UTILIZING OPEN EDUCATIONAL RESOURCES IN SCIENCE EDUCATION: BARRIERS TO ACCESS AND STRATEGIES FOR SUCCESS

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ABSTRACT: *Open Educational Resources (OER) are digital teaching and learning materials that are freely available for anyone to use, modify, and share. These resources such as textbooks, videos, lesson plans, quizzes, and more are accessible under open licenses, typically Creative Commons. This framework allows users to adapt materials to meet their specific needs without the restrictions imposed by traditional copyright laws. The concept of OER emerged to democratize education by reducing barriers to access and making high-quality educational resources available to all, regardless of location or financial circumstances. This study seeks to investigate the barriers to accessing OER in science education and propose strategies to overcome these challenges. OER has the potential to transform education by offering free and accessible resources that cater to diverse learning needs. In science education specifically, OER can alleviate the financial burden of textbooks and foster more inclusive and flexible learning environments. However, several barriers impede the widespread adoption of OER. Teachers have expressed a need for improved infrastructure, professional development, and clearer guidance on legal matters to effectively integrate OER into their teaching practices. To fully embrace OER, schools must prioritize enhancing technological infrastructure and providing ongoing support to educators. This support includes offering curated lists of high-quality resources and ensuring access to training that equips teachers with the skills necessary to use OER effectively. Using a mixed-methods research design, this study examines the barriers and strategies for utilizing OER in science education by combining both quantitative and qualitative data for a comprehensive analysis. Additionally, it proposes actionable strategies, such as targeted professional development for teachers, the implementation of supportive institutional policies, and the creation of user-friendly platforms for sharing and accessing OER. The findings underscore the importance of overcoming these barriers to maximize the potential of OER in enhancing science education. The study concludes with practical recommendations for policymakers, educational institutions, and teachers to ensure the effective integration of OER into science curricula, contributing to a more affordable, accessible, and innovative educational landscape.*

Keywords: Open Educational Resources (OER, digital teaching materials, creative commons, education democratization, barriers to OER access, curated resources

INTRODUCTION

Science education today is one of the most challenging areas to keep pace with the fast expansion of scientific knowledge and to find good quality, up-to-date teaching materials. Most schools, especially the public high schools in the Philippines, lack them. Traditional resources like textbooks and modules are expensive and rapidly outdated, especially for poorly funded or remote areas. Open Educational Resources (OER) is one such solution to this problem, providing free and openly licensed educational materials, including textbooks, videos, and interactive tools, which anybody can use, modify, and distribute. OER in science education provides dynamic adaptable resources that are tailored for specific context adaptation by the teacher so it could remain relevant and updated. OER contributes to enhancing student engagement by providing a rich variety of materials that support active approaches to learning and inquiry-based teaching. In addition, OER is important for advocating accessibility and equity since it eliminates the financial barriers that might be attributed to traditional materials; hence, excellent quality science education becomes accessible to all students irrespective of geographic or economic constraints. This democratization of resources has helped to reduce educational inequality and ensured that students of all backgrounds access the same opportunities for learning and growth in science.

Despite the potential of Open Educational Resources (OER) to revolutionize science education, there are several common barriers to their widespread utilization. Technological barriers include inadequate access to reliable internet and digital devices, especially in under-resourced schools, that hinder the educators' and students' ability to engage with OER. Pedagogical challenges include teachers' lack of knowledge about OER, insufficient training on how to incorporate these resources well into science curricula, and too little time to prepare or tailor materials to the specific needs of the classroom. At the institutional level, schools might not have policies, funds, or infrastructural support for OER initiatives that would make educators' lives easier or more rewarding in the use of OER. Factors also include cultural obstacles, including the preference for traditional books or scepticism toward the quality and credibility of open resources. Although these barriers are known well, there appears to be a wide gap in research that explores specific strategies for overcoming them. For example, there are very few research efforts on the effects of targeted professional development for teachers, institutional change, or the development of contextually relevant OER to address the needs of local education. Such a research gap must be filled to develop effective strategies to make OER more accessible and sustainable in science education.

The study aligns closely with the Sustainable Development Goals (SDGs) of 2030, specifically SDG 4 (Quality Education), SDG 10 (Reduced Inequalities), SDG 9 (Industry, Innovation, and Infrastructure), and SDG 17 (Partnerships for the Goals). Emphasizing the transformative potential of OER in achieving equity, quality, and excellence in science education for all, this study addresses some of the most relevant barriers related to limited access to digital resources, educator awareness, and institutional resistance. It highlights how OER can democratize learning, bridge educational disparities, and foster innovation in teaching practices while supporting sustainable and inclusive development. It therefore underlines the importance of global and local partnerships in scaling the impact of OER so that education systems are better prepared to face the challenges of the 21st century. In general, the study illustrates how leveraging OER can rapidly accelerate progress toward achieving the 2030 Agenda for Sustainable Development.

