agricultural scientists require diverse information to fulfill their multiple professional roles including research, education, management, and extension activities. Leckie, Pettigrew, and Sylvain (1996) argued that work roles prompt particular information needs, which then drive information-seeking processes. These information needs are not static but evolve as work progresses and professional requirements change (Majid et al., 1999). Zaman (2002) noted that agricultural information is an essential input to agricultural education, research and development, and extension activities. According to Gudeta et al. (2021), agricultural researchers primarily seek information on specialized topics such as climate change strategies, soil fertility, farming system characterization, horticulture, plant breeding, and

soil and water management. The Food and Agriculture Organization [FAO] (2005) mentioned that researchers operate as facilitators and communicators, requiring information that helps them support farmers in decision-making and sustainable production practices. In a section of a FAO manual focused on extension management, FAO underscores the need to enhance the linkages among research, extension, and farmers highlighting the informational and facilitative roles these actors play in support of agricultural outcomes.

Devadason and Lingam (1997) argued that understanding the information needs of various professional groups is essential for planning and implementing effective information systems in specific work settings. This understanding becomes particularly crucial in developing countries where resources are limited and must be optimally allocated.

Information Sources and Preferences

Gudeta et al. (2021) found that agricultural researchers in Ethiopia preferred electronic sources over print materials. Similarly, Donkor Acheampong and Dzandu (2015) highlighted that crop research scientists in Ghana favored electronic journal articles over print versions. However, preferences vary by region and available infrastructure. Singh and Satiga (2007) revealed that agricultural scientists in their study expressed significant dependence on their institutional library or information center. Similarly, Mostafizur Rahman and Binwal (2000) found that scientists and technologists do not depend solely on institutional libraries but use other libraries as well, suggesting that a single information center should serve as an access point to worldwide resources. According to Tinashe Mugwisi, Ocholla, and Mostert (2014) researchers rely on various information sources including libraries, the Internet, colleagues, workshops, and personal collections. The

interpersonal exchange of information appears particularly important, as Abune Gudeta (2021) noted that consulting with experts in the subject field and discussions with development agents and farmers were major ways agricultural researchers sought information. Zahed Bigdeli (2001) has found that engineers' information-seeking behavior was primarily motivated by the desire to develop knowledge and expertise, to use new job-related technologies, and to stay current in their specialty motivations likely shared by agricultural scientists.

Barriers to Information Access and Utilization

Inadequate information resources and infrastructure represent significant barriers across multiple studies. Mudannayake (1989), in a study specific to the Sri Lankan context, identified that the major problem faced by agricultural scientists was the inadequacy of information sources in the country, including incomplete periodical sets, outdated collections, and lack of adequate bibliographic tools. Rasouli Azad (2001) reported that more than fifty percent of Iranian agricultural specialists did not have access to computers, special databases, and computer networks in the libraries they referred to. Similarly, Abune Gudeta (2021) identified major problems including slow Internet connectivity, erratic electricity disruptions, and the absence of information and communication technology professionals. It also highlighted the lack of training on information literacy and limited use of available information sources among researchers. Renee Dutta (2009) emphasized that an individual's educational background significantly influences their ability to seek and utilize information, suggesting that both economic and educational factors must be addressed to improve information access.

Zahed Bigdeli (2001) found that distance appears to impact information use and information-seeking behavior, arguing that librarians must consider Zipf's "principle of least effort" when serving clients suggesting that ease of access significantly influences information source selection. Economic conditions profoundly affect the availability and accessibility of resources, particularly in developing countries (Dutta, 2009). These contextual factors shape both institutional capabilities and individual information-seeking behaviors.

According to Sam et al. (2017), study on information needs of agricultural policy makers and managers in Ghana evaluated the adequacy of library collections available to them. The study found that lending, periodicals, and reference collections were only "fairly adequate" in terms of quality, quantity, and availability highlighting the resource constraints common in developing countries.

Research Gap

Despite extensive research on information needs and seeking behaviors, several gaps remain, particularly in the Sri Lankan context. While Mudannayake's (1989) study provided valuable insights, significant technological and institutional changes have occurred in the decades since. The unique characteristics of Sri Lanka's plantation sector research institutes warrant contemporary investigation to understand current information needs, barriers, and opportunities. Additionally, most studies focus on general agricultural researchers rather than specifically examining scientists working in plantation crops like tea, rubber, and coconut who have distinct research requirements and information ecosystems. This gap justifies the current study's focus on major research institutes in Sri Lanka's plantation sector.

Methodology

Study Design

The research adopted a mixed-method research design, incorporating both quantitative and qualitative data collection methods. This data triangulation techniques were used with the aim of improving the overall quality and validity of the research findings. Accordingly, the study consisted of two major components as mentioned below.

Component I – Quantitative study

Component II – Qualitative study

Study Population

Tea Research Institute, Rubber Research Institute, and the Coconut Research Institute are the main state sector research institutes in Sri Lanka, which are responsible for carrying out research related to tea, rubber and coconut. Directors in research divisions, senior research officers and the research officers employed in these three research institutes were considered as Agriculture scientists and selected as the study population.

Study Sample and the Sampling technique

According to the data published in the official websites of these research institutes, approximately 50 individuals are employed as senior research officers and the research officers. Therefore these 50 individuals were purposively selected as the study sample for the quantitative component of the study. Three directors in research divisions of selected three research institutes will be purposively selected for the qualitative component of the study.

Data Collection Methods and Tools

A self-administered semi structured questionnaire was developed to use as the data collection tool to gather quantitative information. Developed questionnaire was administered to the study sample after pretesting. Data collection process was facilitated through a combination of questionnaire and interview methods.

A key informant interview guide was prepared and pre-tested to use as the data collection tool to gather qualitative information.

Results

Socio Demographic Characteristics of the Study Sample

Basic Socio Demographic Characteristics of the Study Sample

The data presented in the Table 01 shows the basic socio demographic characteristics of the study sample. Majority of study sample represent the females with 67.5%. Most of the study participants are in the age between 31–40 years (40%) and a least proportion is below 30 years (12.5%). In terms of their educational background, 75% of participants hold either a Master's degree (30%) or a PhD (45%).

Table 01
Basic Socio Demographic Characteristics of the Study Sample

Basic Socio Demographic Characteristics	Percentage (%)
Gender	
Male	32.5%
Female	67.5%
Age Range	
Below 30 years	12.5%
31–40 years	40%
41–50 years	17.5%
51–60 years	30%
Educational Background	
Bachelor's Degree	25%
Master's Degree	30%
PhD	45%

Institutional affiliation of the participants

Table 02 shows that the majority of study participants are employed in the Coconut Research Institute (42.5%). Other 35% and 22.5% are employed in the Rubber Research Institute and Tea Research Institute respectively.

Table 02
Working Institute of the Participants

Institutional affiliation	Percentage (%)
Tea Research Institute	22.5%
Rubber Research Institute	35%
Coconut Research Institute	42.5%

Current job position of the study participants

Data indicated that majority of the study sample are employed as research officers in the selected three research institutes (70%) following 20% are employed as senior research officers and 10% as heads of their institutions.

Table 03
Current job position of the study participants

Current Job Position	Percentage (%)
Research Officer	70%
Senior Research Officer	20%
Head	10%

Years of Experience of Participants in Agriculture Research

Table 04 indicates the distribution of years of experience of study participants in Agriculture research field. A significant proportion of participants are early career researchers who have up to 5 years of experience in research (22.5%). Another 25% of participants are mid-career researchers with 6 to 10 years of experience. A majority of study participants has more than 15 years of experience in research (52.5%).

Table 04
Years of Experience of Participants in Agriculture Research

Years of Experience in Agriculture Research	Percentage (%)
0 – 5 years	22.5%
6 - 10 years	25%
11-15 years	0 %
16 – 20 years	15%
Over 20 years	37.5%

Information Seeking Patterns of the Agriculture Sector Researchers

T*ypes of Information Resources use for Research Work*

Table 05 depicts the distribution of usage of various types of information resources among study participants for their research work. Most referred information resources by the participants include, journal articles (100%), Theses/Dissertations (95%), and conference abstracts and proceedings (90%). Further, researchers are interested in exploring books (77.5%),

interacting with professional colleagues (75%), engaging with professional meetings/talks/workshops (75%), referring research reports/patents/fact books (75%), and exploring online research databases (70%) when they are engaging with research work. Usage of Newsletters (65%), Bibliographies (60%), and Sources of current contents (50%) are comparatively low among study participants when comparing with other information sources.

Table 05
Types of Information Resources used for research work

Information Resources used for research work	Percentage (%)
Journal articles	100%
Interaction with professional colleagues	75%
Conference abstracts and proceedings	90%
Professional meetings/talks/workshops	75%
Sources of current contents	50%
Research reports/patents/fact books	75%
Books	77.5%
Newsletters	65%
Bibliographies	60%
Theses/Dissertations	95%
Online Research Databases	70%

Relative importance of different information sources

Table 06 depicts the data on how study participants rate the relative importance of common information resources for their research work. Majority of study participants have claimed that journal articles are the most important source of information (85%) followed by the online research databases (37.5%) which serves as another key source of information. Although journal articles and online research databases were claimed as mostly important types of information resources, a gap of 47.5% can be identified in-between them, emphasizing the high relative importance of journal articles. Some sources, such as interaction with professional colleagues (30%) and conference abstracts/proceedings (27.5%), hold

moderate significance. Apart from that the claimed relative importance of all other information sources remains comparatively low.

Table 06
Relative importance of different information sources

Information Resources use for research work	Percentage (%)
1st - Journal articles	85%
2nd - Online research databases	37.5%
3rd - Interaction with professional colleagues	30%
4th - Conference abstracts and proceedings	27.5%
5th - Research reports/patents/fact books	22.5%
6th - Newsletters	22.5%
7th - Bibliographies	22.5%
8th - Professional meetings/talks/workshops	17.5%
9th - Books	15.0%
10th - Sources of current contents	15.0%
11th - Theses/dissertations	12.5%

Most preferred source of information

As per the data presented in Table 07, a majority of 91.89% of study participants prefer electronic information resources while only 8.11% preferably use printed information resources.

Table 07
Most preferred source of information

Preferred Source	Percentage (%)
Electronic	91.89%
Printed	8.11%

Primary purpose of the information seeking

Table 08 indicates the main purposes of the information seeking among agricultural scientists. A majority of agricultural scientists have claimed that they seek information mainly because of the professional interest (85.71%)

and for their agricultural promotional activities (72.73%). Apart from that, other reasons for seeking information include, to acquire general awareness on new knowledge (36.36%), to disseminate knowledge with relevant outreach communities (36.36%), and to write books and articles (24.24%).

Table 08
Primary purpose of the information seeking

Primary purpose	Percentage (%)
Professional interest	85.71%
General awareness on new knowledge	36.36%
Writing books/Articles	24.24%
To disseminate knowledge with relevant outreach communities	36.36%
Promotional activities	72.73%

Time spent weekly on seeking information for research

As depicted in the Table 09, majority of participants (65%) spend more than 6 hours per week on seeking information for their research and scholarly work. 22.5% of participants spend 4-6 hours, while 12.5% dedicate 1-3 hours weekly. Notably, all participants spend a minimum of one hour per week on seeking information.

Table 09
Time spent weekly on seeking information for research

Time Spent Weekly on Seeking Information for Research	Percentage (%)
Less than 1 hour	0 %
1-3 hours	12.5%
4-6 hours	22.5%
More than 6 hours	65%

Frequency of visiting the institutional library

Table 10 depicts the distribution of data on frequency of visiting the institutional library by study participants. As per the data, majority of study participants visit library once or twice a month (85.71%). A significantly low proportion of participants claimed regular visits to the library with frequencies such as more than twice a week (2.38%) and once or twice a week (4.76%). Notably another 7.14% have stated that they never visit their institutional library.

Table 10
Frequency of visiting the institutional library

Frequency	Percentage (%)
Once or twice a week	4.76%
More than twice a week	2.38%
Once or twice a month	85.71%
Never	7.14%

Perception about the institutional library

As per the data shows in the Table 11, majority of study participants (61.90%) perceive the library as effective, while another 11.90% consider it as very effective. However, 23.81% believe that the library is somewhat effective. A minimum percentage of participants (2.38%) view the library as ineffective. Overall, 73.80% of study participants perceived that their institutional library is effective or very effective, reflecting a positive perception towards the library.

Table 11
Perception about the institutional library

Perception	Percentage (%)
Library is very effective	11.90%
Library is effective	61.90%
Library is somewhat effective	23.81%
Library is ineffective	2.38%

Challenges faced during information seeking

Table 12 presents the data regarding the challenges faced by study participants when they seek scientific information from various sources. The most significant challenges include unavailability of subscribed online databases by the library (51.35%), Lack of current awareness sessions from the library (40.54%), and limited arrivals of new library materials (40.54%). Time constraints (39.47%), lack of training on information literacy (37.84%), and unavailability of a centralized information system (36.84%), lack of experience sharing among researchers (32.43%) and limited Internet availability (32.43%) also major concerns. Other notable challenges include lack of awareness of available information (21.62%), lack of skills in using ICT (18.92%), lack of technical support in searching library information (18.92%), and lack of essential textbooks in the library (16.22%), all pointing to gaps in user knowledge, technological proficiency, and resource availability. Lack of computer access (10.81%), lack of Internet searching skills (8.11%), and language barriers (5.26%) are less frequently cited issues but still affect some users.

Table 12
Challenges face during information seeking

Challenges Face When Seeking Information	Percentage (%)
Lack of Internet Searching Skills	8.11%
Lack of Essential Textbooks in the Library	16.22%
Lack of Awareness of Available Information	21.62%
Lack of Arrival of New Library Materials	40.54%
Lack of Current Awareness Sessions from the Library	40.54%
Unavailability of Subscribed Online Databases by the Library	51.35%
Lack of Experience Sharing Among Researchers	32.43%
Lack of Training on Information Literacy	37.84%
Low Internet Availability	32.43%
Lack of Computer Access	10.81%
Lack of Skill in Using ICT	18.92%
Lack of Technical Support in Searching Information from Library	18.92%
Unavailability of a Centralized Information System	36.84%
Time Constraints	39.47%
Language Barriers	5.26%

Suggestions to improve information seeking behavior of the agriculture scientists were obtained through the study participants qualitatively. Qualitative data were gathered using open ended questions in the self-administered questionnaire. All the collected qualitative data were pooled together, transcribed and analyzed using thematic analysis based on a manual coding system. As per the data analysis, the majority has raised main two solutions to improve information seeking behavior among agriculture scientists. First one is, conducting periodic awareness sessions on information resources including the digital information resources. Secondly,

providing institutional access to updated e-resources including e-research databases and establishing digital libraries in their institutions.

Additionally, participants have raised the need for improving the facilities of their libraries. These facilities include, establishing an uninterrupted Internet connection at the library and increasing the resource collections in the library. Furthermore, participants have highlighted the importance of improving budget allocations for the libraries in order to improve the libraries as a centralized unit for acquiring updated research related information.

In addition, participants have stated that providing enough training on online database searching techniques is also imperative to improve information seeking behavior of the Agriculture scientists.

Conclusion

Findings of the study depicts the patterns of information seeking and user needs among agricultural scientists in major research institutes within Sri Lanka's plantation sector. It reveals that agricultural scientists heavily rely on both formal and informal sources of information, including digital databases, research publications, and peer discussions being the most frequently used resources. However, challenges such as limited access to updated databases, inadequate digital literacy, and constraints in institutional support hinder the efficient acquisition of relevant information. Additionally, the study highlights a gap between available information services and the specific needs of scientists, emphasizing the necessity for tailored information dissemination strategies. The research also underscores the importance of user-friendly information retrieval systems that cater to the dynamic needs of

agricultural scientists. While technological advancements have improved access to scientific knowledge, persistent barriers indicate the need for structured interventions to enhance information accessibility and utilization. Overall, the study contributes to the broader discourse on agricultural information management, offering insights into how research institutes can optimize information services to support scientific productivity and innovation in the plantation sector.

Recommendations

Research institutes should enhance digital library systems by securing subscriptions to international agricultural research databases and improving Internet connectivity. Regular workshops should be conducted to improve digital literacy among agricultural scientists, focusing on search techniques and data management. Tailored information services, such as personalized alerts and AI-driven recommendations, should be established to meet researchers' needs. Encouraging interdisciplinary collaboration and international partnerships can enhance knowledge exchange. Institutions should prioritize access to information through dedicated funding, institutional repositories, and information specialists while maintaining a balance between digital and physical resources. Regular feedback mechanisms should be implemented to address scientists' information-related challenges. These measures will strengthen information dissemination and utilization, ultimately advancing agricultural research in Sri Lanka’s plantation sector.

Acknowledgement

The authors would like to acknowledge the financial support provided by Rajarata University of Sri Lanka under the Research Grant No. (RJT/R&PC/2024/R/LIB/02)

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A Study on Information Literacy Skills among Higher Secondary Students in International Schools of Tamil Nadu

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ABSTRACT

In the digital age, Information Literacy (IL) has emerged as a critical competency for students, enabling them to effectively access, evaluate, and utilize information from print and electronic sources. The study examined the level of information literacy skills among higher secondary students in international schools of Tamil Nadu, focusing on their socio-demographic profiles, library visit patterns, and information-related competencies. The research adopted a descriptive survey, targeting Class XI and XII students from 14 international schools. A total of 700 students were selected using a two-stage sampling method initially through convenience sampling for school selection, followed by random sampling of students. The data was gathered through a questionnaire, with a response rate of 87.28%.

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Received: 02 May 2025, Accepted revised version: 30 December 2025.

The data was analyzed using descriptive statistics, t-tests, and Chi-square tests to determine gender, class, and stream-based variations in IL competencies and library usage. The findings revealed a balanced representation of gender, academic class, and study streams among respondents. Most students, irrespective of gender, class, or stream, preferred visiting the library during library periods, with no significant association observed between visit frequency and socio-demographic factors. Female students were significantly more inclined to borrow books and use the library for reference, while male students showed higher tendencies to read magazines and use the Internet. Class-wise analysis indicated significant differences in visit purposes, with Class XII students borrowing more books and Class XI students using the Internet more frequently. Stream-wise, Science students demonstrated higher awareness and usage of library resources compared to Commerce and Humanities students. Overall, over 80% of respondents accurately understood the concepts of information and literacy, and more than 60% displayed high proficiency in essential information literacy sub-skills. However, no significant differences were found in information needs assessment competency based on gender or class. The study concludes that international school students in Tamil Nadu possess a commendable level of IL skills. However, there is a need for strategic improvements. Recommendations include formal integration of IL into the curriculum, enhancing library infrastructure, promoting voluntary library usage beyond library hours, and introducing targeted IL training tailored to academic streams. The study highlights information literacy as a vital academic skill and a foundation for lifelong learning in a complex information environment.

Keywords: *Digital Resources, Information Literacy, Lifelong Learning, Reading Habits, School Libraries, Secondary Education, Tamil Nadu, India*

Introduction

Information Literacy (IL) is a set of skills, attributes, and behavior that support students' learning in the digital age. In this information age, IL is a fundamental component in the education of children who must be equipped to evaluate information competently. This evaluation includes accessing and using the information in electronic and print forms. School libraries and librarians play a fundamental role in promoting IL and reading for information and inspiration. IL skills help students prepare for competitive examinations, offer test-taking strategies, and guide teachers in prioritizing the lessons to be learned. Promoting IL skills is increasingly important as it is an essential component and a key characteristic of lifelong learning, which is important for higher learning. Educational reforms and restructuring make IL skills essential as students seek to construct their knowledge and develop their understandings. IL enables a person to use the information effectively to make decisions and solve problems.

Information is an indispensable resource for all humans and vital to technological and scientific change. Information is a resource with varied definitions according to the format and media used to package or transfer it and the discipline that defines it. In modern times, information is an important source based on a country's economic, social, industrial, educational, and political development. Luenberger (2006) defines information as "the meaning that a human assigns to data through conventions used in their presentation (p. 9)." In other words, information is the processed data given shape to the higher secondary students.

