Journal of Theoretical and Applied Information Technology
30th June 2024. Vol.102. No. 12

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

ENHANCING COLLABORATION IN PROVIDING SCIENTIFIC WRITING LEARNING RESOURCES THROUGH THE DEVELOPMENT OF A LEARNING OBJECT REPOSITORY

SUNTORO[1], IDA ZULAEHA[2], HARI BAKTI MARDIKANTORO[3], AND TOMMI YUNIAWAN[4]
[1]Doctoral Student, Department of Language Education, Faculty Language and Art, Universitas Negeri Semarang, Semarang, Indonesia
[2,3,4]Professor, Department of Language Education, Faculty of Language and Art, Universitas Negeri Semarang, Semarang, Indonesia

Email: [1]suntoro@students.unnes.ac.id; [2]idazulaeha@mail.unnes.ac.id; [3]haribaktim@mail.unnes.ac.id; [4]tommiyuniawan@mail.unnes.ac.id

ABSTRACT
This study aims to develop a Learning Object Repository (LOR) prototype for scientific writing. The research design follows the Waterfall approach which consists of four stages, namely analysis, design, coding, and testing. This study was conducted from June to December 2023, involving 136 students and 6 lecturers at Buddhist Higher Education Institutions in Indonesia. The results showed that: (1) Stakeholders showed urgency towards the development of scientific writing LOR that can be used in learning and accommodating teaching materials in the curriculum. LOR users are classified into two groups, namely knowledge seekers and knowledge holders; (2) Back-end and front-end designs are carried out to facilitate users in managing data in the form of Learning Objects (LO) in LOR. These LOs are in the form of scientific writing teaching materials in various formats, such as courses, learning modules, learning videos, e-books, learning infographics, and learning portfolios, which are presented in PDF, image, video, zip, excel, and URL formats; (3) The results of testing all LOR system functionality are declared valid, indicating that this system is ready to use and has been tested on a wider scale. Users gain positive experiences from utilizing LOR as a means of collaboration in providing learning resources for scientific writing. However, to improve the effectiveness and user acceptance of LOR, in-depth evaluation of user satisfaction, development of additional features, content development, development of a knowledge management model, exploration of the integration of the latest technology, and analysis of sustainability and maintenance are needed.

Keywords: *learning object repository, learning resources, scientific writing*

1. INTRODUCTION

Writing scientific papers has a significant contribution to developing students' cognitive, affective, and psychomotor aspects. In the cognitive aspect, scientific writing is useful in terms of developing analytical and logical skills [1][2]. In the affective aspect, scientific writing can develop a positive attitude and creativity [3]. Widyartono also mentioned that the benefits of scientific writing in the psychomotor aspect include motor skills and physical abilities needed to express ideas and thoughts in writing.

Despite its significant benefits, writing scientific papers remains a challenge for students in Indonesia. The challenges faced by students in writing scientific papers include the lack of availability of references and sources related to the student's thesis topics, insufficient understanding of research methodology, and a lack of knowledge about academic writing conventions [4]. Other challenges are related to issues of technological competence, time management, the complexity of field research, and unstable student motivation [5]. Additionally, students also encounter challenges in finding research topics, writing literature reviews, and using various academic vocabularies [6]. These challenges are also experienced by the majority of students at Buddhist Higher Education Institutions.

Based on the results of a preliminary survey at Buddhist Higher Education Institutions in June 2023, the availability of learning resources is the dominant factor causing student difficulties in

writing scientific papers, reaching a percentage of 44.85%. PowerPoint is the most utilized learning resource, with a percentage reaching 77.21%. In addition, other learning resources used in learning include textbooks, online journals, and campus repositories. With a percentage of 56.62%, most students stated that the learning resources they used in learning were ineffective, while 43.38% stated otherwise. In this context, it needs to be recognized that the ineffectiveness of learning resources can hurt the quality of learning scientific writing and students' ability to write scientific papers.

Learning resources in the digital era should maximize "human" aspects such as curiosity, connection, creativity, and independence in learning [7]. In particular, digital learning resources for scientific writing need to encourage independent learning and critical awareness that can contribute to improving scientific writing skills [8]. Digital learning resources for scientific writing should be able to promote self-learning and critical awareness that contribute to the improvement of scientific writing. Therefore, teachers must be involved in learning resources by providing input for students. The attributes and features that digital learning resources for scientific writing should have include analyzing assignments, tasks, lecture videos, interactive exercises, as well as engaging and informative feedback [9]. The characteristics of these learning resources can be accommodated in the form of a Learning Object Repository (LOR).

LOR is a system or platform designed to store, manage, and disseminate learning objects (LOs). LOs are learning units that include modules, videos, simulations, interactive content, or other educational resources that can be used in a learning context [10][11]. Essentially, LORs can be likened to digital stores that provide services to a specific community by hosting a collection of digital resources for learning and teaching purposes. Lecturers and students have access to tested and verified learning resources, creating a richer and more effective learning experience. In the context of knowledge management, LOR has a variety of functions, including store, search, browse, view, download, rate/comment, bookmark, automatic recommendations, knowledge filter, mash-ups, validate, social tagging, personal accounts, forums, wikis, RSS feeds, blogs, and social networks [12].