Open Educational Resources provides students and educators with free access to high-quality educational content, such as textbooks, lecture notes, videos, and other teaching materials for various sections, and encourages innovative teaching practices in science education. For example, while providing evidence that OER is economically beneficial for learners, a study [1] pointed out that "educators are not aware of OER and lack support from their institutions". A similar study [2] identifies the barriers to adoption concerning OER and details issues such as inadequate training and quality issues with content, matters that resonate with the issues found in this study. However, a systematic review [3] proved to be no less indicative of effective strategies for the implementation of OER, pointing to this as professional development for educators and even curriculum design through collaborative effort, but the biggest challenge to overcome. Likewise, the study [4] highlighted that although teachers are aware of the existence of OER, their actual utilization is limited due to factors such as lack of institutional support, insufficient training, and limited access to technology. A study of how the potential of Open Educational Resources (OER) to reach a broader audience can be integrated with digital platforms that facilitate dissemination and sharing, thereby enhancing accessibility [5]. These barriers resonate strongly with the challenges identified in the present study, which also focuses on the obstacles educators face in accessing and effectively using OER in science education. These studies collectively constitute part of a growing literature that informs the discourse on OER utilization for science education and they both mention the potential benefits and challenges in implementing such a change.

There is therefore a modern focus on teachers' professional development at the optimal unleashing of the potential of OER. It has been discovered [6] that the bulk of instructors want training on how to effectively integrate the same resources in teaching methodologies even though OER empowers teachers with wide banks of adaptive resources. While research [7] reveals a positive approach to using OER among collaborating teachers, as most educators start to involve themselves in online communities, exchange resources, share experiences, and discuss best practices, such characteristics of OER contribute to more quality teaching and innovation in science instruction [8].

A substantial number of studies have examined various aspects of education, including teaching methodologies [9, 10, 11, 12, 13, 14], student preferences and preparedness [15, 16], student motivation and attitudes [17, 18, 19, 20], teachers' competencies, skills, and challenges [21, 22, 23], assessment strategies and tools [24, 25, 26, 27], and other related factors [28, 29, 30, 31, 32, 33, 34], to improve student learning outcomes. However, there has been limited research focused on investigating dental students' conceptualizations of Pharmacology through case-based pedagogy.

However, a study postulates that most instructors need basic digital literacy skills to effectively use OERs; therefore, the need for professional development has always been there. Similarly, research [35] explored the impact of OER on student learning across multiple disciplines and found that the use of OER led to similar or better academic performance compared to traditional resources. This lends support to the argument that OER can be a low cost with no loss of educative quality.

The main goals of this research are twofold. The first is to investigate the major barriers the teachers face when accessing and making use of Open Educational Resources in science education. Technological barriers, lack of institutional support, or improper training, among other things, could be such barriers. The second aspect would be to explore strategies that are known to successfully integrate OER in science classrooms. The study aims to empower teachers, in this case, through the identification of practical solutions that can improve the student learning outcome by using accessible high-quality OER materials.

Specifically, it sought answers to the following questions:

1. What are the major barriers to accessing and using Open Educational Resources in science education?
2. How does the combination of socio-economic, technological, and institutional factors shape the adoption of OER in science education?
3. What strategies can effectively address these barriers to enhance the utilization of OER in diverse educational settings?
4. To what extent does the implementation of OER enhance student engagement, improved learning outcomes, and access to science education resources?

MATERIALS AND METHODS

This study employs a mixed-methods research design to investigate the barriers and strategies associated with the use of Open Educational Resources (OER) in science education. It integrates both quantitative and qualitative data collection methods for a comprehensive analysis. The survey provided quantitative data on perceived barriers and effective strategies for OER integration featuring 5-point Likert-scale items that yield structured, measurable insights into trends and patterns, including levels of accessibility, usage frequency, and satisfaction with OER. Simultaneously, open-ended questions enable respondents to elaborate on their views, share unique perspectives, and suggest solutions, resulting in rich, detailed qualitative data. Thematic analysis is conducted to identify, analyze, and interpret patterns of meaning within the data

related to OER utilization in science education. This mixed-methods approach ensures a well-rounded analysis, capturing both the breadth and depth of participants' responses.