Statement of Problem

The greatest challenge for society in the 21st century is keeping pace with the knowledge and technical expertise necessary to find, apply, and evaluate information. It is acknowledged that we live in an information-rich society where the amount of information in the world doubles every three years. Therefore, it has become necessary in the 21st century to incorporate IL into educational curricula. IL makes the students beyond the role of passive listener and note-taker, allowing them to take some directions and initiative during classes. The primary purpose of including IR in the education system is to direct the students, allowing them to discover the resources and share with fellow students to understand the curriculum. By gaining skills through the education system, the students participate in activities like reading, writing, project assignments, discussion, and co-curricular activities. So, the researcher attempted to evaluate the information literacy level and reading habits of higher secondary students in international schools in Tamil Nadu.

Objectives of the Study

The study's key objective is to evaluate the level of IL skills among the higher secondary school students at the International Schools in Tamil Nadu. The following are the research questions considered to achieve the study's primary objective.

- To trace out the socio-demographic profile of the respondents.
- To find out the frequency and purpose of library visits among the respondents
- To measure the extent of the IL Skills of the respondents

Hypotheses

H_0: Male and female respondents do not significantly differ in their information needs and assessment competency.

H_1: Male and female respondents significantly differ in their information needs and assessment competency.

Scope of the Study

IL is important for today's learners as it promotes problem-solving and analytical thinking skills. The school libraries are the hubs of all intellectual activities and should space stimulate intellectual access to the world of information by providing necessary resources to the students. The school library is where students can interact with the world of knowledge. The present study aims to examine the IL skills among senior secondary school students in international schools in Tamil Nadu.

Literature Review

Rinzin (2024) conducted research focusing on fostering a love for reading among 9th-grade students at Gomtu Higher Secondary School. The study emphasized the importance of teacher guidance, peer influence, and structured school-level interventions such as library activities and reading competitions. Further, it has been concluded that creating a supportive environment and promoting reading as a collaborative activity could significantly enhance students' interest in reading.

Wangchuk (2023) investigated the impacts of Facebook usage on the reading habits of higher-secondary students. The study revealed that while social media often distracts students from academic reading, it can also serve as a platform for sharing and discussing educational resources. The research

stressed the importance of balancing digital engagement and traditional reading habits, with recommendations for incorporating digital literacy into educational curricula to help students better use online tools for academic purposes.

In their study, Mushtaq, Soroya, and Mahmood (2021) examined the reading habits of Generation Z students in Pakistan and their implications for school library services. The study highlighted the shift from traditional reading mediums to digital platforms, emphasizing the need for school libraries to adapt to changing preferences. The findings revealed that students preferred short, interactive, and visual content over lengthy traditional texts. The authors suggested reevaluating library policies and incorporating digital tools to engage students effectively and enhance their reading experiences.

Aulia, FicaRizky, and Rachman (2019) explored the influence of reading material preferences and family support on the reading interests of children from farming communities. The study found that family involvement and access to appealing and relevant reading materials were critical in fostering a reading culture among children. The authors recommended community-based initiatives and school programs to increase access to suitable reading materials and promote family engagement in children's literacy development.

In their study, Chanchinmania and Verma (2018) attempted to assess IL skills among research scholars at Mizoram University. IL is recognizing information needs and locating, evaluating, applying, and creating information within cultural and social contexts. The study revealed that the research scholars had adequate skills in handling information for their basic needs. The study results showed an urgent need for the inclusion of IL

programs in the course curriculum, and more awareness is required among students, which will make the students more information literate.

Foo and Chang (2017) mainly focused on understanding and proficiency in basic IL skills, such as defining information tasks, selecting information sources, seeking information from sources, and synthesizing and using information. The survey suggested an urgent need to review IL education in the Singapore school system, revisit policies and priorities, and assess the relevance and effectiveness of the IL curriculum, practical hands-on classes, and interventions currently employed in schools. The study concluded that cultivating students at a young age and building the proper foundation of literacies, skill sets, and competencies are essential, important, and highly challenging.

Prabhu and Kumar (2015) pointed out that the beginning of the 21st century has been called the Information Age because of the explosion of information output and sources. IL equips them with the critical skills to become independent lifelong learners. IL is important; it promotes problem-solving approaches and analytical thinking skills, finding information, evaluating sources, making decisions, and fostering successful learners, effective contributors, confident individuals, and responsible citizens. It is suggested that IL programs must be implemented mainly by library staff in schools, colleges, universities, and public libraries to achieve library goals and convert their users into lifelong learners and critical thinkers.

Smitha, Elayadom, and Thirunavukkarasu (2015) disclosed the importance of IL in library staff. IL has an important role in the lives of librarians and information seekers. After the invention of printing, many technologies have emerged. All the changes in society are seen and reflected in libraries also.

Internet and other communication technologies have helped the community to–access information even remotely. Hence, librarians must acquire new technical skills in collecting, storing, processing, and disseminating the required information. Without information literacy, librarians may not provide quality services to their clientele. IL equips them with the critical skills to become independent lifelong learners.

Wu and Lin (2014) analyzed the relationship among reading habits, learning strategies, and academic achievement of secondary school students in Taiwan. The study concluded that students with consistent and purposeful reading habits were more likely to employ effective learning strategies, positively impacting their academic performance. The authors advocated holistically integrating reading and learning strategies into school curriculums to improve academic outcomes.

Methodology

Population

The population of the present study includes class XI and XII (Senior Secondary) students from international schools in Tamil Nadu.

Sample Size and the Sampling Technique

A two-stage sampling process was employed to select the sample. Initially, 14 international schools were chosen using the convenient sampling technique based on accessibility and willingness to participate in the study from Tamil Nadu. Subsequently, 50 students were randomly chosen from each selected school, resulting in a total sample size of 700 students. This number significantly exceeds the minimum recommended sample size in Krejcie and Morgan's Table. According to the Krejcie and Morgan Table, for

a population size of 100,000 or more, a minimum of 384 respondents is sufficient. Additionally, the 2025 online sample size calculator by Calculator.net suggests a sample size 385 for an unlimited population at a 95% confidence level. Since the actual population size was not precisely known, a larger sample was purposefully selected to ensure the reliability and generalizability of the findings.

Profile of sample unit

Sl.No	Name of the International School
1	Akshar- Arbol International School - West Mambalam, Chennai
2	APL Global School, Thoraipakkam, Chennai
3	Boston International School, Alwarpet, Chennai
4	St. Joan of Arc International School, Adhavathur, Trichy
5	Chinmaya International Residential School – CIRS, Coimbatore
6	St. Assisi World School, Madurai
7	Kodaikanal International School – KIS, Kodaikanal
8	JSS International School, Ooty
9	Rasi International School, Namakkal
10	SCAD World School, Palladam, Tiruppur.
11	The GeeKay World School, Vellore
12	Good Shepherd International School, Ootacamund
13	Hebron School, Ootacamund
14	Oyster Learning Initiative School, Thiruvarur

Research Instrument

A structured, self-administered questionnaire was used as the primary research instrument for data collection in this study. The questionnaire was carefully designed to gather information on the demography of the

participant, frequency and purpose of library visits, the use of library services and resources, patterns of computer and internet use, and the respondents' level of IL skills. The IL skills component was developed based on the standards of the American Association of School Librarians (AASL) to ensure the instrument's relevance and validity. Prior to data collection, consent was obtained from the principals of the selected international schools in Tamil Nadu, confirming their willingness to participate in the research. Additionally, parental consent for each randomly selected student respondent was secured through a command notice circulated by the schools. A total of 700 questionnaires were distributed to the students via the respective school librarians, who also assisted the researcher in collecting the completed responses. Out of these, 611 fully completed questionnaires were returned, yielding a high response rate of 87.28%, which contributed to the reliability of the study findings.

Statistical Methods for Data Analysis

For the analysis of the collected data, a combination of statistical techniques was employed to achieve the research objectives. Descriptive statistics were used to summarize the socio-demographic characteristics of the respondents and to present the distribution patterns of their library visits, purposes of use, and awareness of library resources. To determine the association between categorical variables such as gender, academic class, and stream with library visit frequency and purposes, Chi-square tests were applied. Additionally, independent *t*-tests were conducted to assess whether significant differences existed in information literacy competencies, such as information needs assessment, based on gender and academic class. Furthermore, regression analysis was performed to identify the relationship between socio-demographic variables and the respondents' overall information literacy skill

levels, helping to predict how these factors influenced their competencies. All statistical analyses were carried out using appropriate software tools, and results were interpreted considering standard levels of significance.

Results and Discussion

Table 1 portrays the Socio-demographic profile of the respondents and the frequency of library visits of the respondents on selected variables.

Table 1

Socio-demographic profile of the respondents and the frequency of library visits based on selected variables

Attributes		Only during Library Periods		Both during the library Periods and other Periods		Chi-Square	Sig. Value
		Count	Percentage	Count	Percentage		
Gender	Male	165	60.22	109	39.78	1.94	**0.621**
	Female	182	54.01	155	45.99		
Class	XI	159	62.11	97	37.89	1.37	**0.785**
	XII	188	52.96	167	47.04		
Stream	Science	147	55.68	117	44.32	1.19	**0.592**
	Commerce	119	58.33	85	41.67		
	Humanities	81	56.64	62	43.36		

**: - Significant at 0.01 level, *: - Significant at 0.05 level

The socio-demographic profile of the respondents reveals a balanced representation in terms of gender, academic class, and study stream. Out of the total respondents, 165 (60.22%) were male, while 182 (54.01%) were female, indicating slightly higher participation from females. In terms of

academic class, 159 respondents (62.11%) were from Grade XI and 188 (52.96%) from Grade XII, showing a relatively even distribution between the two grades. When considering academic streams, the majority of respondents were from the Science stream, accounting for 147 (55.68%), followed by Commerce with 119 respondents (58.33%), and Humanities with 81 respondents (56.64%).

This diverse socio-demographic distribution provides a comprehensive overview of the respondents' background, which is valuable for interpreting the study's findings. The gender-wise analysis shows that 60.22% of male and 54.01% of female respondents prefer to visit the library only during library periods. The Chi-square statistics ($p > 0.05$) show that library visits are independent of students' gender. Regarding class-wise analysis, 62.11% of Class XI and 55.68% of Class XII respondents prefer to visit only during library periods. Related to the stream-wise analysis, 55.68% of Science, 58.33% of Commerce, and 56.64% of Humanities stream respondents prefer to visit the library only during library periods. Chi-square statistics ($p > 0.05$) reveal that the library visit is not significantly associated with the gender, class, and stream of study of the respondents.

Table 2 describes the gender-wise distribution of respondents regarding the purpose of their visit to the library. Students were allowed to give multiple answers if they preferred. More than 66% of male and 68% of female respondents stated that visiting the library is to borrow/return books. The Chi-square test ($p < 0.01$) shows that borrowing books is significantly higher among female students than male students. A similar result can be observed for reference. About 51% of female students use the library for reference, whereas only 58 percent of males visit for the same purpose. For reading a magazine, 45% of females and 44% of males, and using the Internet, 35% of

males and 31% of female students visit the library. The Chi-square test ($p < 0.05$) shows significant differences between male and female students regarding the purpose of visiting the library other than other purposes. In short, female students are significantly more likely to visit the library to borrow books and read newspapers and references than males, whereas male students are significantly more likely to read magazines and use the Internet.

Table 2

Purpose of Visiting the Library: Gender-wise Distribution

Attributes	Male		Female		Chi-Square	Sig. Value
	Count	Percentage	Count	Percentage		
Borrowing books	109	66.06	74	67.89	19.451**	0.0011
Reading magazines	95	57.58	56	51.38	11.276*	0.0471
Reading newspapers	72	43.64	49	44.95	2.674*	0.0324
For reference	67	40.61	55	50.46	8.952*	0.0413
Using Internet	58	35.15	34	31.19	7.649**	0.0021
Others	29	17.58	12	11.01	1.428	0.8941

**: - Significant at 0.01 level, *: - Significant at 0.05 level

Table 3 illustrates the class-wise distribution of respondents about the purpose of visiting the library. Students were allowed to give multiple answers if they preferred. 54.30% of Class XI respondents and 61.41% of Class XII respondents preferred to visit the library to borrow books. 55.21% of Class XII and 49.61% of Class XI stated that they visited the library to read magazines. 46.09% of Class XI and 34.93% of Class XII visited the library for reading newspapers, and 48.44% of Class XI and 51.27 % of Class XII visited the library for reference purposes. 43.75% of Class XI and

27.32 % of Class XII visited the library for internet use. The Chi-square statistics ($p < 0.05$) reveal a significant difference in library visit purposes among Class XI and XII respondents.

Table 3

Purpose of Library Visit - Class-wise Distribution

Attributes	XI		XII		Chi-Square	Sig. Value
	Count	Per cent	Count	Per cent		
Borrowing books	139	54.30	218	61.41	12.327**	0.0012
Reading magazines	127	49.61	196	55.21	14.873*	0.0274
Reading newspapers	118	46.09	124	34.93	17.529*	0.0141
For reference	124	48.44	182	51.27	11.672**	0.0000
Using Internet	112	43.75	97	27.32	15.195*	0.0121
Others	54	21.09	45	12.68	13.542*	0.03514

**: - Significant at 0.01 level, *: - Significant at 0.05 level

Table 4 displays the stream-wise examination of respondents' awareness and use of library resources. Science stream respondents are more aware and use library resources than Commerce and Humanities.

Table 4

Stream-wise Distribution of Respondents, Awareness, and use of Library Resources

Awareness and use of library resources		Science	Commerce	Humanities	Chi-Square	Sig. Value
Collections in the school library	Aware and use	174 (65.91)	132 (64.71)	101 (70.63)	18.289**	0.002
	Aware but not use	58 (21.97)	43 (21.08)	23 (16.08)		
	Not aware	32 (12.12)	29 (14.22)	19 (13.29)		
Magazines and newspapers	Aware and use	146 (55.30)	124 (60.78)	96 (67.13)	19.475**	0.000
	Aware but not use	79 (29.32)	49 (24.02)	27 (18.88)		
	Not aware	39 (14.77)	31 (15.20)	20 (13.99)		
Reference collections	Aware and use	199 (75.38)	129 (63.24)	76 (53.15)	17.523**	0.001
	Aware but not use	37 (14.02)	42 (20.59)	39 (27.27)		
	Not aware	28 (10.61)	33 (16.18)	26 (18.18)		
Library automation and software used	Aware and use	134 (50.76)	114 (55.88)	68 (47.55)	14.217*	0.0311
	Aware but not use	84 (31.82)	54 (26.47)	42 (29.37)		
	Not aware	46 (17.42)	36 (17.65)	33 (23.08)		
OPAC	Aware and use	137 (51.89)	96 (47.06)	64 (44.76)	11.791**	0.000
	Aware but not use	75 (28.41)	61 (29.90)	44 (30.77)		
	Not aware	52 (19.70)	47 (23.04)	35 (24.48)		
Scheme followed (Library Module)	Aware and use	192 (72.73)	143 (70.10)	89 (62.24)	12.169**	0.002
	Aware but not use	43 (16.29)	37 (18.14)	31 (21.68)		
	Not aware	29 (10.98)	24 (11.76)	23 (16.08)		

**: - Significant at 0.01 level, *: - Significant at 0.05 level

Regarding the collections of the school library, awareness of magazines, and newspapers, use of reference collections in the library, Library automation and software used, OPAC, and the scheme followed in the library, the Chi-square statistics ($p < 0.05$) show a significant difference between the three streams. In short, the respondents in all three streams are aware of and use the library resources.

Table 5

Student opinion about the meaning of the "Information"

Sl.No	Information means	Count	Percentage
1	The knowledge received from various sources	61	9.98
2	Data collected from different sources	34	5.56
3	Shreds of evidence learned about something	22	3.60
4	All of the above	494	80.85
	Total	**611**	**100**

Table 5 reveals the respondents' opinions regarding the meaning of information. It is known that more than 80% of respondents chose the meaning of information correctly, and the remaining gave different answers. The results show that most respondents have the right idea about the meaning of information.

Table 6

Student opinion about the meaning of the term "Literacy"

Sl.No	Information literacy means	Count	Percentage
1	Ability to read	48	7.86
2	Ability to visit the library	74	12.11
3	Ability to read, write, and do simple arithmetic	489	80.03
	Total	**611**	**100**

Table 6 divulges that nearly 80% of the respondents correctly identified what literacy means. The results show that most of them understand what literacy means

Table 7

Respondents Information Needs & Assessment Competency

Assessment of Information skill competency	Always		Sometimes		Never	
	Count	%	Count	%	Count	%
Can identify the need	412	67.43	143	23.40	56	9.17
Can formulate questions based on information need	394	64.48	156	25.53	61	9.98
Can identify resources for Information	403	65.96	169	27.66	39	6.38
Can identify different types of resources	387	63.34	177	28.97	47	7.69
Can organize the information related to the problems at hand	362	59.25	181	29.62	68	11.13

Table 7 reveals that the respondents' information skills and related sub-skills were analyzed on a three-point scale. It can be seen that more than 60% of respondents are familiar with the above skills at high levels. The respondents can identify the need for information, formulate questions, identify subject-related resources based on the need, use different keywords, identify different reference sources, and organize information related to the problems.

Table 8 depicts the mean and standard deviation of information needs assessment competency based on gender and class. The independent t-test was used to test whether there is a significant difference in the respondent's skills above. The t-test value (1.57, $p > 0.05$) displays that there is no significant difference between male and female respondents about their information needs assessment competency. Further, it is observed from the t-test value (1.16, $p > 0.05$) that no significant difference was found among Class XI and XII respondents.

Table 8

Comparison of Information Needs Assessment Competency based on Gender and Class of Students

Attributes		Mean	S.D	N	"t"	"P"
Gender	Male	16.231	1.914	274	1.57	0.841
	Female	17.624	1.876	337		
Class	XI	17.269	1.928	256	1.16	0.973
	XII	16.542	1.823	355		

Findings of the Study

The study reveals several insights into students' library usage patterns and information literacy competencies. Gender-wise analysis indicates that 60.22% of male and 54.01% of female respondents prefer to visit the library

only during library periods, while class-wise analysis shows that 62.11% of Class XI and 55.68% of Class XII respondents share this preference. Stream-wise, 55.68% of Science, 58.33% of Commerce, and 56.64% of Humanities students prefer visiting the library only during library periods. Over 66% of male and 68% of female respondents stated that their primary purpose for visiting the library was to borrow or return books, while 58% of males and 51% of females visited for reference purposes. In terms of class differences, 54.30% of Class XI and 61.41% of Class XII respondents visited the library mainly to borrow books. Additionally, 55.21% of Class XII and 49.61% of Class XI students used the library to read magazines, while 46.09% of Class XI and 34.93% of Class XII used it for reading newspapers. Moreover, 48.44% of Class XI and 51.27% of Class XII students visited for reference purposes, whereas only 43.75% of Class XI and 27.32% of Class XII students used the library for Internet access. Chi-square statistics ($p < 0.05$) indicate a significant difference among the three academic streams regarding awareness of library collections, use of magazines, newspapers, reference materials, library automation, OPAC, and classification schemes. Furthermore, more than 80% of respondents correctly identified the meaning of "information," and nearly 80% demonstrated an understanding of "literacy." Over 60% of respondents showed high familiarity with essential information literacy skills such as identifying information needs, formulating questions, selecting subject-related resources, using relevant keywords, and organizing information effectively. Finally, the t-test results ($t=1.57$, $p > 0.05$) indicate no significant difference between male and female respondents in information need assessment competency, and similarly, no significant difference was found between Class XI and XII students ($t =1.16$, $p > 0.05$).

Limitations

1. The study has been conducted among higher secondary school students in international schools in Tamil Nadu.
2. The study focused only on the IL Skills of higher secondary school students and not on other classes and other aspects of information literacy.

Conclusion and Recommendation

Conclusion

The study's main objectives are to evaluate the IL skills of the respondents and to measure the extent of IL skills of the students of the senior secondary stage. The data collected from the respondents from the selected international schools in Tamil Nadu show a clear picture of information literacy skills. The study's findings revealed that librarians in international schools impart IL skills to students, which were assessed through five major skills, and the majority of the IL skills and sub-skills are familiar to the students. They apply these skills whenever they need it. Hence, higher secondary students in international schools are better users of all types of resources available in the library. They know how to access, locate, use, evaluate, synthesize, and communicate information efficiently and effectively. Presently, in the educational context, students depend on various types of resources (print and e-resources for their daily use, either for their academic board exams, competitive exams, etc.) and non-academic co-curricular activities, competitions, etc.). Information environment has become more complex, and users are faced with abundant information available in print and electronic forms. Hence, the students need to develop IL and computer literacy competency to handle the information needs of the

21st century and to use IT resources and utilize them effectively. Before developing various IL skills among the students in this technological era, it is a must to study the existing capabilities of the students. Therefore, this study is significant in that extent that the investigator conducted this study to identify the IL competencies among senior secondary school students.

