

Needs Analysis of the Learning Object Repository Model for Scientific Writing Instruction in Higher Education

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Abstract

This research aims to analyze the requirements of a Learning Object Repository model for scientific writing instruction in higher education from the student's perspective. The employed method is a descriptive survey research design, with a sample of 136 students from a Buddhist Higher Education institution. The research instrument utilizes a questionnaire, and data analysis is conducted using percentage techniques. The findings of this research indicate that: 1) scientific writing exhibits a high level of complexity, with one contributing factor being the less effective utilization of learning resources. Despite this, the availability of learning technology on campus is satisfactory, and students demonstrate a commendable level of digital literacy. 2) A Learning Object Repository for Scientific Writing instruction that meets the needs of students should be capable of providing a meaningful learning experience by being interactive, participatory, and collaborative. The learning objects should also accommodate curriculum development outcomes, teaching activities, research projects, or other creative and academic contributions as learning products. A Learning Object Repository that provides a meaningful learning experience through interactivity, participation, and collaboration can enhance students' scientific writing skills. This research is expected to serve as the foundation for the development of a Learning Object Repository model, specifically in the field of scientific writing.

Keywords: Learning object, Learning object repository, Scientific writing, Scientific writing instruction.

Introduction

Writing scientific papers is indeed a crucial aspect for students. Engaging in scientific writing can enhance students' critical thinking skills (1). They are trained to evaluate information, construct arguments, and make decisions based on solid evidence. Scientific writing hones language skills, scientific communication, and self-directed learning (2). Additionally, it fosters scientific progress, disseminates research findings, and enhances professional development (3). In the context of scientific writing in the rapidly evolving era of information technology, students are confronted with numerous challenges. The first challenge is the diversity of formats and types of resources, presenting obstacles to effective search strategies (4). To navigate information searches effectively, students must possess strong digital literacy skills. The abundance of resources available on the internet also raises issues of information quality and reliability (5). Therefore,

students should be capable of evaluating the reliability and credibility of resources used in scientific writing.

Another challenge is the critical-reflective aspect of learning scientific writing, which requires more space (6). As learning facilitators, lecturers sometimes must prioritize reflection on the learning process and student writing outcomes. The absence of formal mechanisms to record and measure the development of writing skills can lead to a lack of awareness regarding the need for improvement. An integrated and focused documentation system is needed, along with the habituation of reflection as an integral part of the learning process. Implementing such measures will help to create a supportive environment for the growth of students' scientific writing competencies and ensure continuous improvement in the quality of scientific writing at the tertiary level. This forms the basis for

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developing the Learning Object Repository (LOR) to store and distribute learning materials and products, as well as materials for reflecting on the learning process.

An LOR is a digital platform that can present various forms and formats of Learning Objects (LOs) (7). LOs encompass text, quizzes, presentations, images, videos, and an LOR can contain mono disciplinary or multidisciplinary LOs. It consists of three main components: the LOs component, the metadata component, and value-added services (8). Functions within the LOs component include storing, searching, browsing, viewing, downloading, rating/commenting, bookmarking, automatic recommendations, knowledge filtering, and mash-ups. Functions within the metadata component include storing, viewing, downloading, validating, and social tagging. Meanwhile, functions within the value-added services component consist of personal accounts, forums, wikis, RSS feeds, blogs, and social networks.

In its development, the LOR has faced various criticisms when used in learning, with consideration that it is less able to help address specific learning problems and provide feedback on the learning experience of its users (9). Furthermore, the learning experiences and interactions among teachers and students using the digital resources available in the LOR are severely limited. To address these limitations, the LOR needs a more participative and collaborative environment (10). Therefore, the current focus of the LOR's development is on serving as a digital learning resource that can be utilized for more interactive distance learning (11).

A new model is needed to develop LOR to address the challenges of learning experience, interaction, participation, collaboration, and reflection in the digital learning environment. The developed LOR is single-domain, tailored to accommodate specific learning needs related to scientific writing. LOR for Scientific Writing Instruction is created by adopting a social model. This model emphasizes user contribution and participation to sustain the LOR (12). Consequently, the presented LOs are products of the learning process, serving as both reference materials and reflections on the learning experience.

Therefore, it is necessary to conduct a needs analysis to map the characteristics of LOR for

Scientific Writing Instruction based on the social model. Before delving into the study of the LOR characteristics, an analysis of the conditions of scientific writing learning must be conducted. This study aims to assess the current conditions in the field and identify the specific needs of university-level students for an LOR for Scientific Writing Instruction.