Participants

The study surveyed fifty (50) randomly selected science teachers from secondary schools in the Division of Antipolo City. These individuals were chosen to provide a diverse perspective on the use and accessibility of Open Educational Resources (OER) in science education. Their participation also allowed the study to explore the practical challenges and advantages of integrating OER into their classrooms. Ten (10) participants were recruited for interviews and focus group discussions. Confidentiality was ensured throughout the study. Participants were also offered a summary of the findings to empower them with insights that could enhance their practices, particularly in a study focused on OER in science education, where results may directly inform strategies for improving access and utilization.

Data Collection Methods

Surveys: The technological infrastructure for accessing Open Educational Resources (OER), teachers' readiness, and institutional support, as well as the perceived barriers to utilizing OER in science education, are measured using a formal questionnaire. This questionnaire consists of multiple-choice and Likert-scale items combined with open-ended questions to allow for varied responses, ensuring that the sample size yields statistically significant conclusions.

Interviews: In-depth interviews will be conducted to gather qualitative insights into the experiences, perceptions, and challenges of participants regarding the utilization of OER in science education. These interviews provide a platform for participants to elaborate on their responses, share personal experiences, and offer nuanced perspectives that may not emerge through surveys or focus group discussions. Participants for the interviews will be selected based on responses obtained in the survey.

Focus Group Discussions: A focus group consisting of 10 teachers will be conducted to foster collaborative dialogue among participants and explore collective experiences, challenges, and strategies related to the use of OER in science education. The discussions will focus on key themes, including the importance of technological infrastructure, the need for teacher training, and barriers such as limited institutional support and awareness of OER resources. Participants will also identify practical strategies, such as collaborative professional development, improving internet access, and creating awareness campaigns to enhance OER utilization.

Observational Studies: Observational studies will be conducted to gain a firsthand understanding of how OER is utilized in real-world science education settings. By directly observing classroom dynamics, resource accessibility, and teaching strategies, the study aims to capture practical insights that might not be fully conveyed through self-reported data, such as surveys or interviews. The observational studies will focus on key aspects of OER implementation, including the integration of resources into lesson plans, the technological tools used for access, and students' engagement with the materials. Particular attention will be paid to barriers such as technical difficulties, classroom infrastructure, and teachers' proficiency with OER. The data collected through observational studies will provide valuable context to complement findings from surveys, interviews, and focus group discussions.

Data Analysis

Quantitative Analysis: This study used statistical methods to analyze quantitative data gathered from surveys, including multiple-choice and Likert-scale items. Descriptive statistics, such as frequencies, percentages, means, and standard deviations were calculated to summarize participants' responses and identify trends in their perceptions of Open Educational Resources (OER) usage in science education. This quantitative analysis offered an objective assessment of the insights into the extent of OER utilization, the challenges faced by participants, and factors that may influence successful implementation, complementing the qualitative findings from interviews, focus groups, and observations.

To measure the range of responses in the survey on technological infrastructure, teachers' readiness, institutional support, and perceived barriers to accessing OER. The following are indices of interpretation:

Score	Limit	Interpretation
5	4.21 - 5.00	Very Low Barriers
4	3.41 - 4.20	Low Barriers
3	2.61 - 3.40	Moderate Barriers
2	1.81 - 2.60	High Barriers
1	1.00 - 1.80	Very High Barriers

Qualitative Analysis: The analysis of the qualitative data from the open-ended questions will be based on thematic analysis to identify common themes and patterns related to the challenges and potential solutions for integrating OERs into science education. Additionally, the findings from the qualitative study will be cross-verified with the quantitative data to enhance the robustness of the results.

The survey findings indicated that the majority of participants in the teaching workforce were female, comprising 66% of the total sample, while male teachers accounted for 32%. The respondents exhibited diverse expertise across various science disciplines, with a significant portion specializing in physics (44%), slightly surpassing those with backgrounds in biology and earth science. Regarding educational qualifications, nearly half of the participants

(48%) held a bachelor's degree, and a substantial number had advanced degrees, including master's or doctoral qualifications in education. Most participants also had over 15 years of teaching experience, highlighting a highly seasoned and academically qualified group of educators.