In general, there are eight characteristics of LOs in LOR, including accessibility, interoperability, adaptability, reusability, durability, granularity, self-contained, and collaborative (Table 1) [13].

Table 1. LOR Functional Characteristics

Characteristics	Description
Accessibility	LOR not only includes physical accessibility but also embraces the concept of intellectual accessibility, ensuring that anyone can best access and understand learning materials.
Interoperability	LOR allows users to access and utilize learning materials without restrictions, not tied to one specific platform.
Adaptability	LOR dynamically adapts to the latest developments in the digital era and learning trends.
Reusability	The LOR is designed to ensure that the learning materials provided can be effectively reused by various users.
Durability	The sustainability of LOR is not only limited to the physical durability of the platform but also to its ability to endure and provide benefits over a long time.
Granularity	LOR allows users to access detailed information, allowing students to customize the level of depth of knowledge according to their needs.
Self-contained	Each learning resource and information in the LOR can be retrieved independently, allowing students to determine their learning path.
Collaborative	The LOR serves as a tool that facilitates the growth of a dynamic and interactive learning community.
Accessibility	LOR not only includes physical accessibility but also embraces the concept of intellectual accessibility, ensuring that anyone can best access and understand learning materials.
Interoperability	LOR allows users to access and utilize learning materials without restrictions, not tied to one specific platform.
Adaptability	LOR dynamically adapts to the latest developments in the digital era and learning trends.
Reusability	The LOR is designed to ensure that the learning materials provided can be effectively reused by various users.
Durability	The sustainability of LOR is not only limited to the physical durability of the platform but also to its ability to endure and provide benefits over a long time.

LORs can be monodisciplinary or multidisciplinary LOs. Monodisciplinary LORs focus on one particular discipline or learning area, while multidisciplinary LORs cover a wide range of disciplines and learning areas. In this study, the LOR developed is monodisciplinary, particularly in the field of scientific writing.

LOR development for scientific writing in Indonesia is generally done through campus repositories [14]. However, this type of LOR has limitations related to the LO collection and limited accessibility. The campus repository only includes a collection of scientific papers from the institution and can only be accessed by the academic community of the campus. This limitation is in line with the characteristics of a LOR that should be an open-access repository, which means it can be freely accessed by the general public.

The development of LOR by Supriyanta, et al. introduces an innovative new model in LOR development in Indonesia, particularly in the field of visual communication design [15]. By accommodating students' daily work, this LOR not only functions as a repository for final projects but also as a dynamic platform that supports continuous and collaborative learning. Although there are challenges to be addressed, the benefits offered by this model have great potential to enhance the quality of learning.

The development of scientific writing LOR is driven by the many LO developments in the form of teaching materials, both digital and non-digital, that have been carried out. Teaching materials for scientific writing have been developed for students at several institutions, including PGRI Semarang University [16], Stikom Jambi [17], STKIP Muhammadiyah Kotabumi [18], and UIN Syarif Hidayatulah Jakarta [19]. In addition to emphasizing material understanding, writing skills, and data literacy, the LOs developed generally also highlight the importance of positive characters in scientific writing, such as the prevention of plagiarism and upholding scientific ethics.

Based on the new model of LOR development in learning and LO development in the form of teaching materials for scientific paper writing, researchers are interested in developing LOR for scientific paper writing learning. The development of this LOR will be a new learning resource that can be utilized as a repository for LOs that have been developed previously. LOR has the potential to create an integrative and holistic learning environment for scientific writing. By utilizing technology, LOR can present in-depth materials, provide diverse evaluation tools, and facilitate interaction and collaboration between students and lecturers. Hopefully, LOR for scientific writing can provide a more interactive learning experience that is responsive to students' individual needs.

Based on the description of the problems, facts in the field, and opportunities that can be obtained through the development of LOR in scientific writing, the objectives of this study are threefold: 1) Analyzing the needs and designing the LOR system for scientific writing from the user's perspective; 2) Describe the prototype of scientific writing LOR; 3) Test the functional validity and user experience of scientific writing LOR.

2. METHOD

This study uses a Research & Development (R&D) design with the Waterfall model, which involves the stages of analysis, design, coding, and testing [20]. This study was conducted from June to December 2023. The research subjects included students and lecturers at Buddhist religious colleges in Indonesia, including Sekolah Tinggi Agama Buddha Negeri Sriwijaya Tangerang (Sriwijaya State Buddhist College Tangerang), Sekolah Tinggi Agama Buddha Negeri Raden Wijaya Wonogiri (Raden Wijaya State Buddhist College Wonogiri), Sekolah Tinggi Ilmu Agama Buddha Smaratungga Boyolali (Smaratungga Buddhist College Boyolali), Sekolah Tinggi Agama Buddha Kertarajasa Malang (Kertarajasa Buddhist College Malang), Sekolah Tinggi Agama Buddha Dharma Widya Tangerang (Dharma Widya Buddhist College Tangerang), and Sekolah Tinggi Agama Buddha Syailendra Semarang (Syailendra Buddhist College Semarang).