Materials and methods

Research design

The research design is quantitative, utilizing a survey method aimed at analyzing the needs of students for an LOR in Scientific Writing Instruction. Needs analysis aims to identify the gaps between the actual learning conditions in the field and the intended learning objectives that should be achieved (13). Data collection for the research was conducted from June to August 2023. The population of this study consists of 903 undergraduate students from Buddhist Higher Education Institutions in Indonesia, specifically from the Sriwijaya State Buddhist College, Raden Wijaya State Buddhist College, and Smartungga Buddhist College. Following Arikunto's recommendation, that if the population exceeds 100 individuals, a sample size of 10-15% of the population can be taken (14), the researcher employed a simple random sampling technique to select 15% of the total population. This approach was chosen because the population shared similar characteristics. Consequently, a sample size of 136 students was obtained, comprising 68 from Sriwijaya State Buddhist College, 46 from Raden Wijaya State Buddhist College, and 22 from Smaratungga Buddhist College.

Research instrument

This research instrument employs a questionnaire created with the assistance of Google Forms. The questionnaire indicators are tailored to the research needs, aiming to map the conditions of scientific writing learning and the requirements for the LOR model. Two dimensions are elaborated into six aspects, as outlined in Table 1. Before collecting data, the instrument was tested for content validity and reliability with five raters/experts. Aiken establishes a minimum threshold of two raters/experts, while Retnawati recommends involving three raters/experts to ensure stronger content validity and enhance credibility (15).

Table 1: Framework of the survey

Survey domain	Survey indicator	Survey content	Survey form
Conditions of scientific writing instruction	Complexity of the material	1. Level of complexity in scientific writing materials	1. Multiple choices
		2. Factors influencing the complexity of scientific writing	2. Multiple responses
	Availability of technology	3. Conditions of learning infrastructure for accessing digital learning resources	3. Multiple choices
		4. Ownership of gadgets or laptops	4. Alternative
	Utilization of learning resources	5. Types of learning resources utilized in the learning process	5. Multiple responses
		6. Effectiveness of learning resources used in the learning process	6. Multiple choices
	The behavior of digital literacy	7. Habits of accessing information from the internet	7. Alternative
		8. Ability to operate digital devices	8. Multiple responses
The requirements for the LOR model	Requirements for LOR	9. Functional requirements of the LOR	9-10. Multiple responses
	Specifications	10. Requirements for the form of LOs	
	Course requirements	11. Instructional material needs	11-12. Multiple responses
	requirements within the LOR	12. Learning evaluation needs	

The content validity test used the Aiken's formula, while the reliability test employed the Borich formula.

$$V = \frac{\sum s}{n(c-1)} \times 100 \text{ (Aiken Formula)}$$

$$R = 1 - \frac{A-B}{A+B} \times 100\% \text{ (Borich Formula)}$$

The results of the Aiken calculation with five raters and five category ratings obtained V values for all items >0.80, indicating that all items are deemed valid (16). Meanwhile, the results of the reliability calculation using the Borich formula showed a perception equality of the raters with an R-value of ≥75%, signifying reliability (17). Consequently, it can be concluded that the needs analysis questionnaire has met the criteria for collecting research data.

Technique of data analysis

The process of analyzing data involves multiple steps. Initially, review the questionnaire questions filled out by respondents. Once that is done, proceed to the second step, which involves categorizing and inputting data into a computer

program. The third step entails descriptive analysis of the data, focusing on learning conditions and LOR needs through percentage calculations. Subsequently, the fourth step involves interpreting and synthesizing the data. Lastly, conclude the analysis in the final step. Percentage calculations are performed using the formula:

$$P = \frac{f}{N} \times 100$$

P: Percentage

f: Frequency of responses

N: Number of responses

Results

The research results regarding students' requirements for LOR in Scientific Writing Instruction are summarized below.

Complexity of scientific writing materials

The questionnaire results regarding students' perspectives on the complexity of scientific writing materials are presented in Table 2.