III. RESULTS AND DISCUSSIONS

Table 1: Demographic Profile of Respondents

Demographic Variable	Category	Frequency (n=50)	Percentage (%)
Gender			
	Male	16	32%
	Female	33	66%
	Third Gender	1	2%
Years in Teaching			
	Less than 1 year	0	0%
	1-5 years	0	0%
	6-10 years	15	30%
	11-15 years	11	22%
	More than 15 years	24	48%
Field of Specialization			
	Biology	18	36%
	Chemistry	2	4%
	Physics	22	44%
	Earth Science	8	16%
Highest Level of Education			
	Bachelor's Degree	24	48%
	Master's Degree	16	32%
	Doctorate	10	20%

.Table 2. Technological Infrastructure for Accessing OER

Description	Weighted Mean	Mean	Standard Deviation	Verbal Impression
1. Our school has reliable internet access for all students and staff.	2.20	5.48	1.81	High Barriers
2. The available internet speed and bandwidth are adequate for accessing and downloading OER.	2.58	7.62	2.24	High Barriers
3. Classrooms and labs are equipped with the necessary hardware (e.g., computers, tablets) for using OER in science education.	2.44	6.96	2.13	High Barriers
4. There is sufficient access to digital devices for students to utilize OER effectively.	2.10	4.90	1.67	High Barriers
5. Digital platforms and Learning Management Systems (LMS) used in our school support the integration of OER.	2.72	8.12	2.32	Moderate Barriers
Average	2.41	6.62	2.03	High Barriers

***Interpretation**: 1.00 - 1.80 = Very High Barriers; 1.81 - 2.60 = High Barriers; 2.61 - 3.40 = Moderate Barriers; 3.41 - 4.20 = Low Barriers; 4.21 - 5.00 = Very Low Barriers*

The survey results highlighted significant barriers to the effective integration of Open Educational Resources (OER) in schools, particularly concerning infrastructure and access to digital tools. The overall weighted mean of 2.41, along with a standard deviation of 2.03 suggests generally high barriers across the surveyed areas. The most pressing challenge is the insufficient access to digital devices for students, which received a weighted mean of 2.10, indicating this as the greatest limitation. Schools also encounter substantial barriers related to reliable internet access, with a weighted mean of 2.20, and a standard deviation of 1.81. Additionally, the adequacy of internet speed and bandwidth for accessing and downloading OER has a weighted mean of 2.58 and a standard deviation of 2.24. A study [26] suggests that inadequate internet access leads to an inequitable educational experience, particularly for schools in rural or underfunded areas. The lack of reliable connectivity is a primary barrier to integrating digital learning tools and resources effectively.

Further challenges include the availability of essential hardware in classrooms and laboratories, which received a weighted mean score of 2.44. This score highlights the difficulty of equipping educational environments for the use of Open Educational Resources (OER). In contrast,
digital platforms and Learning Management Systems (LMS) performed slightly better, achieving a weighted mean of 2.72 and indicating moderate barriers to OER
integration, suggesting potential for improvement. This issue is consistently highlighted in the literature [27], which emphasizes that access to modern devices is a critical requirement for the successful adoption of OER. Schools lacking up-to-date hardware can significantly hinder students' ability to engage with OER, particularly when interactive and multimedia-rich materials, which require advanced technology, are involved.

Overall, the findings emphasize significant infrastructure gaps, particularly regarding internet reliability, device accessibility, and hardware availability, which impede the effective use of OER in science education. These challenges necessitate targeted interventions to address resource and technological shortcomings, thereby enhancing OER adoption in schools.

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Table 3. Teachers' Readiness to use OER

Description	Weighted Mean	Mean[2]	Standard Deviation	Verbal Impression
1. I am confident in my ability to find and evaluate quality OER for my science classes.	2.64	7.80	2.27	Moderate Barriers
2. I feel prepared to integrate OER into my science classes effectively.	3.70	14.26	3.25	Low Barriers
3. I am knowledgeable about the copyright and licensing aspects of using OER.	3.04	10.04	2.65	Moderate Barriers
4. I am comfortable using digital tools and platforms to access and implement OER.	3.78	14.74	3.31	Low Barriers
5. I am willing to invest time in learning how to use OER resources effectively.	4.08	16.96	3.59	Low Barriers
Average	3.44	12.76	3.01	Low Barriers

***Interpretation**: 1.00 - 1.80 = Very High Barriers; 1.81 - 2.60 = High Barriers; 2.61 - 3.40 = Moderate Barriers; 3.41 - 4.20 = Low Barriers; 4.21 - 5.00 = Very Low Barriers*

The findings Educational Resources (OER) in science education. Teachers reported a moderate level of confidence in their ability to find and evaluate quality OER for their science classes, indicated by a weighted mean of 2.64 and a standard deviation of 2.27. This suggests that while teachers are somewhat familiar with OER, they encounter challenges in effectively identifying and assessing these resources. In terms of preparedness, teachers generally feel equipped to integrate OER into their science classes, with a weighted mean of 3.70. This indicates that many educators possess the foundational skills and understanding necessary for effectively utilizing OER in their teaching.