Recommendations

1. Reinforcing the need for Information Literacy:

   The study confirms the critical role of IR in shaping students into independent learners capable of navigating the information-rich digital age. It is recommended that IR be formally integrated into the curriculum across all streams, as it empowers students with essential skills in locating, evaluating, and effectively using information.

2. Strengthening School Libraries as Learning Hubs:

   School libraries are central to students' exposure to diverse information sources, so they should be transformed into vibrant learning commons. Investment in infrastructure, digital tools, and trained library professionals is necessary to promote an Information-Centric Environment.

3. Encouraging Library use beyond Library Periods:

   The findings suggest that most students only use the library during designated periods. There is a pressing need to encourage a culture of voluntary and purposeful library use by introducing engaging activities such as IL skill workshops, reference hunts, reading challenges, and digital literacy sessions.

4.Gender-Neutral Approach to IL Training:

Since there is no significant difference in IL competency based on gender or class, IL promotion strategies can be implemented uniformly, ensuring all students receive equal opportunities to enhance their competencies regardless of demographic factors.

5. Focus on Reference and Digital Resource Use:

A relatively lower percentage of students use libraries for Internet access and reference purposes. This low use indicates a gap in awareness or availability. Schools should ensure better access to digital infrastructure and train students in using e-resources for academic tasks.

6. Targeted Interventions for Stream-Specific Needs:

The stream-wise differences in awareness of library resources and automation tools indicate a need for customized IL instruction tailored to the academic requirements of Science, Commerce, and Humanities students.

7. Ongoing IL Assessment and Reinforcement:

Since over 60% of students demonstrate familiarity with key IL skills, it is important to build on this foundation with regular assessment and reinforcement strategies. Formative assessments, project-based learning, and cross-disciplinary IL integration are recommended.

8. Promoting Lifelong Learning Values:

IL is a school-level requirement and a cornerstone of lifelong learning. Introducing IL from the secondary school level builds a foundation for higher education and professional development, equipping students to engage with information in varied real-world contexts critically.

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Perceptions and Use of PubMed and the MeSH Thesaurus among Postgraduate Medical and Dental Trainees in Health Information Retrieval

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ABSTRACT

The study mainly focused on the usage of PubMed and the MeSH (Medical Subject Headings) thesaurus during the health information retrieval process. The study investigates the level of awareness, utilisation patterns, and potential benefits of use of the Medical Subject Headings (MeSH) Thesaurus in the retrieval of information of postgraduate medical and dental trainees. It also investigated the trainees' perceptions, attitudes, and satisfaction regarding the MeSH thesaurus help tool. Using a descriptive survey design, data was collected from postgraduate trainees enrolled in the PGIM Library Orientation Programme between 01st January 2025 to 30th May 2025. The main data collection instrument was a questionnaire, which was administered through Google Forms.

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Received: 02 May 2025, Accepted revised version: 30 December 2025.

A mixed-method approach was implemented using both quantitative and qualitative analyses. Findings revealed a moderate level of familiarity with MeSH yet its usage in literature searches remained low. A significant percentage of trainees were unaware of MeSH guidance, but the majority expressed a willingness to adopt it if adequately supported. Confidence in information retrieval was significantly associated with experience levels. Most of the respondents acknowledged the benefits of MeSH thesaurus, emphasizing enhanced relevance ease of use improved accuracy and time efficiency. The study highlights the importance of applying the MeSH tool in information retrieval and providing structured training programs. Key recommendations are threefold: implement mandatory training workshops; provide guidance on how to make use of MeSH tools (e.g., a thesaurus browser and query builder) during search processes through existing health information retrieval platforms to create a more guided search experience; and enhance curricular focus on database proficiency. The goal of the present study is the optimization of the usage of health information retrieval systems available for postgraduate medical and dental trainees through the PGIM Library.

Keywords: *Medical Subject Headings; MeSH thesaurus; Health information retrieval systems; Information needs; PubMed; Postgraduate Medical and Dental Trainees*

Introduction

Seeking quality medical information to support patient care is fundamental to evidence-based medicine. Health professionals and students always look for the most relevant and reliable information for treating patients safely. Evidence-based medicine suggests looking at articles on specific types of studies, such as randomised controlled trials or systematic reviews. To find the correct and authentic information, health professionals need to have good searching skills that go beyond search engines such as Google or Google Scholar. Learning how to search effectively for medical literature takes time and practice, and it involves understanding different types of databases and search terms and search interfaces. Medical and health-related professionals need to acquire a certain standard of information literacy which includes mastering multiple skills. In this context, librarians play a significant role in medical and health-related libraries. Librarians expect that students learn how to conduct efficient searches to find relevant information without feeling overwhelmed. (Gehanno, 2009 ; Gusenbauer & Haddaway, 2020; Sackett et al., 1996). A health sciences librarian who teaches students how to search for medical literature has to decide how much emphasis has to be paid to teaching different search strategies and techniques to obtain effective results. As pointed out by DeMars and Perruso (2022), most of the published research shows that when working with researchers, the main question was what the best way to search for information is.

By providing controlled vocabularies, synonyms, and closely related concepts, a medical thesaurus enables users to formulate queries that retrieve potentially relevant information not expressed in layperson terms. There are more than 150 medical thesauri in the Unified Medical Language System (UMLS) Metathesaurus. Among them, Medical Subject Headings (MeSH) is

one of the most commonly used systems to facilitate health information retrieval (Yeganova et al., 2009; Dilhani & Ranasinghe, 2018).

The Medical Subject Headings (MeSH) Thesaurus

The Medical Subject Headings (MeSH) thesaurus was first introduced by the National Library of Medicine (NLM) in 1960 as the foundational vocabulary for its pioneering Medical Literature Analysis and Retrieval System (MEDLARS). A key innovation of MeSH was its use of a single, unified list of subject headings for both cataloguing books and indexing journal articles, which streamlined information retrieval (Lipscomb, 2000).

The Medical Subject Headings (MeSH) thesaurus is a controlled vocabulary use for organising, cataloguing, and retrieving biomedical and health-related information (Fikar & Hallas, 2024). It facilitates precise indexing and searching by standardising terminology to represent various concepts consistently. MeSH employs a hierarchical structure to enable broad searches to retrieve more specific articles and allows users to navigate the thesaurus effectively. Continually updated by subject specialists, new concepts are added annually, and existing ones are modified to ensure relevance (https://www.nlm.nih.gov/, 2024).

MeSH includes synonyms, related terms, and entry terms to guide users to the most relevant descriptors. In NLM's databases, terms entered by users are automatically linked to MeSH descriptors for efficient information retrieval. Online tools like the MeSH Browser offer access to complete vocabulary, MeSH Entrez databases aid in MEDLINE/PubMed searches, and the UMLS Metathesaurus connects to various controlled vocabularies. This robust system enhances search precision and information access for

researchers in the biomedical field (National Library of Medicine [NLM], 2024).

MeSH was designed to be a dynamic and evolving list, allowing for the inclusion of new terms based on the evolving concepts in the medical field. From an initial list of 4,400 descriptors, it has expanded significantly, containing over 29,000 descriptors and 270,000 supplementary concepts in its modern editions (NLM, 2024). This adaptive approach ensured that MeSH remained current and reflective of the changing landscape of medical literature. (https://www.nlm.nih.gov/, 2024).

Background Studies

As per Mu (2014), Munasinghe and Ranasinghe (2023), a major challenge for consumers searching for health information is their unfamiliarity with medical terminology. Even though medical thesauri such as the Medical Subject Headings (MeSH) and related tools (e.g., the MeSH Browser) were created to help consumers find medical term definitions, the lack of awareness and proper techniques in applying these tools prevent the retrieval of relevant results. Using MeSH has been shown to improve the efficiency of searches, that is, retrieving fewer irrelevant citations (Mu, 2014).

Jenuwine and Floyd (2004) compared text word and MeSH searching and found that text word searches were more sensitive (retrieved a greater number of relevant citations) and that MeSH searching was more specific (retrieved fewer irrelevant citations). Text word searching may have been more sensitive because some concepts important to the search used by Jenuwine and Floyd (2004) such as the concept “healthy,” were not represented in the MeSH database. Searches that have high sensitivity and

high specificity are ideal. Haynes et al. (1994) also found that search strategies designed to find methodologically sound studies in adult medicine retrieved a higher proportion of relevant studies when they included MeSH terms and text words. For the text word portion of the search to be effective, variations in spelling (i.e., British, American), synonyms for the search concept (eg, "aquatic", "pool"), and plurals must be entered into the search query box. Rana et al. (2011) validated a search assessment tool. Appropriate use of MeSH terms was identified as one of the five critical elements in the development of an effective MEDLINE search, further highlighting the need to understand MeSH.

Problem Statement

Efficient retrieval of accurate and relevant health information is vital for medical and dental practice. PubMed, as a prominent biomedical database, and its controlled vocabulary tool, the MeSH Thesaurus, are essential resources for achieving this purpose. However, despite their availability and importance, many postgraduate medical and dental trainees may lack adequate awareness, understanding, and skills to effectively use these tools for information retrieval. Studies conducted in various contexts have shown inconsistent levels of familiarity and proficiency in using PubMed's advanced features and MeSH terms, leading to suboptimal literature searches and limited utilisation of evidence in clinical decision-making and research (Young, 2010; Hirt, et al, 2020 ; Chevalier, & Dosso, 2025). In the Sri Lankan context, unfortunately, no empirical evidence exists regarding how postgraduate trainees perceive and use PubMed and MeSH in their academic and professional activities. This knowledge gap hinders the development of targeted training programs to strengthen health information literacy among future medical professionals. Therefore, it is important to investigate the

perceptions and use of PubMed and the MeSH Thesaurus among postgraduate medical and dental trainees in order to identify existing challenges, gaps, and opportunities for capacity building in health information retrieval.

Significance of the Study

Health Information Retrieval Systems are vital tools for postgraduate medical and dental trainees to access relevant and up-to-date information. This study aims to collect information required to enhance the usage of these systems and to promote the usage of the MeSH terms during search processes. By providing structured training programs trainees can navigate and search for information more effectively, ultimately improving their access to essential medical and dental knowledge. Encouraging them to incorporate MESH terms during searching would streamline the retrieval process and enhance the learning experience for postgraduate medical and dental trainees. This study addresses a critical gap in postgraduate medical and dental education by examining PubMed proficiency among trainees during a formative period of their professional development. Information search skills are an integral part of medical education and continuing professional development. By documenting the extent of inconsistent familiarity with PubMed's advanced features among postgraduate medical and dental trainees, this study will provide evidence to inform targeted educational interventions and speciality training programs. The findings will enable program directors and medical educators to design competency-based training that addresses specific deficiencies in literature search skills, ultimately enhancing trainees' ability to integrate current evidence into clinical decision-making and research activities. This research contributes to

developing a generation of evidence-informed practitioners capable of delivering optimal patient care.

Main Objective

The main objective is to assess the awareness and proficiency levels in using PubMed and MeSH thesaurus help tool among postgraduate medical and dental trainees, and to identify factors influencing their literature search capabilities.

Specific Objectives

- Identify the type of information sources used by postgraduate medical and dental trainees in Sri Lanka for fulfilling their information needs
- Investigate the awareness and utilisation of MeSH Thesaurus of postgraduate medical and dental trainees in Sri Lanka.
- Assess the familiarity and competency in utilising MeSH Thesaurus for retrieving literature searches among the postgraduate medical and dental trainees in Sri Lanka.
- Understand user preferences for use of MeSH Thesaurus in PubMed of postgraduate medical and dental trainees in Sri Lanka.
- Examine the Impact of Training and Education sessions on information retrieval of postgraduate medical and dental trainees in Sri Lanka.

Research Methodology

This study was carried out as a descriptive study using online survey method. The population consisted of those who enrolled in the Library Orientation Programme from 01st January 2025 to 30th May 2025. The whole population was considered as the sample. The questionnaire was designed as a data collection instrument to collect data from the sample. Google forms were

used as the administration method of the data collection instrument. Ethical clearance was obtained from the Ethical Clearence Committee, Postgraduate Institute of Medicine, University of Colombo under ERC/A/2025/ 074.

Data Analysis

Quantitative data was analysed using descriptive and inferential statistics. SPSS 26th edition was used for the analysis. Qualitative data was analysed using the thematic analysis techniques.

Rate of Response

A Total of 130 PG trainees participated in the library orientation programme conducted by the Postgraduate Institute of Medicine between 01st January 2025 to 30th May 2025. Among them, 86 responded to the questionnaire, making the rate of response 66.15%.

Socio-Demographic Profile of Respondents

The descriptive statistics of the information related to the socio-demographic background of the responders are summarised and presented in Table 1. The percentage of females with 65.1% was higher than that of males with 34.9%. Age group of the respondents varied from below 40 and above 60 years. The study demonstrated that the majority of respondents were from the age group of <= 40 years (61.6%). Respondents belonged to 22 different subject specialties. The majority of respondents belonged to the speciality of family medicine, presented 24.4% followed by Human Nutrition (14%) and Community Medicine (10.5%). Experience of the respondents also shows a variation, and most responders had less than 10 years of experience (48.8%). The job location of respondents was scattered in 14 different cities, and the majority was from Colombo which is the trade capital of Sri Lanka that is 67.4 %.

Table 1 indicates the socio-demographic profile of the respondents.

Table 1

Socio- Demographic Profile of the respondents

Indicator	Demographic profile	Frequency N	Percentage %
Gender	Male	30	34.9
	Female	56	65.1
Age	<= 40 yrs.	53	61.6
	> 41 and <= 50 yrs.	20	23.3
	>= 51 and <= 60 yrs.	06	7.0
	>= 61 yrs.	07	8.1
Specialty	Cardiothoracic Surgery	01	1.2
	Community Medicine	09	10.5
	Consultant Anaesthetist	01	1.2
	Dental Surgery	03	3.5
	Dermatology	01	1.2
	Family Medicine	21	24.4
	General Medicine	08	9.3
	Haematology	01	1.2
	Health Sector Disaster Management	07	8.1
	Histopathology	01	1.2
	Human Nutrition	12	14.0
	Medical Administration	06	7.0
	Medical Education	01	1.2
	Medical Virology	02	2.3
	Nephrology and Dialysis	01	1.2
	Obstetrics and Gynaecology	02	2.3
	Orthopaedic Surgery	02	2.3
	Paediatrics	01	1.2
	Public Health	02	2.3
	Radiology	01	1.2
	Rheumatology	01	1.2
	Transfusion Medicine	02	2.3
Experience (yrs.)	< 10 yrs.	42	48.8
	>= 10 and < 20 yrs.	21	24.4
	>= 20 and < 30 yrs.	12	14.0
	>=30 yrs.	11	12.8

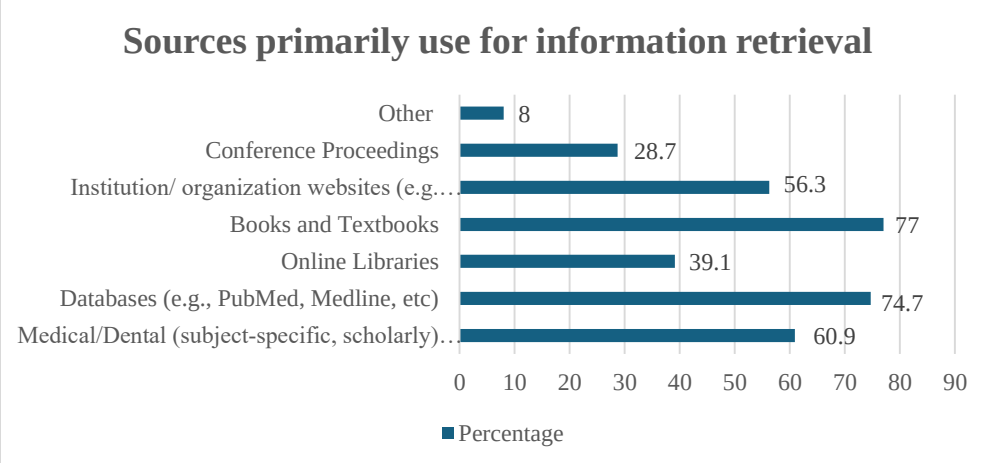
Job Location	Anuradhapura	01	1.2
	Badulla	03	3.5
	Batticaloa	01	1.2
	Colombo	58	67.4
	Galle	04	4.7
	Gampaha	05	5.8
	Jaffna	03	3.5
	Kalutara	01	1.2
	Kandy	04	4.7
	Kegalle	01	1.2
	Kurunegala	01	1.2
	Peradeniya	01	1.2
	Polonnaruwa	01	1.2
	Rathnapura	02	2.3
Total		**86**	**100**

Types of information sources used by the respondents

Figure 1 illustrates the variety of information sources use by the respondents for the retrieval of necessary information.

Figure 01

Sources primarily used for information retrieval



As illustrated in Figure 1, it was found that books and textbooks were used (77%) as the major source, followed by databases (74.7%) and scholarly journals (60.9%). Additionally, 56.3 % have indicated that they have used institutional and organizational websites and low percentages were observed for online libraries (39.1%) and conference proceedings (28.7%).

Search Behaviours of Respondents

The study aimed to investigate the search habits, confidence levels, and familiarity with PubMed and the MeSH thesaurus among medical and dental professionals.

Table 2 highlights the findings related to search habits, confidence levels, and familiarity with the MeSH thesaurus among medical and dental professionals. Accordingly, regarding Search Frequency, respondents mainly searched for medical/dental literature occasionally or rarely, with 30.2% have indicated that they had no need to search for literature using databases. Only 17.4% have indicated that they need to search for health literature often and very often. But, when considering about the confidence levels of searching ability, 54.7% were either extremely confident or confident in retrieving relevant medical/dental information. Further, it was observed that nearly half or 51.2% of respondents are familiar with MeSH thesaurus. In contrast to this, only 17.4% have indicated that they were using the MeSH thesaurus very often or often to refine searches.

This information sheds light on the patterns of literature search behavior in relation to gender. The data shows that 38.5% search often, 34.8% search occasionally, and 27.3% search rarely, with no males searching very often. A significant portion (42.3%) indicated never searching for medical/dental literature. On the other hand, all females (100%) search for medical/dental

literature, with 61.5% searching often, 65.2% searching occasionally, and 72.7% searching rarely. A notable percentage (57.7%) indicated never searching for medical/dental literature.

Table 02

Search habits, confidence levels, familiarity and frequency of using PubMed and Mesh thesaurus among respondents

Question	Response Category	Frequency (N)	Percent (%)
Frequency of searching for medical/dental literature	Very often	2	2.3
	Often	13	15.1
	Occasionally	23	26.7
	Rarely	22	25.6
	Never	26	30.2
Confidence in retrieving information using retrieval systems (e.g., PubMed)	Extremely confident	14	16.3
	Confident	33	38.4
	Neutral	35	40.7
	Not confident	4	4.7
Familiarity with MeSH (Medical Subject Headings)	Yes	44	51.2
	No	42	48.8
Frequency of using MeSH thesaurus	Very often	2	2.3
	Often	13	15.1
	Occasionally	23	26.7
	Rarely	22	25.6
	Never	26	30.2
Total	—	**86**	**100**

The data reveals varying frequencies of searching for medical/dental literature among genders. Majority rarely (42.3%) or never (34.9%) search for medical/dental literature to support their work or studies. Most frequently search occasionally (65.2%) or rarely (72.7%), with no females indicating never searching. This information highlights differences in information-

seeking behaviors between genders, which can be discussed in the context of research practices and utilization of medical/dental literature to enhance academic or professional endeavors. 35.7% are extremely confident, 45.5% are confident, and a minority are not confident (25.7%). More females exhibit confidence, with 64.3% being extremely confident and 54.5% confident. Fewer females express not being confident (25.7%).

Awareness and Likelihood of Using MeSH

Based on the responses, Table 3 tabulates the awareness and likelihood of using MeSH for searching. As depicted in Table 3, 57% of the respondents were not aware of the possibility of using the MeSH terms in health information retrieval systems such as PubMed. But, it seems that 76.7% are ready to use it if they were made aware of its availability (very likely 27.9% and likely 48.8%).