Table 2: Complexity of scientific writing materials

Question	Answer	n	Percentage
How do you perceive the complexity or difficulty of scientific writing materials in relation to your proficiency?	Very difficult	11	8.09
	Difficult	70	51.47
	Easy	44	32.35
	Very Easy	11	8.09
What are the common obstacles to learning scientific writing?	Learning resources	61	44.85
	Learning environment	45	33.09
	Learning methods	46	33.82
	Learning evaluation	36	26.47
	Students' competencies	80	58.82
	Lecturers' competencies	2	1.47

Table 3: Availability of learning technology

Question	Answer	n	Percentage
What is the infrastructure condition for scientific writing instruction?	Highly Inadequate	1	0.74
	Inadequate	8	5.88
	Adequate	111	81.62
	Highly Adequate	16	11.76
Do you have a device, such as a gadget or a laptop, to access digital learning resources?	No	1	0.74
	Yes	135	99.26

Many students perceive scientific writing as highly complex. Various factors, both internal and external, contribute to students' challenges in comprehending scientific writing materials. Internally, students' academic abilities play a significant role. Meanwhile, external factors, particularly learning resources, exert the most influence on the complexity of scientific writing materials. It has been confirmed that learning resources present a significant challenge in scientific writing instruction at the university level.

Availability of learning technology

Students' perspectives on the availability of learning technology are assessed based on infrastructure conditions and ownership of digital devices. The comprehensive availability of digital technology supporting scientific writing instruction is illustrated in Table 3.

Students generally hold a positive perception of the on-campus learning facilities. While there are areas that could benefit from improvement, the overall conditions adequately support technology-based learning processes. The majority of students own digital devices, including

gadgets and laptops, which are instrumental in their learning endeavors. This indicates that nearly all students have seamlessly incorporated technology into their daily lives. The widespread use of digital devices, such as computers, smartphones, or tablets has become the norm in facilitating academic activities and communication.

Utilization of learning resources

The utilization of learning resources in scientific writing instruction is viewed through the variation in learning resources and students' perceptions of their effectiveness. The utilization of learning resources in scientific writing instruction is illustrated in Table 4.

Various learning resources, encompassing both digital and non-digital formats, are employed in the learning process. Among these, PowerPoint presentations and reference books are emerged as the most frequently utilized resources. Nevertheless, students express the need for greater effectiveness in the learning resources dedicated to scientific writing instruction to improve overall learning outcomes. This suggests the presence of obstacles or challenges within the

learning process, particularly concerning learning resources, such as a lack of alignment with students' characteristics or inadequacies. Conversely, the minority of students who perceive the learning resources as effective indicates that certain elements in their utilization are function well. Despite the smaller percentage, this signals positive potential in the learning experience that warrants continuous improvement and enhancement.

Students' digital literacy behavior

Two indicators can be used to observe students' digital literacy behavior: their habit of accessing digital sources and their ability to operate digital devices. The complete digital literacy behavior of students is detailed in Table 5.

In the rapidly evolving information technology era, students have embraced accessing information through the internet. A minority of students remain unfamiliar with the internet use for learning resources. This phenomenon signifies that the majority rely on online resources as their primary information source, capitalizing on the diversity and accessibility offered by the internet.

Students' adeptness in utilizing information technology not only demonstrates their adaptation to changes in the learning environment but also underscores the significance of integrating technology to support the educational process. Overall, students are proficient in operating hardware and software digital devices. This indicates that most students have a strong foundation in utilizing technology for learning and research. It is noteworthy, however, that a small percentage of students less proficient in digital device operation emphasizes the importance of adopting an inclusive approach to technology-based learning. This includes providing additional support and training to students who may require it.

Requirements for LOR specifications for scientific writing instruction

The specifications for LOR specifications in Scientific Writing Instruction cover both the functions and format of LOs. The complete requirements for LOR for Scientific Writing Instruction specifications can be seen in Table 6.

Table 4: Utilization of learning resources

Question	Answer	n	Percentage
What learning resources and media do you commonly use in scientific writing instruction?	Modul	13	9.56
	Reference book	80	58.82
	Power point	105	77.21
	Website	65	47.79
	Printed journals	32	23.53
	Online journals	85	62.50
	Campus repository	13	9.56
How do you assess the effectiveness of the learning resources and media used in scientific writing instruction?	Highly ineffective	6	4.41
	Ineffective	71	52.21
	Effective	47	34.56
	Highly effective	12	8.82

Table 5: Students' digital literacy behavior

Question	Answer	n	Percentage
Are you accustomed to utilizing the internet to access learning resources?	No	1	0.74
	Yes	135	99.26
Can you effectively use digital devices, both software and hardware, for academic purposes?	Highly incapable	1	0.74
	Incapable	17	12.50
	Capable	117	86.03
	Highly capable	1	0.74