2.1 Analysis

The needs analysis aims to map the functional and nonfunctional specifications of the product to be developed [21]. The needs analysis in this study involved 136 students and 6 lecturers as stakeholders. This research instrument uses a questionnaire distributed via Google Forms to respondents during the learning process (Table 2).

Table 2. The framework of the Survey

Survey aspect	Survey content	Survey form
Functional requirements	LOR function requirement LO format requirement	Multiple responses

Non-functional requirements	Need for teaching materials Need for an evaluation format	Multiple responses

Before being used for data collection, the instruments were tested for content validity and reliability. The results of Aikens' calculation showed V values for all items > 0.80, indicating that all items were considered valid [22]. Meanwhile, the results of the reliability calculation using the Borich formula show the similarity of the raters' perceptions with a value of > 75%, indicating that this instrument is reliable [23]. After the data was collected, it was followed by descriptive data analysis.

2.2 Design

At this stage, two tasks are completed: create use case diagrams and activity diagrams. Use case diagrams are created to describe the relationships and types of interactions between the LOR system and the actors. Activity diagrams are created to describe the activities or processes that take place in a LOR system.

2.3 Coding

This stage is done by creating program lines using the Codeigniter 3 framework to produce the back-end and front-end of LOR. Codeigniter is known as a lightweight and fast framework. It has complete and clear documentation, making it easy for developers to understand and use the various features provided. Codeigniter provides strong support for various types of databases, including MySQL, PostgreSQL, and SQLite, providing flexibility in database selection and management.

2.4 Testing

At this stage, the design and function of LOR were tested using the black box testing method. The Black Box Testing method is an approach used to test software without having to focus on the details of the software [24]. In this test, only the output is checked based on the given input. There is no attempt to understand the program code used to generate the output. The Black Box Testing process is carried out by involving lecturers and students (Table 3). The next step is to analyze user experiences (instructors and students) concerning the roles that can be performed in the LOR.

Table 3. LOR Function Testing Indicator with Black Box Testing Method

Function	Expected Outcome
Store	Users store various types of LOs related to the topic of scientific writing.
Search	Users can search for LOs by keyword.
Browse	Users can search LOs based on classification.
View	Users can view LO details according to classification.
Download	Users can download LOs and reuse them as needed.
Comment	Users provide comments on the LO.
Mash-ups	Users can present LOs merged from various sources to provide new functions or insights.
Personal account	Users can create and manage their accounts.
Discussion forum	Users can communicate and exchange ideas within the course.
Blog	Users can read articles containing the latest information in the field of scientific writing.

3. RESULT

The results of research on the development of scientific writing LOR are by the stages of research design, involving needs analysis and design of the LOR system, making LOR prototype designs, and testing LOR prototype results.

3.1 Needs and Design of Scientific Writing LOR System

LOR needs based on responses from students and lecturers as stakeholders can be seen in Table 4.

Table 4. Requirements for Scientific Writing LOR System

Content Survey	Conclusion
LOR Function	The functionality required by stakeholders in LOR includes store, search, view, browse, download, comment, mash-ups, personal accounts, forums, and blogs. Meanwhile, features such as automatic recommendations, knowledge filters, validation, social tagging, wikis, RSS feeds, and social networks are less preferred by stakeholders.
LO format	Stakeholders need teaching materials in the form of courses, learning modules, learning videos, e-books, learning infographics, and learning portfolios. Lecturers can create materials in the form of courses, which can then be accessed by students. In addition, lecturers and students have the facility to collaborate and share LOs in various formats, such as PDF, image, video, ZIP, Excel, and URL.
Teaching material	The need for teaching materials in the form of courses involves several important topics, including 1) Definition, characteristics, functions, benefits, types, and language varieties of

	scientific writing; 2) The preparation stage of scientific work; 3) The data collection stage of scientific work; 4) The stage of organizing and presenting scientific work; 5) The stage of editing scientific work; 6) The stage of presenting scientific work; 7) Citation writing techniques; 8) Bibliography writing techniques; 9) Writing papers; 10) Writing journal articles; 11) Scientific work presentation techniques. Meanwhile, teaching materials that are not a stakeholder preference include 1) Indonesian spelling; 2) Effective sentences; 3) Paragraph development. These three materials are not considered a priority because they have been taught in the previous Indonesian language course.
Evaluation	Students and lecturers alike expect the inclusion of assessment of attitude, knowledge, and skills.

Based on the system requirements, the LOR system design is carried out by creating use case diagrams and activity diagrams according to the needs. Relationships and types of interactions between the LOR system and actors are described through the following use case diagram.