Table 03

Awareness and likeliness of using MeSH in the searching process

Questions	**Responses**	**Frequency N**	**Percentage %**
Awareness: "Are you aware that MESH terms can be incorporated in the searching processes of existing health information systems (e.g. in PubMed)	Yes	37	43.0
	No	49	57.0
Likelihood of usage: If MeSH terms can be used in a health information retrieval system, how likely are you to use them?	Very likely	24	27.9
	Likely	42	48.8
	Neutral	15	17.4
	Unlikely	4	4.7
	Very unlikely	1	1.2

Impact of Training and Education on MeSH Utilisation

The impact of formal training on MeSH utilisation was examined by investigating the prevalence of prior training and the correlation between training, familiarity, and usage. As indicated in the Table 4 below, slightly more than half of the respondents (58.1%, n=50) had received formal training on the MeSH thesaurus. Despite this, as shown in Table 2, only 17.4% (n=15) reported using MeSH frequently. This suggests that the current training may not be fully effective in translating knowledge into consistent practical application. However, the demand for effective education is unequivocal, with an overwhelming 90.7% (n=78) of trainees expressing interest in attending future workshops to maximise their use of MeSH, highlighting a critical opportunity for improved educational interventions.

Table 04

Training on using the MeSH

Questions	Responses	Frequency	Percent
Training Received: Have you received any formal training or education on how to effectively utilise the MeSH thesaurus during your study programmes	Yes	50	58.1
	No	36	41.9
Interest in training: Would you be interested in attending workshops or training sessions on how to make use of the MeSH thesaurus in health information retrieval systems?	Yes	78	90.7
	No	8	9.3
Total (N)		**86**	**100**

Potential Benefits of Using MeSH Thesaurus in Information Retrieval Process

Respondents were asked to indicate the potential benefits of the use of MeSH thesaurus in information retrieval. Table 5 indicates the responses.

Table 05

Potential benefits of using MeSH Thesaurus in the information retrieval process

Benefits	Percentage (%)	Number of Responses
Enhanced relevance of results	72.6	61
Ease of use	60.7	51
Improved search accuracy	60.7	51
Time efficiency	58.3	49
Other benefits	4.8	04

Incorporating the MeSH terms in the search process offers a range of potential benefits. According to the present survey the following benefits were indicated. Enhanced relevance of results emerged as the top priority, with a significant 72.6% (61 responses) of participants recognizing the potential of MeSH integration to enhance the relevance of search results. Regarding ease of use, 60.7% (51 responses) of participants highlighted the importance of improving the user experience by making the system more user-friendly through the use of MeSH. Receiving equal percentage of responses to 'Improved search accuracy' indicated its importance as an aspect of enhancing search accuracy, with 60.7% (51 responses) of participants emphasizing the role of MeSH in refining search results. About time efficiency, 58.3% (49 responses) of participants acknowledged the potential time-saving benefits associated with incorporating the MeSH terms in information retrieval processes. Other benefits received a smaller

percentage of respondents (4.8% - 4 responses) providing additional insights into unique advantages beyond the primary categories identified. These findings underscore the significant potential of use of MeSH in health information retrieval to improve search relevance, user experience, search accuracy, and time efficiency.

Experience vs Respondents' Usage Behaviour of MeSH

In order to seek whether there are deviations in usage behaviour of respondents with the experience, responses to items Q7 (Frequency of information retrieval), Q9 (Confidence in information retrieval), Q11 (frequency of using MeSH thesaurus) and Q13 (Likelihood of using MeSH) by Q6 (experience in years) were analysed and tabulated in tables 6 and 7.

Table 06

Cross tabulation of the responses of the items Q7 (Frequency of information retrieval), Q9 (Confidence in information retrieval), Q11 (frequency of using MeSH thesaurus) and Q13 (Likelihood of using MeSH) by Q6 (experience in years).

Item	Response	Q6A (Experience in years)			Total
		< 10 years	**> 10 and < 20 years**	**> 20 years**	
Q7 Frequency of information retrieval	Occasionally	07	05	01	13
	Often	08	07	06	21
	Very often	28	09	15	52
	Total	43	21	22	86
Q9 Confidence in information retrieval	Confident	16	9	14	39
	Extremely confident	02	02	04	08
	Neutral	24	09	02	35
	Not confident	01	01	02	04
	Total	43	21	22	86

Q11 How often do you use the MeSH thesaurus to refine your searches or explore related concepts?	Never	11	06	09	26
	Occasionally	12	05	07	24
	Often	7	03	03	13
	Rarely	13	05	03	21
	Very often	0	02	0	02
	Total	43	21	22	86
Q13 If MeSH terms can be used in a health information retrieval system, how likely are you to use it?	Likely	20	14	9	43
	Neutral	11	1	3	15
	Unlikely	3	1	0	4
	Very likely	8	5	10	23
	Very unlikely	1	0	0	1
	Total	**43**	**21**	**22**	**86**

The result of Chi-square (χ^2) tests that were performed to evaluate the association between the survey responses and the experience levels of postgraduate medical and dental trainees (<10 years, >10 and <20 years, >20 years) is shown in Table 7.

Table 07

Summary of the χ^2 test performed on the items Q7, Q9, Q11 and Q13by Q6 experience in years.

Item	χ^2 test Value	df	Significance
Q7 Frequency of information retrieval	5.514	4	0.239
Q9 Confidence in information retrieval	14.417	6	0.025
Q11 How often do you use the MeSH thesaurus to refine your searches or explore related concepts?	10.374	10	0.408
Q13 If MeSH terms can be used in a health information retrieval system, how likely are you to use it?	14.449	10	0.153

According to the table, χ^2 and the associated significance between the response to item Q7, and the responders' experience were statistically insignificant (χ^2 Value: 5.514, df. = 4, p = 0.239). However, the association between the responses to item Q9 and the experience of participant was statistically significant (χ^2 = 14.417, df = 6, p = 0.025). This suggests that confidence levels are influenced by the trainees' experience, with more experienced individuals likely to feel more confident. Further, the associations between the responses to the item Q11 (χ^2 = 10.374,df = 10, p =0.408 and Q13 (χ^2 = 14.449, df =10, p = 0.153 were statistically insignificant.

Assessment of the Need for using MeSH Thesaurus

To assess the need for using MeSH thesaurus, respondents were queried on their awareness of existing guidance and their likelihood of using such a feature if it is available. As presented in Table 3, a significant majority (57.0%, n=49) unaware of the possibility of using MeSH in the current systems, indicating a visibility gap. However, when asked about their likelihood of using MeSH, 76.7% (n=66) of respondents indicated they would be ‘likely’ or ‘very likely’ to use it, demonstrating a clear demand and a latent need for such support. This need was further substantiated by the high percentage of trainees who perceived specific benefits from MeSH, such as enhanced relevance of results (72.6%) and improved ease of use (60.7%).

Thematic analysis

For the three open-ended questions employed, responses were received from all 86 respondents. Accordingly, the following themes were identified.

Table 08

Benefits of MeSH Thesaurus and its potential Enhancements in the information searching process

Theme/Area	Details/Features	Notes or Comments
Beneficial features and functionalities of using MeSH Terms	- Auto-Suggestion - Synonym recognition - Mapping to MeSH Terms - Relevance Ranking - Visualisation Tools	These features improve the search process and enhance the usability of health information retrieval systems.
Perceived benefits of MeSH use	Improves precision, recall, and relevance of search results	Enhances the user's information retrieval experience.
Suggestions and Feedback for enhancing Efficiency	- User Training - Feedback mechanism - Continuous Updates - Collaboration with Experts - User Guides	Implementation of these measures ensures continuous user education and successful results in retrieval of information.

Discussion

The results of this study show critical understandings of the information retrieval behaviors of postgraduate medical and dental trainees in Sri Lanka especially related to PubMed and the MeSH thesaurus guidance. The results indicate that while a substantial portion of postgraduate trainees are familiar with MeSH (51.2%), actual usage remains low (only 17.4% utilize it frequently). This discrepancy suggests that regardless of awareness, practical application is hindered by factors such as insufficient training and familiarity with the MeSH thesaurus (Dilhani & Ranasinghe, 2018). This gap between awareness and practical application is consistent with findings from previous studies highlighting the challenges in applying MeSH into routine search practices. For instance, a study by UCL Library (2023) emphasizes that while PubMed automatically searches for MeSH terms, users often lack the training to utilize the MeSH database effectively for advanced search

strategies. The study also revealed that confidence in information retrieval correlates with experience, as more experienced trainees reported higher confidence levels. Similarly, research by the National Library of Medicine (NLM, 2025) indicates that automated indexing has improved the access to MeSH terms but requires user expertise for optimal application. This emphasizes the need for structured training programmes not only to introduce MeSH but also provide hands-on experience in its application. Similar findings were indicated in previous research that highlights the challenges faced by medical professionals in leveraging controlled vocabularies for effective information retrieval (Pasche et al., 2013; Munasinghe, 2024).

The low frequency of database searches, coupled with the high reliance on books and textbooks, raises questions about the adequacy of current training programs in equipping trainees with the skills needed for advanced information retrieval. This reliance on traditional sources may be influenced by the perceived complexity of database search interfaces and the lack of familiarity with structured tools such as MeSH. Although familiarity with MeSH was moderate, its actual usage remained minimal, pointing out the need for targeted interventions to bridge this gap. The moderate familiarity with MeSH but limited usage indicates that trainees may recognize its importance but require additional training and practice to incorporate it effectively into their workflow. Moreover, the interest in workshops dedicated to MeSH usage shown by a significant number of respondents (90.7%) indicates a clear demand for educational resources aimed at improving information retrieval skills.

The significant association between experience and confidence levels reflects the role of professional maturity in developing information-seeking skills.

Experienced trainees are likely to have developed strategies for navigating information systems through practical exposure. However, the absence of significant associations between experience and other variables, such as MeSH usage, suggests that even experienced trainees may not be fully equipped to utilise specialised tools.

The study also demonstrates that use of MeSH in retrieving health information has the potential to address many of the challenges faced by trainees. Enhanced search relevance, accuracy, and ease of use are particularly crucial in a field where timely access to precise information can directly impact clinical decision-making and patient outcomes. The benefits identified by respondents such as, enhanced relevance (72.6%), ease of use (60.7%), improved search accuracy (60.7%), and time efficiency (58.3%) highlight the importance of use of MeSH in information retrieval. These findings are supported by prior research demonstrating that MeSH improves precision and relevance in search results. For example, a study by Darmoni et al (2012) found that using MeSH Concept indexing in MEDLINE significantly enhanced the precision of retrieved articles compared to default PubMed searches. Similarly, a systematic review of Leblanc et al (2024) revealed that queries incorporating both MeSH and free-text terms retrieved more relevant articles than free-text-only queries.

Furthermore, the willingness of 90.7% of respondents to attend workshops on maximizing MeSH usage indicates a strong demand for educational interventions. Effective training programs should not only cover the theoretical underpinnings of MeSH but also include hands-on sessions to demonstrate its practical application in various clinical scenarios. Such initiatives can enhance the confidence and competence of trainees, fostering a culture of evidence-based practice. Another notable finding is the

willingness of 76.7% of respondents to adopt MeSH-guided systems if support mechanisms are in place. This highlights the importance of user-friendly interfaces and clear guidance to facilitate the integration of MeSH into routine searches.

The implications of these findings extend beyond individual trainees to the broader healthcare system. Improved information retrieval capabilities can enhance the quality of research, clinical decision-making, and patient care. Therefore, use of MeSH in a proper way in the information searching process is a practical necessity for advancing medical education and practice.

The frequency of searching for medical/dental literature to support work or studies varies among individuals, as highlighted in the data presented. The data indicates that females tend to search for medical/dental literature more consistently compared to males. This information can be discussed in the context of information-seeking behaviour, gender differences in research practices, and the implications for accessing and utilizing medical/dental literature in academic or professional settings. Understanding these patterns can help tailor information retrieval systems and resources to better meet the needs of different user groups.

The data indicates varying levels of confidence in retrieving relevant medical/dental information using existing retrieval systems based on gender. This information suggests gender-related differences in confidence levels when utilizing retrieval systems for accessing medical/dental information. These findings can be discussed in the context of user experiences, training needs, and system usability considerations to enhance user confidence and proficiency in information retrieval tasks.

The data from Table 2 reveals varying frequencies in searching for medical/dental literature and confidence levels in information retrieval systems among healthcare professionals. The respondents also displayed mixed familiarity with the MeSH thesaurus, highlighting a balanced ratio between those familiar with it and those who are not. Additionally, there appears to be considerable interest among professionals in utilising MeSH in the health information retrieval process, particularly if accompanied by formal training or educational workshops. These findings underscore the importance of considering user habits, confidence levels, familiarity with indexing tools, and the potential impact of enhanced guidance.

The fourth objective of this study was to examine the impact of MeSH thesaurus training and education. The findings reveal a critical disconnect: while a majority of trainees have had some formal training, this has not translated into high levels of practical usage. This indicates that the *current nature* of training may be insufficient, perhaps focusing on theory over hands-on, repetitive practice. The remarkable interest by respondents (90.7%) in further workshops is a powerful indicator that trainees themselves perceive a gap in their skills and see training as a vital solution. This aligns with adult learning principles, emphasizing the importance of applied, relevant, and participatory learning. Therefore, the 'impact' of future training is potentially very high. Implementing mandatory, structured, and practical workshops, as recommended, could be the key to bridging the observed gap between awareness and usage, ultimately empowering trainees to make use of MeSH for more effective evidence-based practice.

Conclusion

The present study highlights the information-seeking behaviours, confidence levels, and familiarity with PubMed and the MeSH thesaurus among health and medical postgraduate trainees, revealing gender-related differences in search habits, confidence in retrieval systems, and interest in MeSH application. Females demonstrate more consistent search behaviour and higher confidence levels, indicating potential gender variations in information retrieval practices. There is a notable interest in utilising the MeSH thesaurus, especially when guided by training workshops to enhance its effectiveness.

Moreover, the study found that trainees perceive the MeSH as a tool to significantly enhance search experiences, precision, recall, and relevance of results. The prioritisation of benefits emphasises the importance of improved relevance, user experience, search accuracy, and time efficiency through the application of MeSH. This signifies the critical role of the MeSH Thesaurus in optimising healthcare information retrieval.

Additionally, the diverse sources used for information retrieval, including medical/dental databases, books, reports, institutional websites, and conference proceedings, indicate the varied approaches in accessing healthcare information among postgraduate trainees.

In conclusion, the study highlights the value of understanding user behaviours and the imperative of resources like PubMed and the MeSH thesaurus to enhance information retrieval experiences in healthcare. Implementation of targeted training programmes on effective use of MESH tools in searching can further enhance proficiency and efficiency in

accessing medical/dental literature, ultimately advancing healthcare research and practice.

Suggestions and Recommendations

Based on the findings, several recommendations can be drawn in order to enhance the effective and proper usage of PubMed and the MeSH thesaurus. Librarians and information professionals can play a major role in this aspect. To enhance awareness and improve searching skills, can introduce mandatory workshops and training sessions on advanced database searching and the effective use of PubMed and the MeSH Thesaurus. Further, developing online tutorials and user guides tailored to postgraduate trainees, emphasizing the practical applications of MeSH in clinical and academic contexts, is important.

By addressing these recommendations, institutions can empower postgraduate trainees to leverage the full potential of the MeSH Thesaurus in PubMed searching, ultimately enhancing the quality of health information retrieval and improving clinical and academic outcomes.

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Measuring the Research output of General Sir John Kotelawala Defence University (KDU), 2000-2024: A Bibliometric approach using Web of Science (WoS)

M.P. Rajapaksha [1]

ABSTRACT

This study presents a bibliometric analysis of the research output of General Sir John Kotelawala Defence University (KDU) from 2000 to 2024 using the Web of Science (WoS) database. The objectives were to examine publication growth, authorship and collaboration patterns, identify prolific authors and citation impact, map collaborative networks, and analyze subject-wise research distribution. Addressing a notable research gap, this is the first institution-specific bibliometric study on KDU. Data extracted on 27 March 2025 were analyzed using Biblioshiny, VOSviewer, and MS Excel. A total of 367 WoS indexed articles were published during the study period, with the first appearing in 2011. Research productivity increased significantly after 2011, accompanied by strong collaborative trends, as reflected in the rising collaboration coefficient from 0.50 in 2011 to 0.77 in 2024. Overall, 2,471 authors contributed to KDU's research output. De Silva, A.D. was identified as the most prolific author, with 35 publications, an h-index of 14, and 921 citations.

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Received: 02 May 2025, Accepted revised version: 30 December 2025.

Subject analysis revealed a focus on public, environmental, and occupational health; tropical medicine; science and technology; and immunology fields with the highest citation impact. Among the top ten cited papers, Science and Immunology ranked first. Funding support was primarily from the University of Sri Jayewardenepura (31 publications), the National Research Council, Sri Lanka (21), and internationally by the National Institutes of Health, United States of America (22). The study highlights KDU's growing research productivity, expanding collaborations, and increasing global visibility. Recommendations include promoting publications in high-impact journals, improving access to scholarly databases, and fostering a research-oriented environment to enhance institutional ranking and policy development.

Keywords: *Research productivity, Bibliometrics, Web of Science (WoS), General Sir John Kotelwalada Defence University (KDU), Biblioshiny, VoSviewer*

Introduction

Research has long been recognized as a foundation of scholarly activity, providing a systematic approach to generating new knowledge and addressing critical challenges. As a foundation of higher education, the primary goal of any academic institution is to disseminate knowledge through teaching, learning, and research in different fields (Hase & Gaikwad, 2024). Hence, an institution's reputation is largely influenced by the research output of its academics. "Research productivity" refers to the quantity and quality of research output generated by individuals, research groups, departments, institutions, or entire fields or countries within a given period (Hase & Gaikwad, 2024). As higher education institutions attempt for

excellence, assessing research output through bibliometric analysis provides valuable insights into publication trends, citation impact, collaboration impact, and emerging research areas. It covers a wide range of scholarly contributions, including journal articles, books, book chapters, conference proceedings, research papers, and posters, whether published or unpublished. These scholarly contributions act as a valuable source of information, potentially influencing policy decisions, guiding decision-making processes, and stimulating further research (Jiang et al., 2014). In addition, they can be used to monitor advancements in specific fields of study.

The General Sir John Kotelawala Defence University (KDU), founded in 1981 as an academy and elevated to university status in 1988, is situated in Ratmalana. Moreover, the KDU operates a Southern Campus in Sooriyawewa, which houses the Faculty of Architecture and Spatial Sciences. At present, the university has produced over 3,500 graduates for Sri Lanka's tri-services while expanding its contributions to include fee-levying degree programs for day scholars since 2010. Furthermore, KDU attracts foreign students, especially from SAARC nations, which contributes to its international reputation (Discover KDU | CSA - KDU, 2025). The KDU now has nine faculties in the fields of Medicine and Allied Health Sciences, Engineering, Technology, Computing, Management, Social Sciences and Humanities, Law, Criminal Justice, Police Science, Defense and Strategic Studies, and International Relations. In addition to these faculties, the Faculty of Graduate Studies was established to enhance the university's contributions to national research and development, fostering advanced scholarly inquiry and innovation. Furthermore, KDU has been established as a separate institute, the Institute for Combinatorial Advanced Research and Education (CARE), with the intention of developing knowledge and innovations in

areas such as health, biomedicine, biotechnology, chemistry, engineering and technology, computing, social sciences, and international relations. Also, KDU organizes annual research conferences, international conferences, and research symposiums. Additionally, most faculties in the university publish their own academic journals. Notably, the Faculty of Law publishes a journal indexed in a reputed database such as HeinOnline, while three other faculty journals are indexed in Sri Lanka Journals Online.

Different studies have employed scientometric methods to analyze the productivity of research in educational institutions and individuals (Janen, 2022). Furthermore, bibliometric studies help examine the quantitative aspects of research output among researchers and institutions revealing valuable insights into the overall research landscape of the institutions (Hase & Gaikwad, 2024). The Web of Science (WoS) is among the most widely used sources for assessing institutional research output and has been extensively used by researchers as a bibliometric data source (Kumar Roy & Mandal, 2021.; Stock et al., 2025). However, according to existing literature no studies have examined the research productivity of KDU. Hence, this study aims to fill this gap by mapping and analyzing the research publications authored by KDU academics indexed in WoS using a scientometric approach to provide institution-specific insights that have not been previously explored. The study also systematically evaluates KDU's publication trends that may help universities refining their research policies, address shortcomings, and enhance their national and international rankings. Additionally, it provides insights for university librarians to select relevant information resources to support academic research.