Table 6: Requirements for LOR specifications

Question	Answer	n	Percentage
What functions do you require in the LOR for Scientific Writing Instruction?	Store	77	56.62
	Search	78	57.35
	Browse	62	45.59
	View	61	44.85
	Download	60	44.12
	Rate/comment	48	35.29
	Mash-ups	48	35.29
	Automatic recommendation	38	27.94
	Personal account	88	64.71
	Forums	47	34.56
	Blogs	25	18.38
	Social network	19	13.97
	Video/audio	98	72.06
What format do you expect learning products to be stored as in the Letter of Recommendation (LOR) for Scientific Writing Instruction?	Presentation	93	68.38
	Image	84	61.76
	Text	84	61.76
	Tools	57	41.91

Table 7: Course requirements

Question	Answer	n	Percentage
Which scientific writing materials do you find particularly complex and believe should be included in the course provided by the LOR?	The nature of scientific writing	99	72.79
	The stages of scientific writing	56	41.18
	General guidelines for the Indonesian language	35	25.74
	Effective sentence structure	27	19.85
	Paragraph development	24	17.65
	Writing citations and bibliography	60	44.12
	Writing various types of academic papers	73	53.68
	Presentation techniques	38	27.94
What evaluation domains do you need in the course?	Affective	101	74.26
	Cognitive	94	69.12
	Psychomotor	60	44.12

Students require an LOR equipped with functions for searching, viewing, downloading, bookmarking, and providing reviews. Additionally, students desire a personal account to manage their data. The inclusion of discussion forums within the LOR allows users to communicate and exchange ideas asynchronously. Conversely, three functions less anticipated in the LOR for scientific writing are automatic recommendations, blogs, and social networks. Meanwhile, the expected formats for learning products to become LOs include video/audio,

presentations, images, text, and scientific writing tools.

Course requirements

Students' requirements for courses, including teaching materials and evaluations, can be seen in Table 7. The teaching materials expected to be presented as a course due to their high complexity include 1) the nature of scientific writing, 2) stages of composing scientific papers, 3) citation and bibliography writing techniques, and 4) writing various academic papers. Conversely, there is a lower demand for materials covering

Table 8: LOR for scientific writing instruction functionalities

LOR Functionalities	Description
Store	The LOR enables users, particularly educators and students, to store and reuse LOs, products of scientific writing education.
Search	The LOR allows users to search for relevant LOs.
Browse	The LOR enables users to search for LOs based on classification according to metadata and descriptions.
View	The LOR allows users to view the details of LOs according to metadata and descriptions.
Download	The LOR allows users to download and reuse LOs as needed.
Rate/comment	The LOR allows users to provide ratings and comments on LOs, especially those in the form of courses.
Mash-up	The LOR enables the presentation of data obtained from various sources, combined in such a way as to provide new functions or insights.
Personal account	The LOR allows users to create and manage their accounts.
Forums	The LOR enables users to communicate and exchange ideas regarding LOs.

general guidelines for the Indonesian language, effective sentence structure, paragraph development, and presentation techniques. Additionally, students express a desire for comprehensive assessment covering affective, cognitive, and psychomotor aspects, aiming to reflect their abilities and potential throughout the learning process.

Given the inherently complex nature of scientific writing materials, coupled with sufficient technology availability, the widespread use of PowerPoint in learning resources, and a robust technology literacy behavior, the inclusion of an LOR for Scientific Writing Instruction becomes crucial in education. Learning resources in an LOR can present varied learning materials, incorporate interactive evaluation tools, and provide a platform for students and educators to interact and share experiences.

The LOR for Scientific Writing Instruction establishes a collaborative, integrative, and holistic learning environment. Leveraging technology, repositories can offer in-depth materials and diverse evaluation tools, fostering interaction and collaboration among students and educators. Utilizing this repository is expected to enhance the learning experience, offering a more interactive approach and addressing individual student needs. Consequently, in addressing the complexity of scientific writing materials, the integration of a digital reference repository becomes critical for improving learning effectiveness and meeting the demands for deeper and more contextualized learning.

Therefore, the summarized needs for the functions of the LOR for Scientific Writing Instruction are as presented in Table 8.

Discussion

"The concept of developing a mono disciplinary LOR has been introduced previously in education. Various specific domains of LORs have emerged, including FILILBAB, which concentrates on English as a Foreign Language (18). Additionally, LORs with specific domains beyond language learning have also been created, such as GROW (Geotechnical, Rock and Water Digital Library), serving as a repository and portal for civil engineering LOs, and MACE (Metadata for Architectural Contents in Europe), focusing on the field of architecture (19).