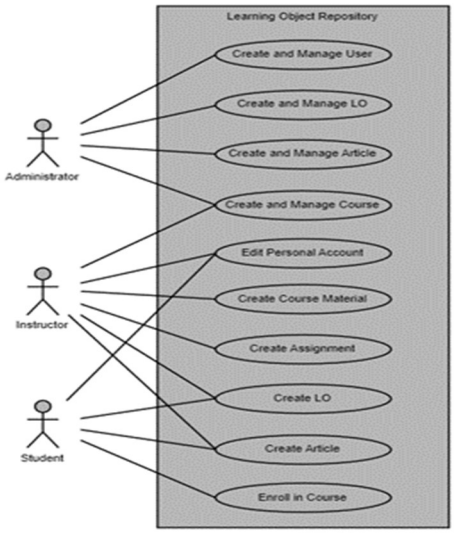

Figure 1. Use Case Diagram of Scientific Writing LOR

Based on Figure 1, there are three actors in the LOR system, namely administrators, lecturers/instructors, and students. Administrators have the authority to 1) Create and manage users; 2) Create and manage LOs; 3) Create and manage teaching materials in the form of courses; and 4) Write and manage articles. Lecturers/instructors have the authority to 1) Create and manage teaching materials in the form of courses; 2) Change personal accounts; 3) Create course materials; 4) Make assignments in courses; 5) Upload LOs; 6) Write articles. Meanwhile, students have the authority to 1) Edit personal accounts; 2) Upload LOs; 3) Write articles; and 4) Learn the material by taking courses. Teaching materials in the form of courses are standardized by a group of lecturers so that they can be used by all students at Buddhist Religious Higher Education Institutions.

Although lecturers and students have clear authority in the LOR system, in practice both can act as knowledge seekers and knowledge holders. The description of activities or processes that occur in an LOR system is explained through the following activity diagram.

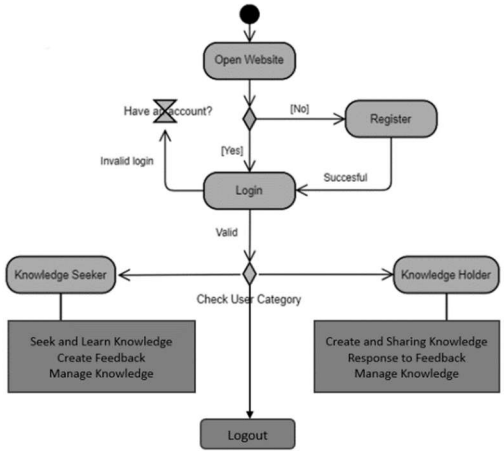

Figure 2. Activity Diagram of Scientific Writing LOR

Based on Figure 2, every user who acts as a knowledge seeker or knowledge holder must be registered in LOR. As a knowledge seeker, users can search and learn various knowledge, provide feedback, and manage the shared knowledge. As a knowledge holder, users can create and share knowledge, respond to feedback, and manage knowledge.

3.2 Prototype Design of Scientific Writing LOR

LOR prototype design is divided into two types, namely back-end and front-end. The back end is part of the data and infrastructure that makes the website function, while the front end includes visual elements that can be seen by users, such as buttons, checkboxes, graphics, and text messages. To access LOR, users must register, either as students or lecturers.

Journal of Theoretical and Applied Information Technology
30th June 2024. Vol.102. No. 12

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

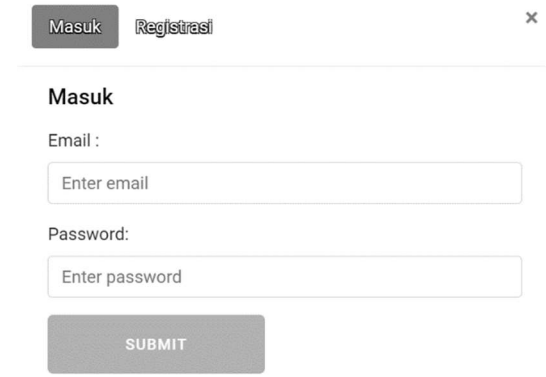

Figure 3. Registration and Login Page Display

After successful registration, users can log in and go to the dashboard page. If the user identifies himself as a knowledge seeker, he can go directly to the LOR homepage through the "view client site" menu to search and learn new knowledge. If the user identifies himself as a knowledge holder, several menus can be utilized. The "teaching materials" menu can be used to add LOs in the form of courses. The "reference" menu is used to add LOs in the form of learning modules, learning videos, e-books, learning infographics, and learning portfolios in PDF, image, video, ZIP, Excel, and URL formats. The "articles" menu is used to add the latest information related to scientific writing. The "tasks and questions" menu is used to create quizzes and assignments in the course. The "application" menu is used to add links to scientific writing applications, such as reference management and plagiarism checking. The "grades" menu is used to view student learning outcomes. Meanwhile, the "logout" menu is used to complete activities as a knowledge holder in LOR.