Bibliometric studies fall into four categories: a) bibliometric analysis in different subject areas, b) bibliometric analysis of scientific publications of

different countries/regions) c) bibliometric analysis of scientific journals, and d) bibliometric analysis of universities and research institutes (Rostami et al., 2024). As the present research aligns with the fourth category, the most relevant and recent studies on the topic are comprehensively reviewed in the following section.

Literature Review

Measuring research productivity of an academic institution is very crucial for its quality of education. Various studies have been conducted to determine the research productivity of different types of institutions at both national and international levels using widely recognized indexing services such as Web of Science (WoS) and Scopus. In this section, the study discusses recent and relevant selected literature pertaining to research productivity of universities both nationally and internationally.

Sri Lankan Context

Bibliometric studies, including those conducted in the Sri Lankan context, provide insights into research publication trends. To map the research productivity of the Eastern University of Sri Lanka, Ravikumar (2025) conducted a study based on the Scopus database. Most of the research was published in journal articles. The study encouraged academics to publish their research in international journals and conferences rather than focusing on local journals or conferences. Additionally, the study suggested organizing additional workshops and cultivating a research-based environment to enhance research productivity. Further, it is recommended that scholars maintain their profiles on research networks to improve visibility and university standing.

Latha and Lakshman (2020) researched publications from the Faculty of Science at the University of Jaffna between 2003 and 2018. When the overall output increased, the growth rate became unstable, and the output fluctuated accordingly. The Department of Zoology led in publication counts, and collaborative publications were dominant than single-author ones. Abstracts were the most common publication type, followed by journal articles. Findings revealed a fluctuating mean relative growth rate and recommended focusing on journal articles and interdisciplinary research to enhance the university's research impact.

Pratheepan and Weerasooriya (2015) conducted a scientometric analysis that investigated publication output, citations, and the h-index. The findings of the study showed that the faculties of Science and Medicine performed in terms of research productivity with h-indices of 5.55 and 5.25, respectively. The University of Peradeniya excelled in these disciplines, while the University of Kelaniya ranked highest in Medicine, and the University of Jaffna recorded the highest h-index in Management. Conversely, faculties in Arts and Social Sciences encountered challenges due to local publication practices and showed a preference for book chapters over journal articles, which limited their visibility in global databases such as Google Scholar. To address these issues, the authors recommended strengthening research support systems, improving citation practices, and assisting with high quality publications through targeted initiatives aimed at high-impact journals.

Similarly, Pratheepan (1999) emphasized the importance of developing a scientometric profile for the research and development of a country, institution, and scientists. His study revealed that, the University of Peradeniya was predominant in terms of research productivity and citation patterns in Sri Lanka during the period 1999-2010. Similar findings were

reported by Wijetunge et al., (2020), who also highlighted the predominance of research productivity and citation impact within the same context.

Although bibliometric studies have been widely conducted across various academic institutions, there remains a notable gap in research focused on scholarly output of General Sir John Kotelawala Defence University (KDU). However, several Sri Lankan universities have conducted bibliometric analyses, providing insights into publication trends, collaboration patterns, and citation impact as outlined above.

An International Context

Globally, bibliometric studies have been widely utilized to assess institutional research productivity. These comparative analyses highlight the significance of bibliometric approaches in evaluating institutional research landscapes (Daimary, 2024; Hasan & Singh, 2015; Hase & Gaikwad, 2024; Kumar et al., 2018; Kumar Roy & Mandal, n.d.; Rostami et al., 2024; Stock et al., 2025).

In the international context, Daimary (2024) examined the research output of Tezpur University from 1995 to 2023 using the Web of Science database, covering four academic disciplines: Management Science, Humanities and Social Science, Engineering, and Science. The analysis revealed considerable variation in research output over the past 29-year period, with science recording the highest number of publications (1,780), followed by Engineering (1,354), and Management Science with the lowest (102). Generally, the distribution supports patterns observed in both national and international studies.

Rostami et al. (2024) investigated the scientific publications of the Iran University of Medical Sciences from 1980-2020, using advanced visualization techniques to examine publication trends and research impact across disciplines. This study revealed that IUMS researchers mostly collaborated with the Tehran University of Medical Sciences. Researchers have primarily focused on pharmaceuticals, epidemiology, general/internal medicine, immunology, and meta-analysis/systematic reviews. “PLOS One” and “The Lancet” were the journals most cited by IUMS researchers. According to the co-occurrence map, highly frequent keywords, such as prevalence, expression, oxidative stress, diagnosis, risk factors, and therapy, were leading from mid-2016 to mid-2017, revealing growing trends over time.

Kumar et al., (2018) examined 136,156 publications from the Indian Institute of Technology indexed in the Web of Science database from 1989-2018. The most productive year was 2017, when articles were the dominant publication type. The most productive authors were Sharma, A. K., Kumar, A., and Gupta, A. Engineering, Chemistry, and Physics were among the leading subjects. The citation counts for leading articles ranged from 1486 to 12676. In summary, this study revealed remarkable research output during the specified period.

Hasan and Singh (2015) evaluated the research output of five top-ranked Indian Institutes of Technology (IITs) based on research papers indexed in the Web of Science database for the period of 2009-2013. This study presented a scientometric assessment of the trend of research papers, including the year-wise distribution of publications among IITs versus total Indian research output, institutional distribution, and degree of collaboration with other countries and institutions from India. This study retrieved 215,019

records for India, which accounted for 2.72% of the global records for the same period. Among these records, 9.32% were attributed to the top five IITs in the field. The maximum number of articles (22.27%) were indexed in 2013. India collaborated with 177 countries, with the USA and Germany topping the list.

Regardless of the growing body of literature, no comprehensive bibliometric study has examined KDU's research output using the Web of Science (WoS) database. This gap represents a significant limitation in understanding the university research output. The present study addresses this gap by systematically analyzing KDU's publications indexed in WoS from 2000 to 2024, thereby providing institution-specific insights previously unexplored in existing literature.

Objectives

- To determine the publication growth rate of General Sir John Kotelawala Defence University (KDU) from 2000 to 2024, as indexed in the Web of Science database.
- To analyze authorship patterns and collaboration quantity of KDU research output.
- To recognize the most productive authors and their citation impact within the KDU research community.
- To study the subject distribution of KDU publications.
- To Identify the university's international collaborative strengths and funding agencies.

Research Design & Method

Study Design

This study adopted a scientometric approach, a widely recognized methodology for quantitatively assessing research activities. Scientometrics, as a specialized branch of bibliometrics, focuses on measuring and analyzing scholarly literature to evaluate research impact, monitor emerging trends, and support policy formulation and strategic planning for future research directions (Ningayya & Kumar, 2025).

Data Source

Data for the study was retrieved from the Web of Science (WoS) database. WoS database is one of the most reputed indexing databases used by many scholars to measure the research productivity of their institutions (Birkle et al., 2020; Liu & He, 2023; Michael, 2025; Ravi et al., 2024). Data records were downloaded in plain text format in March 2025.

Data Extraction

Bibliographic data were obtained from the Web of Science (WoS) using the search terms “General Sir John Kotelawala Defence University,” “KDU,” and “Kotelawala Defence University”. Although records were retrieved for 2000–2024, the earliest indexed publication appeared in 2011. As the dataset was compiled in March 2025, the analysis was restricted to publications indexed between 2011 and 2024.

Data Analysis

The data were analyzed using MS-Excel, Biblioshiny (a bibliometric analysis tool), and VOSviewer for network visualization. Data was analyzed using both qualitative and quantitative indicators including total publication

trends, citation analysis, research areas, authorship patterns, institutional collaborations, and geographic distribution.

The number of authors per paper was counted using MS-Excel. Authorship was categorized into four categories: single-authored, two-authored, multi-authored (three and four authors), and mega-authored (five or more) (Janen, 2022). Also, authorship analysis was performed using the complete counted method, in which each author listed on a publication is assigned full credit for that publication. The collaborative coefficient was determined using the formula proposed by Ajiferuke et al., (1988).

$$CC = 1 - \frac{\sum_{j=1}^{A} \frac{1}{j}(fj)}{N}$$

where j = Authorship, fj= Number of j – authored research papers, N=the total number of research papers, and A= the total number of authors per paper.

The data was systematically organized and presented through tables, graphs, and charts to facilitate clear visualization and interpretation of publication trends, authorship patterns, and collaborative networks.

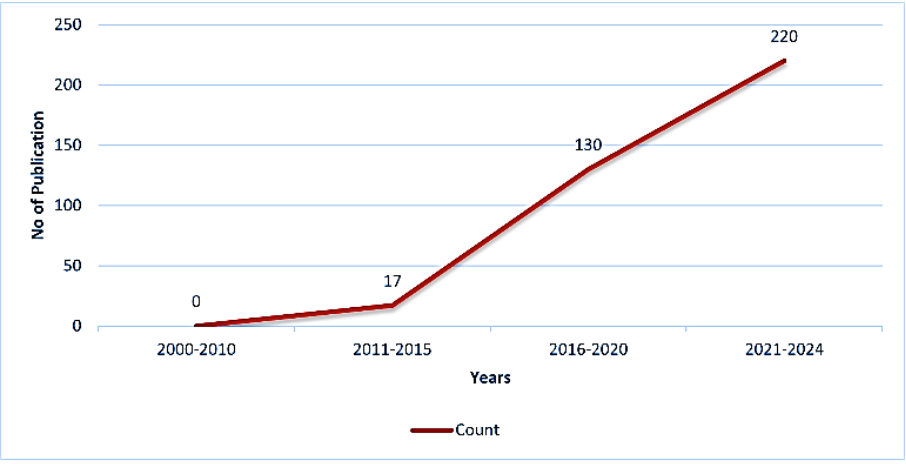
Results and Discussion

Figure 01 shows the publication growth rate of General Sir John Kotelawala Defence University during the study period.

A ten-year period was considered for analysis, aligning with the approach adopted in similar bibliometric studies found in the literature. Furthermore, the research publications of KDU began to be indexed in the Web of Science

(WoS) database only from 2011 onwards. The study period was divided into intervals of five years to ensure consistency and comparability across time spans. However, the final period (2021–2024) covers only four years, as the data collection was conducted prior to the commencement of the year 2025, necessitating a shorter final interval.

Figure 01
Publication growth rate



The time frame of 2000–2024 was initially considered to capture a comprehensive view of publication trends. However, as the Web of Science database does not include indexed publications affiliated with KDU prior to 2011, the analysis effectively covers the period from 2011 to 2024. This ensures consistency and accuracy in the data presented.

The total publication output for each period was as follows: 2011-2015 (34), 2016-2020 (260), and 2021-2024 (440).

The first publication indexed from KDU in WoS appeared in 2011. From 2011 to 2023, the research output of the KDU represents a consistent upward, beginning with a single publication in 2011 and reaching a peak of 60 publications in both 2022 and 2023. This trend reflects a substantial

development in research output over the years. Nevertheless, a decline was observed in 2024, with the number of publications decreasing to 44. This reduction may suggest a shift in research priorities, resource allocation, other institutional or external factors influencing publication activity.

Authorship Analysis

Authorship pattern analysis is a crucial step in scientometric studies, as it is considered as a significant factor in an institution's information dissemination and communication**.** Collaborative research allows scientists from diverse disciplines to address present challenges more effectively and efficiently. Such collaborations extend beyond individual authors, encouraging partnerships across institutions and countries. The total number of authors who contributed to research publications during the study period was 2471 of which single authored articles were 7. According to the authorship analysis, average co-authors per article was 8.48, while the collaboration index which also represents the average number of authors per article was calculated as 5.14.

Most Productive Author

The most productive author is identified based on the number of publications published in the study period in WOS-indexed journals. The h-index is an author-level metric that counts the number of publications and citations (Porcel & Liesa, 2023). It also correlates with the number of citations and publications (Table 01). Among the top 10 publications, seven were from the Faculty of Medicine. Two were from the Faculty of Engineering. De Silva, A.D., attached to the faculty of Medicine, led the top 10 author list with 35 publications and 14 h-index followed by De Silva, N.L., with 24 publications

and Dampage, U. with 15 publications. Considering the number of citations, De Silva, A.D., attached to the Faculty of Medicine, led with 921 citations for his 35 publications.

Table 01
Top 10 authors based on number of publications

Author	Articles	Total Citations	Average Citation per item	h-index
De Silva A.D	35	921	26.31	14
De Silva N.L	24	350	14.58	8
Dampage U.	15	229	15.27	8
Balasuriya A.	13	61	4.69	5
Fernandopulle R.	11	93	8.45	5
Gamage A.U	17	27	1.59	3
Goonasekara C.L	10	101	10.10	3
Marikar F.M.M.T	6	101	16.83	3
Premaratne P.H	6	29	4.83	3
Pushpakumara B.H.J	6	21	3.50	2

Author Collaboration

Table 02 depicts the single, two, multi, and mega-authored articles and collaboration measurements during the study period.

According to Table 02, the Collaboration Coefficient (CC) shows a clear upward trend over the years. It began at 0.5 in 2011-2012 and gradually increased, reaching 0.77 by 2024, showing a very high level of collaboration. In the early years (2011-2015), publications were more commonly co-authored by two or three authors, while later years (2016-2024), except for 2018, there was a noticeable increase in papers authored by five or more authors. A significantly strong collaboration was observed in 2019, with a CC of 0.79. Overall, the constant increase in CC values from 0.5 to above 0.77 depicts the growing author collaboration at KDU over the study period.

Table 02

Author collaboration of KDU

Year	Single	Two	Multi-authored	Mega authored	Total	CC
2011	0	1	0	0	1	0.50
2012	0	0	0	2	2	0.50
2013	0	0	1	3	4	0.68
2014	0	0	2	1	3	0.71
2015	0	0	3	4	7	0.76
2016	0	0	5	4	9	0.69
2017	1	0	9	16	26	0.79
2018	0	0	1	20	21	0.78
2019	0	0	7	26	33	0.79
2020	1	0	7	23	31	0.77
2021	2	0	12	37	51	0.78
2022	2	0	25	26	53	0.70
2023	0	0	16	40	56	0.76
2024	1	0	13	29	43	0.77

Authorship Collaboration Pattern with Countries

Figure 02

Authorship collaboration pattern with countries

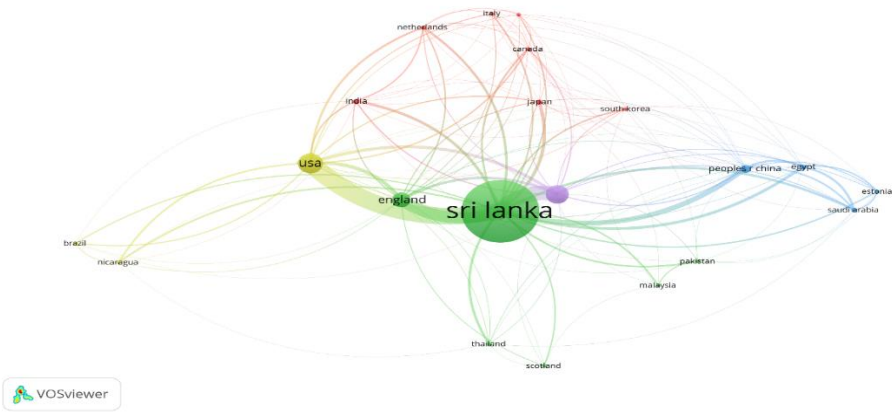


Figure 02 visualizes the collaboration between authors and countries. A total of n=68 countries contributed to n=2471 publications in this study. Sri Lanka

was the central hub in the collaboration network with 67 links and 363 (15%) documents. The major international collaborators of Sri Lankan authors were the USA with 73 (3%) documents, Australia with 65 (3%) documents, the UK with 49 (2%) documents, and China with 21 (1%) documents.

Author Collaboration with other Institutions

Figure 03

Author collaboration with other institutions

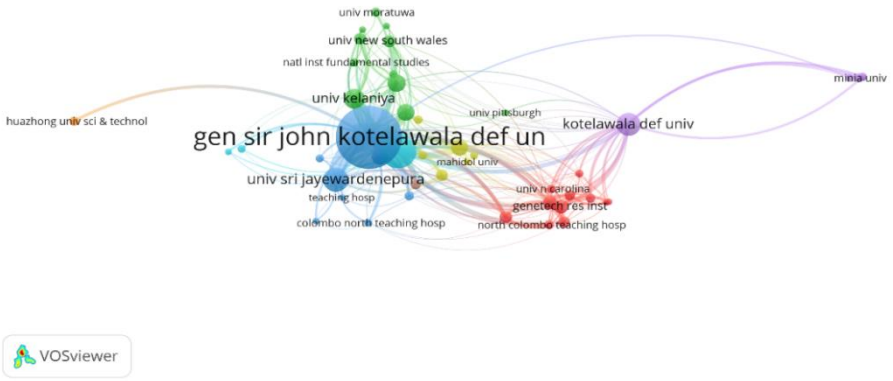


Figure 03 illustrates the collaboration of authors with other institutions. During the study period, General Sir John Kotelawala Defence University collaborated with 46 institutions locally and internationally.

Most Highlighted Research Areas

Table 03 shows the most highlighted research areas in which researchers published their studies in WOS during the study period. According to the above data, the highest number of articles was published in Public, Environmental & Occupational Health; Tropical Medicine with 42 articles, followed by Science & Technology 38, and Internal Medicine 15. Table 03 indicates the citations received for the respective subjects; Immunology

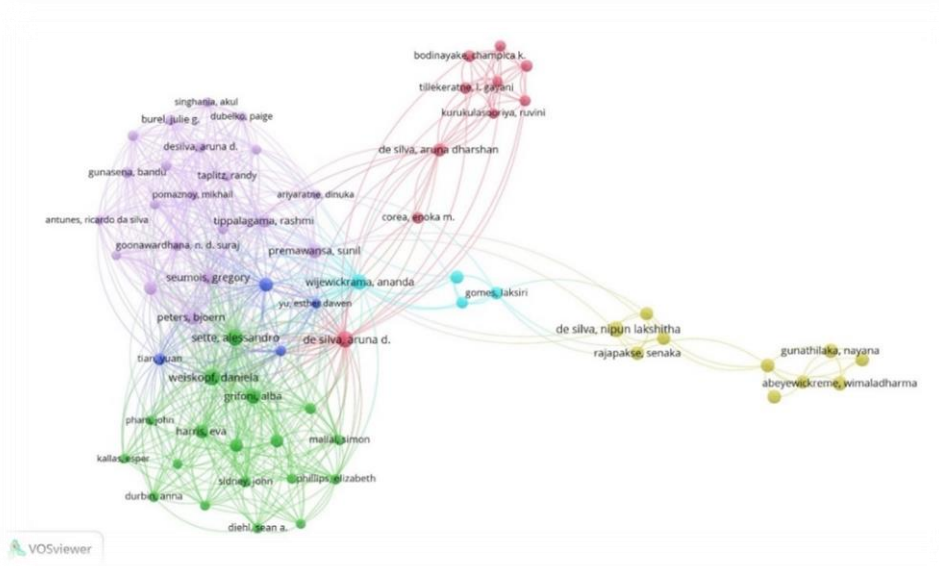
received the highest number of citations (787) among the total citations (4873), followed by Science & Technology (566), Public, Environmental & Occupational Health (396), and Environmental Sciences & Ecology (394). Environmental Sciences & Ecology has the highest average citation per item, at 65.7. The subject h-index explains the number of publications that are equal to the number of citations (Janen, 2022). In this study, Science & Technology and Endocrinology & Metabolism obtained the highest number of h-index, which was 14 and 12, respectively. The h-index indicates that 14 out of 38 publications received either equal or more than 14 citations in Science & Technology.