The development of an LOR involving stakeholders brings several significant benefits. With their participation, the LOR can be designed to be more relevant to the needs and requirements of the learning process (20). This also enhances the level of support and acceptance for the learning resources, ensuring sustainability and efficient resource utilization. The diverse perspectives brought by various stakeholders enrich the design of the learning resources and ensure the fulfillment of the diverse needs of student groups. A profound understanding of the local context, support for diversity, and improved quality are also positive outcomes of involving stakeholders in the development of the LOR. Based on the LOR for Scientific Writing Instruction development needs analysis, the

novelty it offers lies particularly in providing a meaningful learning experience through interactivity, participation, and collaboration. This is what sets LOR apart from existing learning resources such as PowerPoint presentations, reference books, and modules.

Developing an LOR adopting a social model requires teachers' and students' active participation in LOs. This approach emphasizes a method "with" the students rather than "for" them, and both the process and outcomes are collectively owned (21). LOs can originate from curriculum development, teaching activities, research projects, or other creative and academic contributions. In other words, LOs in the LOR have a deep background and learning context. LOs are not just materials; they represent the end product of a learning process involving development, analysis, and curation (22). By understanding that LOs in the LOR are essentially the products of learning, users of the LOR, both instructors and students, can better appreciate the value and context behind each learning resource. This can also enhance the effective use of these in supporting teaching and learning in an academic environment.

LOs within learning products can serve as the subject of critical reflection. This process allows lecturers to evaluate and make modifications to learning materials (23). Encouraging students to reflect on challenging concepts can actively stimulate learning and deepen understanding (24). Students are expected to review their comprehension, search related knowledge, and attempt to identify challenging concepts through the LOs published in the LOR.

The presentation of course materials in an integrated format, along with evaluations and discussion forums, is highly suitable for supporting the characteristics of technology-based learning. This approach emphasizes human aspects such as curiosity, making connections, creativity, and independence in learning. While many e-learning systems, including interactive learning systems, are designed to "push" course materials to students, they often fall short in "collecting" or "drawing out" ideas from them (25). Additionally, online evaluations can liberate instructors from space and time constraints, enabling them to assess and store student records online (26). Instructors can easily monitor and

assess students' learning progress with the assistance of evaluation tools provided by the online learning platform.

Collaborative learning communities play a crucial role in enhancing learning performance (27). Web learning communities serve as platforms for students to share knowledge and experiences. Web 2.0 is highly effective in building learning communities, supporting the acquisition of competencies, and enhancing students' skills (28). These communities not only boost educators' competencies but also foster a sustainable collaborative learning culture, ultimately improving students' learning outcomes. With shared goals, each member actively participates in every learning process within the community.

LOR, providing a meaningful learning experience through interactivity, participation, and collaboration, can enhance students' scientific writing skills. Conditioning students to express opinions and gather evidence in a digital environment can improve their argumentative abilities in scholarly writing (29). Additionally, an experiential writing-based learning model has proven highly effective in enhancing students' capabilities in exploring topics, formulating problems, determining methods, analyzing data, and formulating findings (30). Moreover, an LOR designed with a focus on active learning experiences can also foster students' engagement in the self-reflection process regarding their work. This process opens opportunities for students to understand better the strengths and areas that need improvement in their scientific writing skills. By facilitating communication among students, the LOR serves as a platform for the exchange of ideas and constructive feedback, supporting collaborative development in the context of scientific writing.

The LOR for Scientific Writing Instruction, essential for students, can provide a meaningful learning experience by fostering interactivity, participation, and collaboration. Placing students as active constructors of their knowledge, this research enriches the theoretical foundation of constructivism. This needs analysis presented here serves as a new framework for developing an LOR within specific domain, with a particular focus on learning environments, such as Buddhist religious higher education institutions. Implementation requires adequate not only

technology infrastructure but also strong digital literacy skills. While the results of this research may be highly relevant to learning environments with specific technological characteristics, they may not be directly applicable to different technological contexts. Therefore, further in-depth studies are necessary to obtain more comprehensive results.

Abbreviations

Nil

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Author contributions

Suntoro: Conceptualization, design, analysis/interpretation, and writing. Ida Zulaeha: Conceptualization and final approval. Hari Bakti Mardikantoro: Reviewing and supervision. Tommi Yuniawan: Reviewing and critical revision of the manuscript.

Conflict of interest

The authors declare no conflicts of interest or competing interests related to the publication of this work. We affirm that there are no personal, professional, or affiliations that could be perceived as potentially influencing the objectivity and integrity of the research presented in the manuscript.

Ethics approval

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