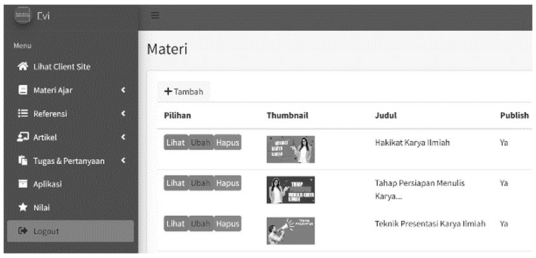

Figure 4. User Dashboard Menu Display

LOs and information uploaded by users through the back end will be displayed by the LOR front end, both on the home page and on specific pages. A keyword-based search field is provided to make it easier for users to find LOs that are relevant to their needs. Examples of LO front-end displays, such as teaching materials in the form of courses, can be seen in Figure 5, while LOs in the form of learning modules, learning videos, e-books, learning infographics, and learning portfolios can be seen in Figure 6.

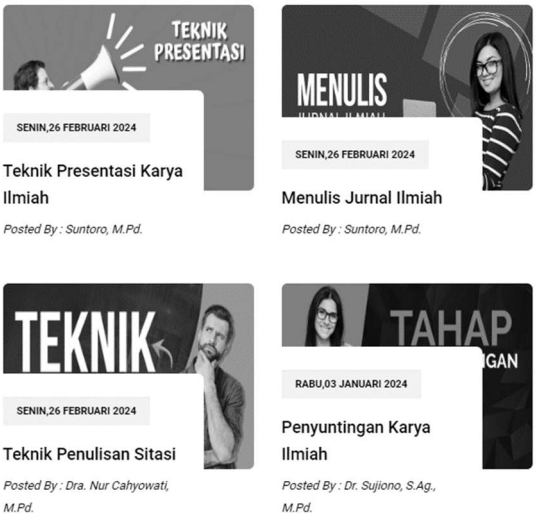

Figure 5. LO Page View in the Form of Courses

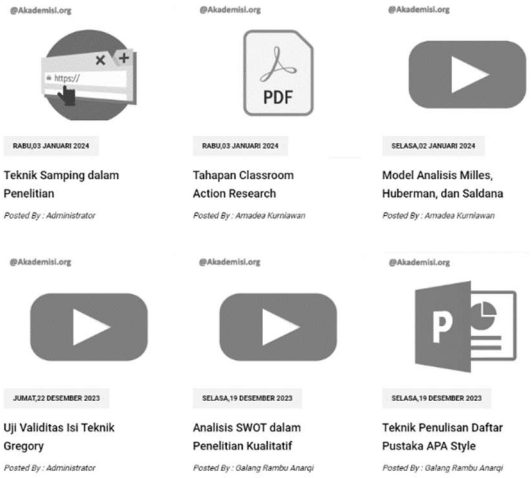

Figure 6. Module, Video, E-Book, Infographic, and Learning Portfolio LO pages

3.3 Functional Validity and User Experience of Scientific Writing LOR

After designing the back-end and front-end of scientific writing LOR, researchers tested the LOR function with the black box testing method. The results of testing the LOR function using the black box testing method can be seen in Table 5.

Journal of Theoretical and Applied Information Technology
30th June 2024. Vol.102. No. 12

ISSN: 1992-8645 www.jatit.org E-ISSN: 1817-3195

Table 5. LOR Function Testing Results with Black Box Testing Method

Function	Test Scenario	Testing Result	Conclusion
Store	Saving a LO in video form	LO successfully saved and displayed on the homepage	Valid
Search	Searching for a LO using keywords	LOs found according to keywords	Valid
Browse	Browsing LOs related to research methods without using keywords	LOs related to research methods are found	Valid
View	Opening a LO	LO displays metadata in the form of title, description, author, upload time, and download access	Valid
Download	Downloading the LO through the link provided	LO can be downloaded and stored on the device	Valid
Comment	Commenting on a LO	Comment successfully added	Valid
Mash-ups	Uploading a LO in RAR form	The RAR file was successfully uploaded and can be downloaded	Valid
Personal account	Uploading a profile picture	Profile photo uploaded successfully	Valid
Discussion forum	Leaving a discussion comment in the course	Comment successfully added	Valid
Blog	Opening one of the articles	The blog article opens properly	Valid

Based on the test results in Table 5, all aspects or functions of LOR desired by stakeholders as a whole are declared valid. This indicates that the implementation or fulfillment of LOR needs is reliable and to the expectations of stakeholders.

Instructor satisfaction with the functions of creating and editing personal accounts (100%), creating articles (100%), creating LO (100%), creating assignments (83.33%), creating course material (83.33%), and creating and managing course (83.33%) (Figure 7).