Table 03
Most highlighted research areas

Most highlighted research areas	No of Articles	Citation	Average Citation per item	h-index
Public, Environmental & Occupational Health; Tropical Medicine	42	396	9.4	9
Science & Technology - Other Topics	38	566	14.9	14
General & Internal Medicine	15	79	5.3	5
Endocrinology & Metabolism	14	253	18.1	14
Immunology	12	787	65.6	12
Cardiovascular System & Cardiology	10	12	1.2	1
Infectious Diseases/Nursing	9	174	19.3	9
Parasitology/Pharmacology & Pharmacy	7	125	17.9	7
Veterinary Sciences	6	54	9.0	6
Environmental Sciences & Ecology	6	394	65.7	6

Co-authorship Network Map

Figure 04
Co-authorship Network Map



Co-authorship maps were developed through the analysis of data from academics who contributed a minimum of two publications with at least one citation in the WOS database using VOSviewer (Oyewola & Dada, 2022). Among the authors in the dataset, 357 met the threshold, with the largest set of connected items comprising 67 authors organized into six clusters. Figure 04 shows the results. The considerable number of citations and link strength illustrated by De Silva, Aruna D. who is representing a KDU academic staff is noteworthy. This author appears to be a key collaborator across multiple research groups, indicating interdisciplinary or cross-institutional work.

Highly Cited Top Ten Publications

Table 04 shows the highly cited top 10 publications contributed by KDU authors. It has been found that the research paper titled "Precursors of human CD4 cytotoxic T lymphocytes identified by single-cell transcriptome analysis" co-authored by De Silva Anura D., is ranked first with a total citation of 176 in 'Science Immunology' in 2018. Among the top ten publications, the manuscript co-authored by De Silva Anura D. placed 1st, 2nd and 3rd ranks. The next highest citation rate marked by De Silva Nipun L. in 'Diabetologia' in 2022 with 105 citations.

Table 04
Top ten ranked publications based on citation

Author	Source Title	Year	TC	Average Citation per year
De Silva, Aruna D	Science immunology	2018	176	25.14
De Silva, Aruna D	Science immunology	2019	148	24.67
De Silva, Aruna D	Journal of infectious diseases	2018	108	15.43
De Silva, Nipun L.	Diabetologia	2020	105	21
De Silva, Nipun L.	Journal of clinical endocrinology & metabolism	2022	85	28.33
Goonasekara, Charitha L.	Saudi pharmaceutical journal	2019	78	13
Dampage, Udaya	Scientific reports	2022	66	22
Faiz M. M. T.	Toxics	2021	65	16.25
Fernando, W. C. D. K	Atmospheric research	2019	64	10.67
Kumarasinghe, Nishantha	Schizophrenia research	2016	64	7.11

Funding Agencies Supported KDU Research

Table 05

Funding agencies supported KDU research

Funding agencies	Number of publications	% of total
University of Sri Jayewardenepura	31	20.53
National Institutes of Health (NIH), United States of America	22	14.57
National Research Council, Sri Lanka (NRC)	21	13.91
Ministry of Health, Sri Lanka	14	9.27
National Science Foundation (NSF), Sri Lanka	13	8.61
National Natural Science Foundation of China	8	5.30
University of Colombo	7	4.64
WHO	6	3.97
University Grants Commission, Sri Lanka	6	3.97
Science and Technology Human Resource Development Project, Ministry of Education, Sri Lanka	3	1.99
Griffith University Postgraduate Research Scholarship	3	1.99
King Saud University	3	1.99
Muscular Dystrophy Association, USA	3	1.99
National Institute for Health and Care Research, UK	3	1.99

Funding sources for every research are a crucial factor in the quality of research output. The quality of research depends on the accuracy of the research methodology, results, and equipment used (Janen, 2022). Researchers from the natural and applied sciences need more funds to purchase chemicals and other lab equipment. Therefore, they mostly depend on research grants and funds. As shown in Table 05, the University of Sri Jayewardenepura (USJP) is the most prominent local contributor to KDU publications (20.53%). Furthermore, the National Institute of Health (NIH), USA leads among international agencies, supporting 14.57% of the research. In addition, other prominent international institutions and agencies, including

the WHO, NSF, and NRC, also contributed to KDU research, indicating a wide range of collaborations.

Conclusion and Discussion

This study provides a comprehensive analysis of the research publications of General Sir John Kotelawala Defence University indexed in the Web of Science (WoS) database during the period of 2000-2024. It was found that there was a clear upward trend in KDU research productivity during the study period with a notable peak in 2022 and 2023. This publication trend shows the university's increasing contribution to scholarly research and growing contribution to national and local academic communities.

It is evident that there was a strong culture of collaboration among KDU researchers. This was indicated by the authorship analysis with gradual increase in the collaboration coefficient from 0.5 to 0.77 indicating that multi- and mega-authored publications have become predominant.

In maintaining international collaborations, KDU researchers have engaged with 46 local and international institutions, mainly with the USA, Australia, the UK, and China. It is suggested that international collaborations with more countries would enhance research visibility and productivity of the KDU. Such collaborations can foster innovation, share knowledge and resources among institutions.

KDU researchers show dominance in key research areas, including public, environmental & occupational health, tropical medicine, and science & technology. The most prolific researcher is De Silva, A.D., in terms of the quality and visibility of the research output of KDU. Moreover, there were

several funding agencies assisting with KDU research, which include both local and international agencies such as University of Sri Jayewardenepura, the National Institute of Health, the World Health Organization, the National Science Foundation, and the National Research Council which have significantly contributed to the research enhancement of KDU.

In general, this study reveals that KDU has developed a strong research environment by cultivating productivity, multidisciplinary collaboration, and international partnership. The output of the study could assist policy makers of the university to strengthen the research support, encourage high-impact publications, and enhance the university's position in national and international academic rankings.

This study provides valuable input into KDU's research productivity; however, it is not without limitations. It depends mainly on data indexed in the WoS database, which may not fully cover KDU's research output, especially publications in local journals or other databases such as Scopus or Google Scholar. The main limitation is that it is focused on a single institution and a single country, which restricts the generalization of the findings. Additionally, the analysis did not include qualitative assessments of research quality or impact beyond citation metrics. Thus, future studies could expand the range by incorporating multiple databases to provide a more comprehensive overview of KDU's research productivity. Comparative studies with other Sri Lankan universities or regional institutions could also provide significant understandings. Moreover, exploring institutional policies, funding structures, and academic incentives would enhance the understanding of factors leading to scholarly productivity.

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Bridging Science and Society: Libraries as Partners in Citizen Science: A Rapid Review of Literature

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ABSTRACT

Citizen science enables public participation in scientific research, often facilitated by institutions such as libraries, schools, societies, NGO's etc. which can play a significant role in promoting and supporting these initiatives. Analysis of global literature reveals that libraries are emerging as contributors or vital partners in citizen science. Though citizen science approaches have wide applications in the Global North, such remain relatively rare in the Global South. Sri Lanka's potential in developing citizen science initiatives is enormous due to its rich biodiversity, environmental challenges and pressing social issues. However, Sri Lanka lacks documented frameworks, case studies, or practical guidance on library engagement, preventing libraries from leveraging their resources despite the country's potential. Consequently, it is unclear how libraries and librarians in the country can contribute to citizen science projects effectively.

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Received: 02 May 2025, Accepted revised version: 30 December 2025.

This review addresses this gap by examining global practices to provide actionable insights for Sri Lankan libraries. A rapid review approach was employed, drawing on peer-reviewed and grey literature on citizen science and libraries. Searches in Scopus and Web of Science identified 21 relevant articles (2004–2024), supplemented by authoritative online sources to ensure comprehensive and up-to-date insights into library involvement in citizen science. The review focuses on two preliminary questions relevant to the context. 1. How can libraries support citizen science projects? 2. What are the contributions and roles of librarians in citizen science? According to reported studies, libraries can provide support in four ways: 1. Organising and hosting citizen science events, 2. By providing spaces for collaboration and learning, 3. Providing infrastructure and equipment, and 4. Supporting open access to knowledge resources and establishing data repositories. In the emerging domain of citizen science, librarians play a pivotal role acting as connectors, facilitators, educators and data curators. The study recommends future research to identify the challenges and barriers that prevent librarians from actively engaging in citizen science.

Keywords: *Citizen Science; Community Science; Crowd-sourced Science, Participatory Research, Sri Lankan Libraries, Capacity Building, Open Science*

Introduction

What is Citizen Science?

Scientific research has long been a somewhat foreign or inaccessible concept for the general public or people outside academia. Historically, citizens have often viewed scientific research as spectators, not as active participants or

even direct beneficiaries. The professionalisation of science in the 18th century marked a turning point that widened the divide between amateur enthusiasts and professional scientists (Eitzel et al., 2017). This divide continued to grow over the following centuries as scientific research became increasingly complex and shifted from fieldwork to more specialised laboratory settings. However, bridging science and society is essential, as wisely emphasised by Smallman (2018), "for science to reach its full potential, it must be set free of its laboratories and take its rightful place – at centre stage in everyone's lives" (p. 253). The concept "citizen science" offers a way to bridge this gap, creating opportunities for collaboration between professional scientists and the general public (Harrington, 2019). Such collaboration is seen as a two-way process, empowering citizens to play a role in research activities that yield benefits and discoveries for society as a whole (Ignat et al., 2018).

Early reports of citizen science projects and the term CS appeared in publications such as MIT technology review (1989) and Cornell Laboratory of Ornithology magazine (1996) (Boney et al., 2015).The term citizen science was formalized through Alan Irwins book in 1995 'Citizen Science: A Study of People, Expertise, and Sustainable Development' (Follett & Strezov, 2015; Vohland, 2021). Subsequently the term was added to Oxford Dictionary (2016) which defines citizen science as scientific work carried out by members of the general public, in collaboration with or under the direction of professional scientists, often facilitated by institutions such as libraries, schools, societies, NGO's etc. Although the term came into use much later, the concept has been practiced as early as 1900. For example, the Christmas Bird Count project of the Audubon Society in the United States encouraged volunteers to collect data on bird populations and is considered

the longest-running citizen science project (LeBaron, 2021).Citizen science is a quickly evolving field that is mobilizing people's involvement in information development, social action and justice, and large-scale information gathering. Currently, a wide variety of terms and expressions are being used to refer to the concept of citizen science and its practitioners (Eitzel et al., 2017) and still lacks universal definition due to diverse applications across contexts (Follett & Strezov, 2015; Vohland, 2021). The concept overlaps with crowdsourcing, participatory research, collaborative mapping, and civic engagement (Eitzel et al., 2017; Fraisal et al., 2022: Rathnayake et al., 2020).

Functioning of Citizen Science Projects

Citizen science projects are frequently launched to address a current problem or research question while also strengthening the general public's capacity to participate in science. The objectives of citizen science projects include funding research, enhancing the scientific knowledge base through publications, providing data and analytics to inform management plans and developing public awareness of and interest in science (Follett & Strezov, 2015). It also lays the foundation for long-term implementation of policies (Özden & Velibeyoglu, 2021).

Through citizen science, vast amounts of data can be collected efficiently and cost-effectively, allowing researchers to tackle complex issues. Such projects encompass various forms, depths, and aims of collaboration across a broad range of scientific disciplines, including astronomy, biology, geology, archaeology, biodiversity monitoring, environmental conservation, public health, urban planning and design, architecture etc. (Hekker et al., 2018; Kullenberg & Kasperowski, 2016).

Citizen science is built on four key features: (a) anyone can participate, (b) participants follow a common protocol to ensure high-quality, combinable data, (c) the data contributes to real scientific conclusions, and (d) scientists and volunteers collaborate and share openly accessible data (Flagg, 2016). In this context, 'any participant', regardless of background is considered a citizen scientist, typically a member of the public who contributes to scientific research, often in collaboration with professional scientists (Oxford Dictionary of English, 2016).

For citizen science projects to be feasible, firstly, it must be sensitive to the interests and concerns of the community, secondly, the potential for citizens to generate trustworthy scientific knowledge should be high (Irwin,1995).Technological advancements in information science, such as data informatics, graphical user interfaces, geographic information system-based web applications, the Internet and smart devices, have further increased the feasibility of citizen science, enabling remote data sharing and analysis across diverse locations (Dickinson et al., 2012; Roger et al., 2023).

According to Bonney et al. (2009), three models for public participation in scientific research occur based on the extent of citizen involvement in the research process: (1) contributory projects, where citizen participation is largely limited to contributing to data collection and recording; (2) collaborative projects, where the involvement of non-scientists also includes data analysis and, possibly, interpretation; (3) co-created projects, where citizen participants are actively involved in most or all steps in the scientific process. In the first two types of participation, citizen scientists are involved merely as research assistants who are not involved in the planning of the

research process. By contrast, co-creation means that citizens participate collaboratively in the decisions regarding the research process (Table 1).

Table 1
Models for public participation in citizen science projects

Step in the scientific process	Steps included in contributory projects	Steps included in collaborative projects	Steps included in co-created projects
Choose or define question(s) for study			X
Gather information and resources		X	X
Develop explanations (hypotheses)			X
Design data collection methodologies	(X)	X	X
Collect samples and/or record data	X	X	X
Analyze samples	X	X	X
Analyze data	(X)	X	X
Interpret data and draw conclusions	(X)	(X)	X
Disseminate conclusions/translate results into action	(X)	(X)	X
Discuss results and ask new questions			X

Note. X = public included in step; (X) = public sometimes included in step.

Note. Adapted from "Public Participation in Scientific Research: Defining the Field and Assessing Its Potential for Informal Science Education," by R. Bonney, H. Ballard, R. Jordan, E. McCallie, T. Phillips, J. Shirk, and C. C. Wilderman, 2009, Center for Advancement of Informal Science Education. https://files.eric.ed.gov/fulltext/ED519688.pdf

A Growing Global Movement

Citizen Science Projects (CSPs) are closely aligned with major international treaties, conventions, and agreements that promote public participation in scientific endeavors. For example, biodiversity monitoring projects such as iNaturalist support the Convention on Biological Diversity (CBD, 1992) (Chandler et al., 2017). Climate related projects that track temperature variations, carbon emissions, or sea level rise, such as NASA's Global Observer, follow the United Nations Framework Convention on Climate Change (Bonney et al., 2016; UNFCC, 1992) . CSPs that monitor wetland ecosystems, water quality, or bird populations (eBird project) are relevant to Ramsar Convention on Wetlands, 1971 (Sullivan et al., 2014). The Aarhus Convention, 1998, which emphasises public access to environmental information and participation, also strengthens citizen-driven initiatives such as open air quality monitoring (Schade & Tsinaraki, 2016).

International policy frameworks further support citizen involvement in science. UNESCO's guidelines encourage public input in scientific processes, contributing to democratization of research (UNESCO, 2021). Similarly, the European Union's open science policy recognizes citizens as valid contributors to scientific knowledge (European Commission, 2014). Citizen science is considered one of the eight pillars of Open Science by the Open Science Policy Platform, an EC Working Group (OSPP, 2018). The Open Science Roadmap of the European Association of Research Libraries (LIBER) highlights citizen science as part of cultural change and endorses libraries as partners in these efforts. The League of European Research Universities (LERU) provides guidelines for raising awareness, supporting CS activities in research funding and evaluation processes (Wyler et al.,

2016). Formal structures are also emerging globally with organisations like the Association for Advancing Participatory Sciences (AAPS) in U.S., European Citizen Science Association (ECSA) in Europe, ACSA in Australia, and growing networks in Africa and Asia.

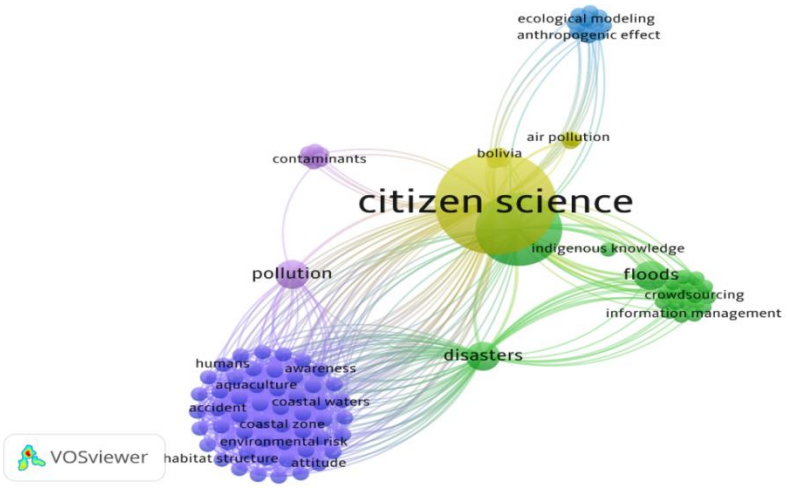
Interest in citizen science has grown rapidly over the past two decades, as reflected through number of projects and research publications (Hecker et al., 2018; Kullenberg & Kasperowski, 2016). These projects contribute data to globalefforts while empowering communities and strengthening participatory democracy. Overall, CSP contributes directly to monitoring and achieving UNESCO SDGs, particularly SDG 13 (Climate Action), SDG 14 (Life Below Water), and SDG 15 (Life on Land).

Citizen science initiatives in Sri Lanka

Though citizen science approaches have wide applications in the Global North, such remain relatively rare in the Global South (Rathnayake et al., 2025). Sri Lanka's potential in developing citizen science initiatives is enormous, as Sri Lanka has been listed among 36 global biodiversity hotspots by the Convention on Biological Diversity (IFAW, 2024). On the contrary, biodiversity and ecosystem stability are deteriorating day by day. Citizen science can be used to address environmental issues as well as other social, economic issues. Empirical studies on citizen science projects in Sri Lanka included in Scopus and Web of Science bibliographic databases from 2017 to 2025 can be mapped as shown in Figure 3. It shows several interconnected clusters, which demonstrate dispersion of CS projects across multiple domains.

Figure 3

Co-occurrence of keywords in Sri Lankan citizen science research



Source: Generated by Authors

The central citizen science hub (yellow) connecting all other themes, represents the fundamental participatory approach where non-scientists contribute to scientific research in Sri Lanka, serving as the organising framework for various environmental monitoring initiatives. The Indigenous Knowledge and Disaster Response cluster (green) connects traditional ecological knowledge with modern disaster management, particularly for floods in Sri Lanka. Cluster depicting Ecological Modelling and Anthropogenic Effects (Blue) uses citizen science to monitor and model human impacts on ecosystems, including air pollution in rural areas and tracking effects on wildlife like jungle cats in Sri Lanka. The purple cluster - Pollution and Contaminants Monitoring focuses on community-based tracking of environmental pollutants, prominently featuring the citizen response to the M/V X-Press Pearl ship disaster that contaminated Sri

Lanka's beaches with plastic nurdles. Coastal and Marine Ecosystems (blue), covers citizen science initiatives in coastal waters, aquaculture, habitat structures, and marine environmental risks, particularly along Sri Lanka's coastline.

In 2014, Karunarathne urged scientists to use this invaluable and important tool properly to transform the research culture in the country. Current technological infrastructure in the country remains supportive for such initiatives: As of January 2025, Sri Lanka had 29.3 million mobile connections (127% of the population) with 93.3% being broadband-enabled, indicating the widespread mobile access. Internet penetration reached 53.6%, with 12.4 million users, marking a 7% increase from the previous year. Social media usage stood at 8.2 million users, or 35.4% of the population (Datareportal, 2025). Though Karunarathne (2014) pointed it out, convincing people to participate in scientific research would be a challenge. The electronic and printed media should play a vital role linking researchers with the general public, and it could be a blessing in disguise for Sri Lankan library systems.

Libraries and Citizen Science

Analysis of global literature reveals that libraries are emerging as contributors or vital partners in citizen science by providing tools, spaces, and expertise for citizen science projects (Mumelaš & Martek, 2024). Their involvement not only supports scientific research but also enhances their community value, attracting more visitors and enriching their roles as community knowledge hubs.

Historically, libraries have strived to serve beyond their walls, catering to disadvantaged and marginalised populations who might otherwise lack access to information. These initiatives were known as outreach services. Over the years, outreach has evolved, with libraries hosting activities that cater to various interests and needs, such as book clubs, skills development programs, training activities, workshops, and wellness programs. In Sri Lanka, institutions like the Outreach Services Division of University of Moratuwa and the regional library network and Foundation for Library Awareness (FOLA) of South Eastern University of Sri Lanka have demonstrated the transformative power of library outreach, bridging gaps in information access and empowering local communities with information (Seneviratne & Weerakoon, 2024). Krishanthy and Gamage (2024) explored the commitment of Sri Lankan university libraries in achieving SDGs and highlighted their localized activities in comparison to global practices such as seed libraries, zero-waste initiatives, recycling projects, sustainable landscaping, rainwater harvesting etc. However, the involvement of Sri Lankan librarians in raising environmental literacy and strategic management of natural resources cannot be overlooked (Jayawardena & Seneviratne, 2024; Lavanya et al., 2025; Navaneethakrishnan & Sivakumar, 2015, 2016; Rubini et al., 2023).Such initiatives highlight libraries' role as community-centered institutions, a foundation that seamlessly supports the integration of citizen science today. With their established outreach experience, libraries can now extend their services to help engaging the public in scientific research. Libraries’ deep-rooted community connections enable them to facilitate citizen science projects that foster learning and promote active involvement in societal progress.