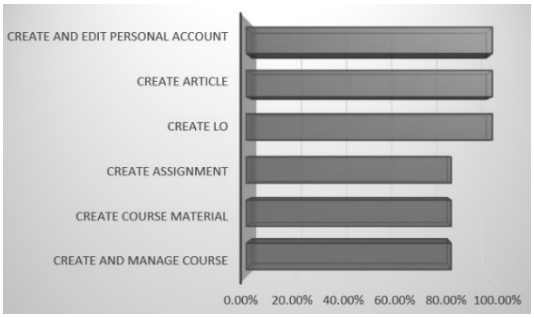

Figure 7. Instructor Experience with LOR Functions

Instructor satisfaction with various functions in LOR, such as creating and editing personal accounts, creating articles, LOs, assignments, course materials, and course management, reflects the effectiveness of the platform in supporting their teaching activities. High levels of satisfaction indicate that instructors feel comfortable using this tool to manage content and interact with students. However, a slight decrease in satisfaction with functions such as creating assignments, course materials, and managing courses may be areas that need further attention. This suggests the need for updates or adjustments in the platform to ensure that instructors can make the most of this tool in their teaching processes.

Student satisfaction with the functions of creating and editing personal accounts (88.97%), create articles (41.17%), create LO (70.58%), and enroll courses (88.97%) (Figure 8).

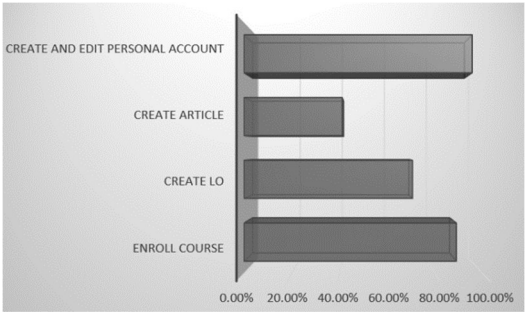

Figure 8. Student Experience with LOR Functions

The high level of satisfaction from students with the basic functions of LOR, such as creating and editing personal accounts, as well as enrolling in courses, indicates their comfort level in interacting with the platform. However, lower satisfaction with advanced features such as creating articles and LOs suggests potential challenges in using more complex features. Improving student satisfaction with creating articles and LOs can be a primary focus, enabling them to become more actively engaged in

learning content. With this understanding, LOR providers can enhance the student experience in online learning and ensure that the tool provides maximum benefit to end users.

4. DISCUSSION

The initial objective of this study was to develop a prototype of scientific writing LOR in higher education. In general, the purpose of developing LOR for scientific writing is no different from the previously developed LOR, which is to improve the ease of access to learning resources [14]. However, LOR for scientific writing is different from the previous LOR because it adopts a knowledge management model in its system in its system as done by Supriyanta et al [15]. If previously students were only considered as passive recipients of knowledge, with this concept students are recognized as active knowledge owners and can share knowledge [25][26]. With this approach, LOR is not only a place to store and distribute teaching materials by lecturers but also a place where students can participate more actively in the learning process [12]. Students are invited to not only consume information but also engage in knowledge creation through writing their scientific papers.

Different from Supriyanta et al., The LOR developed by the author has been integrated with the Learning Management System (LMS), making it an effective learning tool. This integration allows the LOR to function optimally in supporting the teaching and learning process, as learning materials can be easily accessed through a centralized platform. With this integration, lecturers can easily upload and manage teaching materials, while students can access, collaborate, and share knowledge efficiently. Additionally, the LMS provides various additional features such as learning progress tracking, automatic assessment, and discussion forums, all of which contribute to a more interactive and in-depth learning experience. This integration ensures that the LOR is not only an information repository but also a dynamic and interactive tool to enhance the quality of learning.

LOs are not just materials but also represent the end product of a learning process that involves development, analysis, and curation [27]. This approach allows students to develop critical thinking, analysis, and writing skills while being active contributors to the learning community. By treating students as active knowledge owners, LOR creates a foundation for more participatory learning, supports the development of creativity, and motivates students to take an active role in the educational process. This approach not only adds value to the learning aspect of scientific work but also creates high-tech and high-touch learning technology innovations [28][29]. Technology should not condition students to think with only one pattern; instead, technology should be a medium that can encourage students to be able to think with varied patterns and approaches.

On the one hand, giving all users a role as knowledge holders has strengths to support learning, but it also has weaknesses, especially in maintaining the quality of LOs. This is different from the LOR developed for learning in previous universities, where lecturers are designated as the sole knowledge holders in the system. This weakness can be overcome with the strategy of making lecturers as local administrators in their respective campuses [30]. Thus, each LO uploaded by students will go through a desk evaluation stage by lecturers as local administrators. In addition, feedback in the form of comments on each LO can be a natural assessment instrument to determine the feasibility of LO quality.

In general, researchers agree with previous research that Learning LOR has the power to improve learning quality [10]. LOs in the form of courses, materials, tutorials, and theories are highly relevant to support the characteristics of technology-based learning [31]. Blogs, wikis, and podcasts, as well as social devices, are emerging forms of technology that encourage connectivity among members of a group [32]. However, the researchers recognize that this study is a first step in the development of LORs, and further, more in-depth investigation and development is required. For example, exploring the possibility of wider scale use and diversification of existing LOs.

5. CONCLUSION

The development of the LOR prototype for scientific writing is based on the needs of stakeholders, namely students and lecturers in Buddhist Higher Education Institutions. The needs analysis became the basis for designing use case diagrams and activity diagrams. Furthermore, researchers created the back-end and front-end design of LOR based on the use case diagram and activity diagram to facilitate LO and data management in LOR. By referring to the knowledge management model, all LOR users have two roles at once as knowledge seekers and knowledge holders. LO in LOR is in the form of scientific writing teaching materials in the form of courses, learning

modules, learning videos, e-books, learning infographics, and learning portfolios presented in PDF, image, video, ZIP, Excel, and URL formats. The results of testing the functionality of the LOR system were declared valid, which means that the system is ready to be used and tested on a wider scale.

The research on the development of the LOR prototype for scientific writing certainly has some limitations. The researchers identify at least four things to note, namely: (1) At the needs analysis stage, the number of lecturers who became respondents was limited because the number of lecturers teaching scientific writing courses at Buddhist Higher Education Institutions was limited, (2) LOR prototype for scientific writing was only tested on limited users and has not been tested on a wider scale, (3) this LOR prototype has not been assessed for feasibility by experts, both in terms of material, design, and system, (4) it is necessary to test the application of LOR for scientific writing in learning to determine its effectiveness.

Some recommendations to improve the quality, acceptability, and effectiveness of LOR in the future include:

1) Conducting an in-depth evaluation of user (students and lecturers) satisfaction with the scientific writing LOR. Receiving feedback on the user interface, ease of use, and adequacy of features.
2) Identifying and developing additional features that can enhance the user experience. An example is integration with interactive platforms or gamification elements to increase user engagement.
3) Focusing on developing and improving the learning object content within the LOR. In addition to teaching materials, consider presenting learning objects in more innovative or interactive formats to motivate learning.
4) Further researching the knowledge management model used in LOR by considering ways to further improve the efficiency and effectiveness of knowledge exchange among LOR users.
5) Exploring the integration of emerging technologies, such as artificial intelligence or virtual reality, to enhance the functionality and learning experience of the LOR.
6) Examining the sustainability and ongoing maintenance of the LOR system and identifying effective strategies to ensure the continued use and maintenance of the system in the long term.

REFERENCES

[1] Cintamulya. Ability Of Students With Reflective And Impulsive Cognitive Styles In Writing A Scientific Article. MIER J Educ Stud Trends Pract 2021;7:135–45. https://doi.org/10.52634/mier/2017/v7/i2/1410.

[2] Serra T, Gras ME, Cañabate D, Colomer J. Fostering cognitive control through reflection in scientific writing. Reflective Pract 2023;24:433–46. https://doi.org/10.1080/14623943.2023.2210064.

[3] Widyartono D, A D, Ghazali AS, Harsiat T. Cognitive, Psychomotor, and Affective Domain in Instruction on Writing Papers Atuniversity. Int J Soc Sci Humanit Invent 2017;4:4144–8. https://doi.org/10.18535/ijsshi/v4i11.09.

[4] Safitri CD, Azisah S, Annur MJ. The Analysis of Students' Challenges to Thesis Writing at UIN Alauddin Makassar. English Lang Teach EFL Learn 2021;3:41–53. https://doi.org/10.24252/elties.v3i2.21013.

[5] Nurkamto J, Djatmika, Prihandoko LA. Students' Problems Of Academic Writing Competencies, Challenges In Online Thesis Supervision, And The Solutions: Thesis Supervisors' Perspectives. Teflin J 2022;33:123–47. https://doi.org/10.15639/teflinjournal.v33i1/123-147.

[6] Mali YCG. Narratives of Two Indonesian Lecturers about Challenges of Writing an Undergraduate EFL Thesis. J Foreign Lang Teach Learn 2023;8:42–60. https://doi.org/10.18196/ftl.v8i1.17551.

[7] Selwyn N, Pangrazio L. Digital Media in Higher Education. Int. Encycl. Media Lit., Wiley; 2019, p. 1–13. https://doi.org/10.1002/9781118978238.ieml0054.

[8] AlMarwani M. Academic Writing: Challenges and Potential Solutions. Arab World English J 2020;6:114–21. https://doi.org/10.24093/awej/call6.8.

[9] Nickolaevna Bezus S, M. Mekeko N, Akbilek EA. Digital Resources for Learning and Teaching Academic Writing in English. Proc. 2021 12th Int. Conf. E-Education, E-Business, E-Management, E-Learning, New York, NY, USA: ACM; 2021, p. 53–9. https://doi.org/10.1145/3450148.3450206.

[10] Becksford L, Metko S. Using a Library

Learning Object Repository to Empower Teaching Excellence for Distance Students. J Libr Inf Serv Distance Learn 2018;12:120–9. https://doi.org/10.1080/1533290X.2018.1498621.

[11] Knapp M, Risha Z, Gatewood R, Van Der Volgen J, Brown R, Kizilboga R. Learning to Love the LOR: Implementing an Internal Learning Object Repository at a Large National Organization. Med Ref Serv Q 2019;38:143–55. https://doi.org/10.1080/02763869.2019.1588049.