Why should libraries engage in citizen science

Libraries' engagement in citizen science offers both internal and external benefits. Externally, it strengthens community partnerships, attracts new users, and enhances the library's visibility and public image while positioning them as partners in scientific and social progress (Mumelas & Martek, 2024). By involving citizens in research, libraries become active spaces for collaboration and shared learning rather than traditional book-centred institutions (Golumbic et al., 2017). They also promote the idea that "science is for everyone", bridging the gap between academia and everyday life.

Internally, citizen science involvement improves staff skills, supports collection development, and encourages innovation in library services (Ignat et al., 2021). Participation also offers professional development opportunities for librarians through activities like data management and community engagement (Duerinckx et al., 2022; Kaarsted et al., 2021). Overall, citizen science enhances the relevance of libraries in the digital age.

Aim and Objectives

Published global literature reveals the evolving role of libraries as hubs and librarians as facilitators for citizen science. Examining these roles highlights the transformative potential of Sri Lankan libraries as well. However, Sri Lanka lacks documented frameworks, case studies, or practical guidance on library engagement in citizen science, preventing libraries from leveraging their resources despite the country's rich biodiversity and environmental challenges. Consequently, it is unclear how libraries and librarians in the country can contribute to citizen science projects effectively. This rapid review addresses this gap by examining global practices to provide

actionable insights for Sri Lankan libraries. Therefore, the main aim of this rapid review is to analyze the global literature on the involvement of libraries and librarians in citizen science and draw insights to inspire the local library community. The review focus on two preliminary questions relevant to the context.

- How can libraries support citizen science projects?
- What are the roles and contributions of librarians in citizen science?

By answering the above questions, the review aims to inspire similar initiatives among local communities.

Method

This research adopts a rapid review methodology, which simplifies the selection and review process compared to systematic reviews. Rapid reviews are conducted with the needs of the decision maker in mind and involve a close relationship with the end-user (Haby et al., 2016). While methodological shortcuts can increase bias risk (Haby et al., 2024), the authors adhered to recommended practices to minimize this limitation.

The review draws from peer-reviewed articles and grey literature. Given citizen science's evolving multidisciplinary nature, peer-reviewed sources alone may not capture current practices. Therefore, authoritative websites (European Citizen Science Association, SciStarter, government initiatives) were included for pragmatic examples and current data, selected based on credibility, institutional affiliation, recency, and relevance (Scistarter, 2020).

A literature search was performed in November 2024 using "citizen science AND (libraries OR librarians)" in TITLE, ABSTRACT, and KEYWORDS fields across Scopus and Web of Science. From 400 Scopus results, 42 peer-

reviewed English articles were selected; Web of Science yielded 17 additional articles. After removing duplicates, 21 articles (2004-2024) were identified, with 9 describing direct library involvement. Combining scholarly and grey sources enhances the review's comprehensiveness and practical applicability.

Findings

1. How can Libraries support citizen science projects

According to reported studies, libraries can contribute in four ways to the CSPs: a. Organising and hosting citizen science events, b. By providing spaces for collaboration and learning, c. Providing infrastructure and equipment,and d. Supporting open access to information resources and establishing data repositories. Sometimes a library may support just one of these activities, while others may engage in several, depending on their resources and community needs.

(a) Organising, hosting citizen science projects

Public libraries, in particular, are well-positioned to become "societal knowledge hubs" by organising CS projects and encouraging citizen science participation (European Commission et al., 2023).The European Citizen Science (ECS) project provides a good example for this initiative. Ten public libraries across Europeorganized local community events and focus groups on citizen science, demonstrating how libraries can serve as community hubs for collaborative scientific activities (Chalant, 2024). In addition, many case studies from Europe, such as the France Bevk Public Library Citizen Science project; “the seed library” (https://zenodo.org/records/13223079); “living labs” project in public libraries in Barcelona, Spain; Intermunicipal Network of Libraries of Beiras and Serra da Estrela (RIBBSE) in Portugal,

demonstrates the potential of public libraries to partner with other organizations and launch CS projects. Libraries were the driving force behind these projects, choosing themes, organising and energising activities in their communities, and establishing partnerships (Pimentel & Gomes, 2024). In April 2024, US libraries and their diverse communities were engaged in a programme called "One Million Acts of Science" by hosting, promoting, and participating in events and projects engaging the public in research ranging from the total solar eclipse to Alzheimer's to nature and the All of US program (Moundalak, 2024).

Examples from Academic libraries include projects like SPIPOLL (a biodiversity monitoring initiative) where University of Bordeaux host citizen science events and exhibitions. Additionally, the University College London and the University of Barcelona have been highlighted for their direct engagement in organising citizen science projects, serving as institutional case studies of library-led initiatives (Ignat, 2018). The National and University Library in Zagreb Croatia, has implemented citizen science activities, positioning itself as a key organiser and implementer of such initiatives within its community (Mumelas & Filipeti, 2025).

In the "A Healthier Funen" project, libraries on the island of Funen, Denmark, collaborated with University Library of Southern Denmark (SDU), alongside with Odense University Hospital and a regional broadcaster. The University Library holds joint leadership with the Faculty of Health Sciences in the Citizen Science Network at SDU, playing a collaborative role in the project (LIBER Citizen Science Working Group).

(b) Providing spaces for collaboration and learning,

Libraries can provide both physical and virtual spaces for stakeholders in citizen science projects. When collaborations occur, libraries can provide spaces to host events, house collections or train participants. Public libraries in Barcelona have provided physical and social spaces for collaboration and learning by hosting co-creation activities involving librarians, library users, and professional scientists (Cigarini, 2020). Two public libraries in Slovenia had taken the leadership to co-host meetings for public libraries involved in citizen science, held in a social and creative hub that includes maker spaces (Chalant, 2024).

(c) Providing infrastructure and equipment

Libraries have established mechanisms for lending information resources to users. This practice is now extended to empower citizen science projects by lending specialized equipment. Many libraries lend equipment such as air quality sensors, camera traps, microscopes, recording equipment, 3-D printers, and technology such as design and statistical software (Ignat et al., 2018). This shows how libraries can act as local infrastructure hubs, by giving access to specialized equipment and enabling citizens to contribute meaningfully to scientific research even without their own equipment.

The lakes project in Denmark is a useful example where public libraries partnered with biiologists from the University of Southern Denmark to map water quality in lakes. Libraries lent sampling kits, collected samples and helped recruit participants; acting as a link between researchers and the community.

North Carolina State University Library and over 50 North Carolina Public Libraries provide camera traps to monitor wildlife populations across the state. Libraries check kits in and out, volunteers and provide assistance on the camera trapping and data uploading process (Arizona State University, 2019).

In the United States, the Natural History Museum of Los Angeles County works with the Los Angeles County Library to develop community science kits. These include an instructional guide, field guides, a journal, and tools to support outdoor exploration. Children and parents can borrow kits for free from library. The Museum hosts events in libraries to introduce the kits (SciStarter, 2019).

Other examples come from Canada, the UK, Qatar and Poland. Toronto Public Library provides equipment and space for environmental monitoring while the British Library enables the public to join crowdsourcing projects through digital tools. Qatar National Library offers tools, technology, and software for projects. In Poland, libraries provide access to resources and offer technical infrastructure, although participation in these services is sometimes constrained by limited resources (Kowalska-Chrzanowska, 2024).

(d) Supporting open access to knowledge material and establishing data repositories

Libraries contribute to managing the citizen science knowledge ecosystem in two ways;by i). Establishing data collection portals where community members can submit findings and ii.) Providing access to educational material or access to ongoing project data. Ultimately, the data collected and shared through these portals can support local or global initiatives through information sharing.

The responsibility of libraries is to create sustainable communication channels where public input is valued and knowledge dissemination is streamlined. The data input procedures by citizens should be transparent and ethical (Hecker et al., 2018).Whereas the data /information storage and sharing should follow FAIR (Findable, Accessible, Interoperable, and Reusable) principles. For instance, the University of Southern Denmark and Qatar National Library have contributed to building and maintaining such data infrastructures, facilitating data collection and sharing for citizen science projects (Ignat, 2018).

2 Roles and contributions of librarians in citizen science

Throughout history, librarians have faced multiple challenges arising from technology and societal changes and have managed to evolve into a dynamic professional group. In the digital age, they have identified another new domain - citizen science, where they can play a pivotal role acting as connectors, facilitators, educators and data curators. Their contributions improve both the accessibility and effectiveness of CS projects.

(a)Community connectors - bridging scientists and the public

Librarians maintain solid relationships with community organisations, local government, and educational institutions. Therefore, theyare well-positioned to act as the connection node between institutions/scientists and the public. Their role is to encourage public participation and support a collaborative research culture (Cohen et al., 2015). One example is the annual “Citizen Science Day Expo” by the San Diego Public Library, which brings the community and Citizen Science organisations together. This event allows the community to explore a wide range of research projects that need volunteers,

helping address the challenge many CS organisations face in raising awareness and recruiting participants (Arizona State University, 2019).

(b) Project facilitators – initiating and supporting citizen science activities

Librarians' role extends beyond just connectors. They support both the initiation and ongoing success of projects. Their responsibilities include community engagement, recruitment, documentation, and event organisation. Because librarians frequently interact with the community through community networks and local forums, they have a deep understanding of community needs. This insight enables them to identify and recommend citizen science initiatives that align with local interests.

Within library communities, there can be individuals and families interested in engaging in scientific endeavours to help address real-time issues and learn more about the surroundings. Since libraries have records of personal details and preferences of patrons, they can connect patrons with relevant projects (Recruit volunteers) (Arizona State University, 2019; Rabe, 2024).

Librarians are regularly engaged in marketing and promotional activities of library services. They can use their expertise to raise awareness of citizen science projects through targeted promotions using social media, newsletters, and collaborations with local organisations. Events such as citizen science fairs, workshops, and exhibitions allow libraries to showcase ongoing projects and highlight the societal benefits of public involvement in scientific research (Moundalak, 2024).

They also assist with project documentation, ensuring that data collection, outcomes, and best practices are recorded and shared, supporting transparency and knowledge dissemination (Cigarini et al., 2020).

(c) Educators - offering training and support for citizen science participation

Libraries are traditionally engaged in empowering communities by hosting workshops, training sessions, and boot camps based on local needs. Librarians can extend these services to educate the public about citizen science. This includes teaching standard data collection techniques, data validation, and critical analysis, ensuring that participants can contribute accurate and reliable data to scientific projects (Downs et al., 2021; Follett & Strezov, 2015). They can also offer activities to build information literacy and digital literacy skills.

Librarians may also offer training for their own community. For example, the Los Angeles Public Library has collaborated with the Global Learning and Observations to Benefit the Environment (GLOBE) Program to train a group of librarians to host hands-on Neighbourhood Science pilot programs at 13 branch libraries. These programs help improve participants' environmental and data literacy while promoting community involvement (SciStarter, 2019).

Librarians' technical skills, such as cataloguing, indexing, and abstracting, can also support citizen science. These skills can be used to create or contribute to toolkits that help start and maintain projects. Such toolkits usually include protocols, data collection forms, and educational materials to guide participants through the research process. By using standards to develop and manage these resources, librarians help ensure consistent and effective practices and make it easier to share the toolkits with other organisations.

(d) Data curators

Information management is a core responsibility of librarians. This includes collecting, storing and disseminating information. They can use their expertise to manage research data from CS projects by organising and curating datasets to ensure they are accessible, usable and reusable. Librarians also play a vital role in disseminating new findings, supporting both scholarly communication and public science awareness.

Librarians are known to have sound knowledge of intellectual property laws. Therefore, they can support citizen science projects by identifying legal and ethical issues, such as copyright and data protection, drafting terms of participation, and motivating good data handling practices (Hansen et al., 2021).

Quality assurance is essential in citizen science, as data collected by citizen scientists should meet scientific standards. Librarians can contribute significantly to quality assessment and quality control. This involvement enhances the reliability of research outcomes and strengthens trust between professional scientists and the public.

By taking on these diverse roles, librarians reinforce their position as indispensable facilitators of citizen science, promoting meaningful public participation and encouraging culture of shared scientific discovery.

Discussion

Public and academic libraries are increasingly seen as strong supporters of citizen science because they function as “knowledge hubs” within their communities. Their accessibility, inclusiveness, and ability to share

information make them ideal partners for citizen science initiatives. In many countries in the global North such as in Europe and the United States libraries have supported citizen science by hosting events, providing space for collaboration, lending equipment, and offering access to information resources and data repositories. These activities show how libraries can connect scientific institutions with the public.

In Sri Lanka, such initiatives are limited, yet the country's public and university libraries have significant untapped potential. With Sri Lanka's biodiversity, cultural heritage, and various environmental and health challenges, libraries could become platforms for projects on environmental monitoring, public health, or documenting indigenous knowledge.

The role of librarians in citizen science also goes beyond their traditional duties. Around the world, librarians act as connectors, facilitators, educators, and data curators. Because they work closely with a wide range of community groups, they can bridge the gap between researchers and the public. They also have strong information management skills—organising, storing, and sharing information—which are valuable for handling citizen science data. With these strengths, librarians can guide communities, provide learning resources, and support people as they engage with scientific processes.

Several countries already train librarians for citizen science work. For example, in Australia, public librarians have been trained to help citizens use scientific apps and tools to collect environmental data. In Sri Lanka, where citizen science is still developing, librarians can start by raising awareness, offering basic training, and working with communities. With proper support, they could eventually take on larger roles as facilitators of participatory

research, managers of community-generated data, and educators who inspire interest in science at the local level.

Conclusion and Recommendations

This rapid review highlights the growing role of libraries worldwide in supporting citizen science by offering space, equipment, information resources, and community engagement opportunities. Librarians act as facilitators, educators, and data managers linking citizens with scientific activities. In Sri Lanka, the absence of formal frameworks, case studies, and supportive policies limits the integration of citizen science into library services.

To strengthen this area, librarians should first receive training on citizen science, data handling, and community outreach. Libraries can then introduce citizen science activities through existing programs such as reading clubs, environmental events, or digital literacy workshops. Building partnerships with universities, research institutions, and NGOs will help create local projects suited to community needs. Over time, libraries may also develop small digital repositories to store and share project results. Finally, professional bodies should consider including citizen science in national library policies to support long-term growth.

By embarking on these initiatives, Sri Lankan libraries can become active partners in community-based research and help promote scientific literacy and public participation across the country. The authors also recommend that future studies examine the barriers and challenges that may hinder the integration of citizen science within library services.

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Journal of the University Librarians Association of Sri Lanka, Vol. 29, Issue 1, January 2026, 138–163, DOI: https://doi.org/10.4038/jula.v29i1.8119

Intentions to Use E-resources in University Libraries by Postgraduate Students in Sri Lanka: An Application of the Theory of Planned Behaviour

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ABSTRACT

In today's digital era university libraries are compelled to offer e-resources to fulfil the evolving information needs of their user community and to sustain their relevance. Postgraduate students are an important user category of university libraries and they are provided with support for academic growth and success. Despite significant investments in e-resources by Sri Lankan universities, the effective use of these valuable resources by postgraduate students is still under question. Therefore, this research attempts to examine the significant factors that affect postgraduate students' intention to utilize e-resources for academic purposes by the application of the prominent Theory of Planned Behaviour. A quantitative approach was followed employing a questionnaire-based survey among a convenient sample (n=102) of postgraduate students enrolled in state universities of Sri Lanka. Results exhibited that Attitude (β =0.521; $p<0.05$) and Perceived Behavioural Control (β=0.335; $p<0.05$) were strong predictors of the intention of postgraduate students to use e-resources. However, Subjective Norm was revealed to be a non-significant predictor of the intention.

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Received: 02 May 2025, Accepted revised version: 30 December 2025.

Further the results verified that the Theory of Planned Behaviour (TPB) explains a considerable proportion of the variance in intention (R^2=0.534) within the examined sample. The study renders significant insights into the applicability of TPB within a specific subset of postgraduate students in Sri Lanka and suggests that further studies employing a more representative sample could explore the generalizability of these findings. Understanding the drivers identified through this research could help design interventions that encourage the use of e-resources among postgraduate students in Sri Lanka. This will ultimately enhance their overall educational experience and academic success.

Key Words: *Theory of Planned Behaviour, Intention, Sri Lanka, E-resources, Postgraduates*

Introduction

In the current digital era university libraries are compelled to offer e-resources to fulfill the evolving information demands of their user community. With the growth of online learning and remote research the university community expects instant access to a wide array of scholarly information from anywhere and anytime. In this context, e-resources play a salient role in meeting the needs of tech-savvy users and adapting to the digital world. E-resources include databases, e-journals, e-books, e-theses and dissertations, online catalogues etc. In a networked surrounding, e-resources stand out as the primary choice of resource for teaching and research within the university library (Bellary & Surve, 2019). Shuling (2007) also emphasizes that electronic resources have increasingly become an important resource in university libraries. Further, it is important to note that “because of the easy accessibility, low cost and effective presentation

with multimedia tools e-resources have become the most popular source of information" (Veer & Panda, 2021, p. 01). E-resources enrich the learning process through the provision of relevant information and they open up an interactive medium of communication (Millawithanachchi, 2012). In order to meet the evolving requirements of their users and to sustain their value in the academic environment, university libraries are expanding their collections to ensure user accessibility to a diverse range of e-resources.

The increasing reliance on e-resources is crucial for all user groups served by university libraries including undergraduate students, postgraduate students, teaching staff and researchers. Among these user categories, postgraduate students are significant and university libraries are dedicated to fulfill their research needs. The academic pursuits of postgraduate students normally involve specialized and intricate information needs and these students heavily rely on library resources to access scholarly material, conduct literature surveys and develop research competencies (Farooqui & Hadagali, 2022). Thus, university libraries play a vital role in facilitating the academic development and success of postgraduate students through the provision of various e-resources.

Nevertheless, Sri Lankan university libraries are investing large amounts of finances, time and efforts to provide access to various e-resources. However, there remains a concern regarding their actual use, especially among postgraduate students. One major initiative in this regard was to formulate a consortium by the University Grants Commission of Sri Lanka utilizing a centrally funded model to offer enhanced access to e-resources in a cost-effective way (Wijetunge, 2017). Also, universities offer various types of e-resources such as CD-ROM, e-books, e-journals, online catalogues, online past papers etc. (Dilrukshi, 2015; Hindagolla & Weerasinghe, 2021;

Lavanya & Santharooban, 2018). Some universities independently subscribe to certain databases like JSTOR, HINARI, AGORA, OARE, EBSCOHost (Lavanya & Santharooban, 2018; Gunasekera et al., 2021), while also actively promoting open access resources and links through library websites (Premarathne, 2017). Furthermore, several university libraries have established institutional repositories allowing scholars to self-archive their publications (Arachchige & Karunaratne, 2012).

But, the mere availability of these e-resources does not ensure their effective use. It is questionable whether these e-resources are optimally utilized by postgraduate students in Sri Lanka. Prior studies in Sri Lanka have indicated that postgraduate students are not making optimal use of e-resources (Gunasekera & Balasubramani, 2019; Peiris & Peiris, 2013). Lack of comprehensive understanding of factors influencing postgraduate students to use e-resources may contribute for the underutilization of these valuable resources, which in turn, can be a hindrance to the overall educational experience of postgraduate students in Sri Lanka.

This highlights a gap in understanding the factors driving e-resource adoption, particularly from a behavioural and motivational perspective. In the Sri Lankan context there are limited studies that explore the psychological and motivational aspects influencing user decisions in engaging with e-resources, especially among postgraduate students who are expected to involve heavily with academic research. User perceptions have a strong impact on the technology adoption behavior (Jeong, 2011). Thus, it is important to determine the key motivational factors that drive users to utilize e-resources through a sound theoretical base. In the Sri Lankan context, there is a scarcity of such research which examines the intentions of postgraduate students towards using e-resources for academic purposes.

Hence, this study attempts to address this research gap by exploring the intentions of postgraduate students in Sri Lanka to use e-resources with the application of Theory of Planned Behaviour (TPB). In this regard, the TPB offers a well-established model for the prediction and explanation of individual intentions and has been successfully applied in various information and educational technology studies (Owusu et al., 2020; Sok et al., 2021). However, TPB has received less attention in e-resource usage studies in Sri Lanka, in particularly at the postgraduate level. The application of this model will render deeper insights of how personal attitudes, social influence and perceived control affect the postgraduate students' intention to use e-resources. This theoretical base allows for a systematic investigation of user intention, enabling explanatory power as well as practical applicability. Addressing this research gap is crucial for optimizing university investments, enhancing library services, contributing to the literature on e-resource adoption in developing nations and informing policies and strategies to promote the effective use of valuable scholarly resources.

Research Objectives

The overall objective is to examine the intention of postgraduate students to use e-resources in university libraries in Sri Lanka. The following specific objectives guide this study:

- To find the factors affecting the intention of postgraduate students to use e-resources in university libraries.
- To examine the extent to which the TPB predicts the intention of postgraduate students to use e-resources in the context of university libraries in Sri Lanka.

Literature Review

E-resource Usage of Postgraduate Students in the International Context

Several researchers around the world have studied the e-resource usage of postgraduate students in various institutions (Garg & Tamrakar, 2014; Ozoemelem, 2009; Soyizwapi, 2005; Thanuskodi, 2012) and they emphasized that e-resources are not utilized at an optimum level by these students. In his study focused on postgraduates and research scholars of an Indian university. Thanuskodi (2012) observed that certain types of e-resources including e-theses, e-abstracts, catalogues and databases were poorly used by postgraduates due to their unawareness regarding these resources. In a similar study, Garg and Tamrakar (2014) mentioned that the library played a vital role in creating awareness and training postgraduate students to use e-resources in a better way. Various challenges in accessing electronic databases were identified from the study performed by Soyizwapi (2005) targeting postgraduates of Faculty of Science and Agriculture in a South African university. In a related attempt, Ozoemelem (2009) surveyed postgraduate students in the LIS discipline at a Nigerian university and found that these students did not possess adequate skills in ICT use, which may in turn hinder the effective use of e-resources by them. Similarly, in a recent study, Farooqui and Hadagali (2022) carried out a survey (n=540) among postgraduates of management colleges attached to an Indian university to examine how they utilized library services. Findings revealed that a significant proportion of students visited the library twice every week and the main reason for these visits included borrowing books and reading. Further, results highlighted the varying levels of students' awareness with regard to different library services. Overall, most of the postgraduates expressed satisfaction with their respective library services and collections.

E-resource Usage of Postgraduate Students in the Sri Lankan Context

In the Sri Lankan context, only few researchers have engaged in examining the use of e-resources by postgraduate students. In the recent past, Gunasekera and Balasubramani (2019) examined the electronic information seeking behaviours of postgraduates in the field of Education. A survey was conducted among postgraduate students of the Faculty of Arts, University of Peradeniya, Sri Lanka. Findings exhibited that majority of the respondents used e-resources of the library whereas catalogues and websites were the most popular e-resources among others. The authors underscored the importance of sufficient training and well-structured programs for users to maximize e-resource utilization. Similarly, Peiris and Peiris (2013) conducted a survey to find out the use of Electronic Information Resources (EIR) by postgraduates of University of Peradeniya, Sri Lanka. It was observed that most respondents (77%) had used EIR and these resources were mainly used for writing reports. Yet, it was found that library databases were the least accessed resource by postgraduates. Also, majority of students learned to use EIR through trial and error and self-learning. However, it was revealed that they were not satisfied with the current e-services of the library and they strongly perceived that EIR were not optimally used due to various problems. In a similar way, Sritharan (2018) carried out a research to assess the level of satisfaction towards EIR by postgraduate trainees at the Postgraduate Institute of Medicine, University of Colombo, Sri Lanka. Data were gathered via a survey performed among a random sample of 100 trainees from 32 medical specialties. It was revealed that majority of respondents (98.6%) used EIR to update knowledge and for study purposes. A considerable proportion (60.2%) of them was satisfied with Internet access of the library and more than half of them were satisfied with e-journals

subscribed by the library. The recommendations of the researcher included providing more training opportunities for these users. However, these studies have not applied a theoretical framework for their investigations. The absence of a guiding theoretical framework to systematically explain students' behaviours highlights a gap which the current study addresses by applying a prominent theory (TPB) to better understand postgraduate students' intentions to use e-resources in Sri Lanka.

In a different study, Millawithanachchi (2012) identified critical success factors on e-resources use by postgraduates of University of Colombo, Sri Lanka. This study was carried out as a case study at University of Colombo involving 302 postgraduate students from 7 faculties. Nine important factors were identified as to influence e-resource usage. Among them "technology" emerged as the most critical factor affecting e-resource use of postgraduate students. The other critical success factors for utilizing e-resources for learning purposes included Library support, information literacy, computer competency, usefulness and user attitudes. On the other hand, Jayakanthan and Jeyaraj (2019) applied the Unified Theory of Acceptance and Use of Technology (UTAUT) model to examine factors influencing the behavioral intention to utilize EIR by postgraduates of Eastern University of Sri Lanka. The authors tested a conceptual model with 208 postgraduates. Facilitating conditions and effort expectancy were found to be the most significant determinants of students' intention to use EIR. Also, intention was revealed to have a strong influence on the actual use of these resources. The authors stressed the importance of these types of studies done through the application of emerging technology acceptance models.

Selection of Theory of Planned Behaviour

Literature indicates that various theories and models explain user acceptance and adoption of technologies, including the Theory of Reasoned Action (TRA), Technology Acceptance Model, Theory of Planned Behaviour (TPB), Social Cognitive Theory, Innovation Diffusion Theory etc. Among these the TPB is a well-established, rigorously tested and widely employed social cognitive model for predicting user behaviour intentions (Austvoll-Dahlgren et al., 2012). Addressing limitations of the TRA, the factor Perceived Behavioural Control (PBC) has been introduced in TPB which recognizes that an individual's ability to engage in a behaviour may depend on their own capacity to perform it (Kripanont, 2007). Thus, TPB offers a comprehensive explanatory framework capturing multi-faceted influences on e-resources use. It provides specific information rendering deeper insight into why an individual or a user group might not use technology (Matheison, 1991). Studies have verified that the TPB has a sound predictive capability in explaining behavioural intentions across various contexts in technology adoption (Ajzen, 1991; Owusu et al., 2020; Sok et al., 2021). Therefore, TPB was chosen as the theoretical basis for the current study.

Application of TPB in Information Systems Research

In the realm of information systems, Ugwu and Ejikeme (2020) applied the TPB to investigate Library and Information Sciences (LIS) students' intentions to utilize e-resources. Findings indicated that all three constructs of TPB were predictors of the intention. However, attitude was the most salient determinant of intention, while PBC was a stronger determinant than subjective norm. In a related study, Zamani-Miandashtiet et al. (2013) employed TPB to predict the use of Internet behaviour among agriculture undergraduates of an Iranian University. A survey was performed among

214 students to gather data. Findings demonstrated that intention and subjective norm were the strongest predictors accounting for 57% of the variance. The most significant determinant of the intention was PBC whereas attitude did not directly influence the use of Internet behavior. TPB was found to be a successful model for explaining the use of Internet. Extending the higher order conceptualization of the basic factors of the TPB, Taneja (2006) examined the adverse use of Information Systems (IS) assets by employees. The author sought to predict employees' intention towards the adverse use of IS assets. Findings showed that attitude and social influence were significant predictors of intention. However, PBC exerted less influence on the intention. In another study, Austvoll-Dahlgren et al. (2012) applied the TPB to investigate cognitive factors that predict user intention to seek health information. A questionnaire was administered among a mixed population sample (n=30) and parents' sample (n=45). Findings revealed that attitudes and PBC were significant predictors of intention. The authors concluded that the questionnaire developed based on TPB served as a promising tool for explaining beliefs and intentions concerning health information seeking.

The aforementioned literature survey demonstrates that there is a dearth of systematic studies which have analyzed individual level factors that affect the use of e-resources by postgraduates in Sri Lanka. Therefore, it is crucial to investigate underlying factors influencing the intention of postgraduate students to use e-resources through a theoretical perspective. Moreover**,** despite the widespread applicability of TPB across various fields, the applicability and value of TPB in the LIS field is still uncertain (Ugwu & Ejikeme, 2020). Addressing this literature gap, the current study aims to apply TPB for the better understanding of postgraduate students' intentions

to use e-resources. The study will contribute to update the existing body of knowledge by extending the application of TPB into the context of LIS in Sri Lanka.

Research Model and Hypotheses

The Theory of Planned Behavior (TPB) is applied as the theoretical framework of this study. The TPB was introduced by Icek Ajzen in 1985 and it theorizes that user intention to engage in certain behaviour is influenced by three main factors: Attitude (AT), Perceived Behavioural Control (PBC) and Subjective Norm (SN).

However, the current study sought to identify key drivers of postgraduate students' intention to use e-resources, as a critical initial step in understanding the acceptance and adoption of these resources. While the TPB typically includes the behaviour component, this study omits the behaviour component, primarily shedding light on the formation of intentions than the actual use behaviour. Also, measuring the actual behaviour is beyond the scope of the current study as well as due to various practical limitations measured actual behaviour may not accurately reflect the underlying intentions.

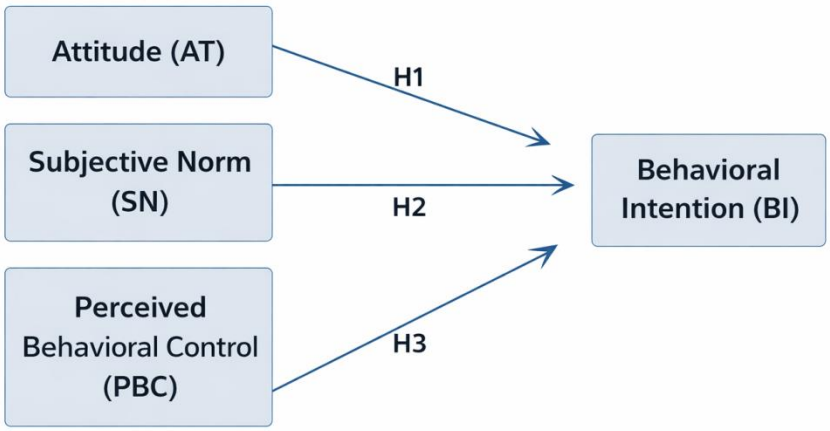
In the present study, the targeted behaviour is use of e-resources for academic purposes. Intention is the immediate predictor of behavior (Ajzen, 1991) and in this research Behavioural Intention (BI) is the users' willingness or readiness to use e-resources (Ugwu & Ejikeme, 2020). SN refers to the "perceived social pressure to perform or not to perform the behavior" (Ajzen, 1991, p. 188). In this study, SN is the perception of expectations of important referents such as supervisors, peers, lecturers etc. with regard to postgraduate students' use of e-resources for their academic

work. PBC is "the perceived ease or difficulty of performing the behavior and it is assumed to reflect past experience as well as anticipated impediments and obstacles" (Ajzen, 1991, p. 188). PBC can be operationally defined as the postgraduate students' believed ability to use e-resources effectively including their confidence in the ability to access, retrieve and utilize various e-resources successfully. Attitude is referred to "the degree to which a person has a favorable or unfavorable evaluation or appraisal of the behavior in question" (Ajzen, 1991, p. 188). In this study attitude is the postgraduate students' overall positive or negative evaluation of utilizing of e-resources to fulfill their academic endeavours.

Based on the TPB and aforementioned literature the following research hypotheses are proposed in this study:

H1: There is a significant positive effect of attitude towards the behavioural intention to use e-resources by postgraduates in Sri Lanka.
H2: There is a significant positive effect of subjective norm towards the behavioural intention to use e-resources by postgraduates in Sri Lanka.
H3: There is a significant positive effect of perceived behavioural control towards the behavioural intention to use e-resources by postgraduates in Sri Lanka.

Figure 1
Adaptation of Theory of Planned Behaviour



Note. From Author Ajzen, 1985, 1991

Methodology

The study followed a quantitative approach using the survey strategy. The study targeted the population of all postgraduate students enrolled in Sri Lankan state universities. However, due to practical constraints a convenience sample which consisted of 150 postgraduate students was used to conduct the survey. Postgraduate students enrolled to follow a research methodology course at University of Kelaniya as well as postgraduate students registered at University of Peradeniya were considered in this sample (See below page 15). Convenience sampling method was deemed appropriate due to the exploratory nature of this study. While convenience sampling provides easy access to the geographically dispersed study population, the limitation in terms of generalizability is acknowledged.

Data were collected using a structured questionnaire created using Google form and it was distributed through email and social media platforms. The

measurement items for constructs of the model were adapted from previous research (Boyko et al., 2011; Hebeshy et al., 2020) and modified to fit with the current research context. For example, the following items were adapted to measure the construct of PBC:

"The decision to use e-resources is beyond my control"

"I am confident that I can use e-resources"

"Whether or not I use E-resources is entirely up to me"

A multiple-item 7-point Likert scale, ranging from "strongly disagree" to "strongly agree" was used to measure the items. Data analysis was conducted using Statistical Package for Social Sciences (SPSS) software applying descriptive statistics and regression analysis techniques.

Results and Discussion

Out of the distributed 150 questionnaires, 102 usable responses were received yielding a response rate of 68%.

Out of the respondents, the majority were females (51%) while 49% were males. Almost half of the postgraduates (49%) fell within the 31-40-year age category, with 35% belonging in the 41-50-year age category. Further, most of the respondents (60%) were pursuing a Master's Degree program, followed by 27% of them enrolled in MPhil level. With respect to their subject discipline, majority were in the Science stream (43%), followed by Social Sciences (19%). The rest of the respondents were enrolled in various fields such as Humanities, Medicine, Commerce, Music and education. A significant proportion of postgraduate students (39%) were registered at University of Kelaniya, Sri Lanka whereas 31% of them were registered at University of Peradeniya, Sri Lanka for their programs.

Table 1
Demographic Profile of the Respondents

Demographic categories	Percentage (%)
Gender	
Male	49
Female	51
Age	
<30 years	7
31-40	49
41-50	35
51-60	7
>60	2
Study level	
PG Diploma	4
Masters	60
MPhil	27
PhD	9
Subject field	
Social Science	19
Science	43
Medical Sciences	7
Commerce/Management	6
Humanities	8
Education	11
Ayurveda	2
Music	4
University	
Kelaniya	39
Peradeniya	31
Colombo	10
Sri Jayewardenepura	12
Open university	8

Table 2 presents the reliability of the model constructs and it's evident that all Cronbach's alpha values of the items exceeded the acceptable level of 0.7 (Sekaran, 2000), reflecting the high internal consistency of the measures.

Table 2
Cronbach's Alpha Values of the Model Constructs

Construct	Number of Items	Cronbach's Alpha Value
Behavioural Intention	3	0.966
Attitude	3	0.994
Subjective norm	3	0.816
Perceived Behavioural Control	2	0.728

Multiple regression analyses with ordinary least squares method in SPSS, was applied to test the research hypotheses proposed in this study and the results are depicted in Table 3. The direct effects of each independent variable namely, AT, SN and PBC on the dependent variable of BI were tested.

Table 3
Hypotheses Testing Results

Hypothesis	Path	Standard Beta Coefficient	Results
H1	AT → BI	0.521 ($p<0.05$)	Accepted
H2	SN → BI	-0.153 ($p>0.05$)	Not Accepted
H3	PBC → BI	0.335 ($p<0.05$)	Accepted

According to the findings, H1 was accepted. That is, there exists a significant positive relationship between attitude and the BI (β =0.521; $p<0.05$). This finding is in accordance with related prior studies (Austvoll-Dahlgren et al., 2012; Taneja, 2006; Ugwu & Ejikeme, 2020). It indicates that postgraduates' overall attitudes towards using e-resources strongly influence their intentions to actually utilize these resources. Thus, if the postgraduate students have positive attitudes towards e-resources, perceiving those to be relevant, beneficial and valuable they are more likely to engage with these resources. Also, H3 was accepted. That is, there exists a

significant positive relationship between PBC and the BI (β =0.335; $p<0.05$). This result complies with some previous studies (Austvoll-Dahlgren et al., 2012; Ugwu & Ejikeme, 2020). This result indicates that postgraduates' beliefs about their ability to use e-resources have a sound impact on their intentions to actually use these resources. Accordingly, postgraduate students who perceive that they have the necessary resources, skills and support to use e-resources are more likely to use these resources.

However, H2 was not supported indicating that the subjective norm was not a predictor of the BI (β =-0.153; $p>0.05$). This finding is contradictory with findings obtained in some prior studies, in which subjective norm was revealed to be a sound predictor of the BI (Taneja, 2006; Ugwu & Ejikeme, 2020). It highlights that in the current research context postgraduate students are not much influenced by the opinions of peers or faculty in the adoption of e-resources. This result may be attributed to the fact that postgraduate students may have a high level of autonomy and independence in their academic work, leading them to make their own judgments over social norms.

In addition, the highest Beta value was obtained for attitude, complementing the results of Ugwu & Ejikeme (2020). The dominance of the attitude construct suggests that postgraduate students are mainly driven by their own beliefs about the value of e-resources for their academic goals. Thus, they are more likely to embrace e-resources if they have positive perceptions that these resources will enhance their learning experience.Further, as demonstrated in Table 4, it was found that R^2 =0.534, reflecting that all three predictors (AT, SN and PBC) in the model jointly explained 53.4% of variance in the BI (dependent variable) to use e-resources by postgraduates in Sri Lanka. This shows that TPB has a high predictive power to explain the

intentions of postgraduates towards e-resource use for academic purposes in the Sri Lankan context.

Table 4
Model Summary of the Multiple Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.740[a]	.548	**.534**	.87334

a. Predictors: (Constant), Attitude, Subjective Norm, Perceived Behavioural Control

ANOVA[a]

Model	Sum of Squares	Df	Mean Square	F	Sig.
1					
Regression	42.21	3	14.07	39.61	.000[b]
	34.82	98	.355		
Residual	77.03	101			
Total					

a. Dependent Variable: Behavioural Intention
b. Predictors: (Constant), Attitude, Subjective Norm, Perceived Behavioural Control

Conclusion

In the context of applying TPB to gain insight into the postgraduates' intention to use e-resources it was revealed that attitude and PBC were salient determinants of the intention, while attitude was the strongest predictor of the intention. It reflects that, positive attitudes towards e-resources will strongly influence students' intentions to use them. Library management must take measures to promote the positive aspects of e-resources, through effective communication and targeted training, outlining

their advantages, value, relevance, convenience etc. which will help shape the students' attitudes towards e-resources and in turn increase their intentions to use these resources. Also, PBC of postgraduates, that is their perceptions about their ability to effectively utilize e-resources play a vital role in shaping their intentions to use these resources. Thus, it is important that the library management provide necessary tools, resources and training to enhance students' confidence in using e-resources which will in turn have a positive impact on their intentions to use these resources. Yet, subjective norm was found to be a non-significant determinant of the intention to use e-resources. Based on this result, it can be suggested that instead of solely focusing on social influences, the library management should adopt more effective approaches such as emphasizing the benefits of e-resources, addressing individual beliefs and offering personalized resources and support to popularize the use of e-resources among postgraduates in Sri Lanka. Furthermore, the TPB was proven to be a successful model to predict the intentions of postgraduate students towards using e-resources and the study provides empirical evidence to support the applicability of TPB into the context of Sri Lanka. Taking into consideration the motivational factors identified via this study, library management and practitioners could design effective interventions and strategies to increase the e-resource use by postgraduates in Sri Lanka which will ultimately lead to better outcomes in their academic endeavors.

This study had a single-country focus and limited to the university sector libraries. Also, the study employed a non-probability sampling technique which may give rise to generalizability issues. This study could be replicated by using a wider sample size and the results could be improved by incorporating other factors and moderators into the model to gain deeper insight into the intentions of postgraduates to use e-resources. It should be

noted that the omission of behaviour construct from the TPB frameworks as another limitation of the study. Future longitudinal studies could investigate the extent to which the predictors of intention identified via this study convert into actual use of e-resources.

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