[12] Sampson DG, Zervas P. Learning object repositories as knowledge management systems. Knowl Manag E-Learning An Int J 2013;5:117–36. https://doi.org/10.34105/j.kmel.2013.05.009.

[13] Wagner E. The new frontier of learning object design. ELearning Dev J 2008:1–8.

[14] Mukhlis M. Isu dan Tren Pengembangan Repositori Institusi sebagai Media Komunikasi Ilmiah di Indonesia. N J Ilmu Inf Dan Perpust 2022. https://doi.org/10.20473/pjil.v13i1.35214.

[15] Supriyanta, Rahmawati E, Alvha Ridho Kurnia M. Pengembangan Aplikasi Repository Karya Siswa DenganMetode Waterfall. Indones J Softw Eng 2023;9:92–100.

[16] Ulumuddin A. Pengembangan Bahan Ajar Menulis Karya Ilmiah Berbasis Pendidikan Karakter Untuk Mahasiswa PBSI Tahun Akademik 2012/2013. Sasindo J Pendidik Bhs Dan Sastra Indones 2013;1:1–12. https://doi.org/10.26877/sasindo.v1i2/septembe.675.

[17] Sarmadan. Pengembangan Bahan Ajar Menulis Karya Ilmiah Dalam Pengajaran Bahasa Indonesia Di Stikom Kota Jambi. J Ilm Univ Batanghari Jambi 2017;17:159–71. https://doi.org/10.33087/jiubj.v17i1.112.

[18] Dewi Sri Kuning RS dan. Learning Material Development Of Essay Writing Through Plan And Write In Stkip Muhammadiyah Kotabumi. Edukasi Ling Sastra 2018;16:23–35. https://doi.org/10.47637/elsa.v16i2.91.

[19] Suparno D, Thamrin H, Ismail G. Pengembangan Bahan Ajar Penulisan Karya Ilmiah Untuk Mahasiswa Prodi Tarjamah. Linguist J Bhs Dan Sastra 2022;7:81–91. https://doi.org/10.31604/linguistik.v7i2.81-91.

[20] Pressman RS. Software Engineering A Practitioner's Approach 7th Ed - Roger S. Pressman. 2009. https://doi.org/10.1017/CBO9781107415324.004.

[21] Atthayuwat K, Warunsin K, Promjiraprawat K, Pongyupinpanich S, Suwanloylong P. Applying the Waterfall Model to Develop the Student Learning Record and Assessment System for the Remote Public Primary School in Thailand. J Posit Sch Psychol 2022;6:3120–8.

[22] Aiken LR. Three Coefficients for Analyzing the Reliability and Validity of Ratings. Educ Psychol Meas 1985;45:131–42. https://doi.org/10.1177/0013164485451012.

[23] Borich GD. Observation Skills for Effective Teaching. Routledge; 2016. https://doi.org/10.4324/9781315633206.

[24] Spakova A, Uhanova M. An Overview And Evaluation Of Black-Boxtesting Methods For System Testing. Proc. Int. Conf. Big Data Anal. Data Min. Comput. Intell. 2019; Theory Pract. Mod. Comput. 2019, IADIS Press; 2019, p. 225–9. https://doi.org/10.33965/tpmc2019_201907C030.

[25] Costarides M V. Knowledge Management and E-Learning. Health Promot Pract 2014;15:790–4. https://doi.org/10.1177/1524839914548451.

[26] Judrups J. Analysis of Knowledge Management and E-Learning Integration Models. Procedia Comput Sci 2015;43:154–62. https://doi.org/10.1016/j.procs.2014.12.021.

[27] Diego M, Carlos G, Jose A. Adaptive learning objects in the context of eco-connectivist communities using learning analytics. Heliyon 2019;5:e02722. https://doi.org/10.1016/j.heliyon.2019.e02722.

[28] Shelley B. Re-humanizing "high-tech, no touch" medicine: Narrative medicine and cinemeducation perspectives. Arch Med Heal Sci 2016;4:1–5. https://doi.org/10.4103/2321-4848.183367.

[29] Edmunds JA, Gicheva D, Thrift B, Hull M. High tech, high touch: The impact of an online course intervention on academic performance and persistence in higher education. Internet High Educ

2021;49:100790. https://doi.org/10.1016/j.iheduc.2020.100790.

[30] Pakpahan AF. Study and Development of Learning Object Repository (LOR) Service in Rural Area Using the Perspective of Product Service System. Inf. Syst. Int. Conf., 2013, p. 2–4.

[31] Gordillo A, Barra E, Quemada J. A Hybrid Recommendation Model for Learning Object Repositories. IEEE Lat Am Trans 2017;15:462–73. https://doi.org/10.1109/TLA.2017.7867596.

[32] Yusof R, Ismail MJ, Radzi AM. Online Distance Learning: A New Learning Approach in the Malaysian Gifted Education System. FWU J Soc Sci 2022;16:28–46. https://doi.org/10.51709/19951272/Spring2022/3.