Regarding knowledge of copyright and licensing, teachers reported a moderate understanding, reflected in a weighted mean of 3.04 and a standard deviation of 2.65. This implies that while some educators may have a basic grasp of OER licensing and copyright issues, a lack of comprehensive knowledge in this area could hinder full adoption. When discussing digital tools, teachers expressed a high level of comfort, as indicated by a weighted mean of 3.78. This suggests that digital literacy is less of a barrier for them, making it more likely for teachers to engage with OER, particularly when these resources are integrated into accessible and user-friendly digital platforms.

Finally, teachers demonstrated a strong willingness to invest time in learning how to use OER effectively, as evidenced by a weighted mean of 4.08 and a standard deviation of 3.59. This reflects a positive attitude toward professional development, with many educators eager to enhance their skills and knowledge to better utilize OER resources.

Table 4. Institutional Support for OER Use

Description	Weighted Mean	Mean[2]	Standard Deviation	Verbal Impression
1. Our school provides adequate training on how to find and use OER.	2.90	8.94	2.46	Moderate Barriers
2. There is sufficient technical support at my institution for implementing OER in the classroom.	2.90	8.90	2.45	Moderate Barriers
3. My institution actively promotes the use of OER in science education.	3.30	11.38	2.84	Moderate Barriers
4. I feel supported by my school in adopting OER as part of my teaching practice.	3.38	11.78	2.90	Moderate Barriers
5. I believe my school prioritizes the accessibility of OER for students and teachers alike.	2.92	9.00	2.47	Moderate Barriers
Average	3.08	10.00	2.62	Moderate Barriers

***Interpretation:** 1.00 - 1.80 = Very High Barriers; 1.81 - 2.60 = High Barriers; 2.61 - 3.40 = Moderate Barriers; 3.41 - 4.20 = Low Barriers; 4.21 - 5.00 = Very Low Barriers*

The findings in Table 4 indicate that while teachers recognize the importance of institutional support for the successful integration of Open Educational Resources (OER), there are moderate barriers to the level of support their institutions provide. Teachers reported a weighted mean of 2.90 and a standard deviation of 2.46, suggesting that their schools offer only moderate training on how to find and use OER. This implies that while some training may be available, it might not be sufficient or widespread enough to equip all educators with the skills needed to effectively search for and implement

OER in their classrooms. Likewise, the perceived availability of technical support for implementing OER is also rated as moderate.

Teachers rated the promotion of OER by their institutions with a weighted mean of 3.30, indicating that there is some encouragement for using OER in science education. However, this support is neither actively prioritized nor widely promoted. Although some support exists, it may not be robust or consistent across all teachers, resulting in obstacles to fully integrating OER into their teaching methods.

The belief that schools prioritize the accessibility of OERs received a weighted mean of 2.92 and a standard deviation of 2.47 suggesting that institutions are not consistently ensuring easy access to OER for both students and teachers. Insufficient attention to OER accessibility, particularly in schools with limited resources or technology infrastructure, can significantly hinder effective OER use. The average weighted mean of 3.08 indicates that while institutions generally provide some support, substantial improvements are needed in certain areas to facilitate broader adoption of OER.

Table 5: Perceived Barriers to Accessing OER in Science Education

Description	Weighted Mean	Mean[2]	Standard Deviation	Verbal Impression
1. I find it challenging to locate quality Open Educational Resources (OER) for science subjects.	3.52	12.76	3.04	Low Barriers
2. I believe that accessing OER requires specific digital skills that may be lacking in my school.	4.00	16.40	3.52	Low Barriers
3. Limited internet access is a barrier to using OER effectively in my classes.	4.48	20.32	3.98	Very Low Barriers
4. I lack training or skills on how to effectively incorporate OER into my existing science subject	3.62	13.98	3.22	Low Barriers
5. Copyright and licensing issues make it difficult to utilize OER in my teaching practice.	3.86	15.30	3.38	Low Barriers
Average	3.90	15.75	3.43	Low Barriers

Interpretation: *1.00 - 1.80 = Very High Barriers; 1.81 - 2.60 = High Barriers; 2.61 - 3.40 = Moderate Barriers; 3.41 - 4.20 = Low Barriers; 4.21 - 5.00 = Very Low Barriers*

The findings from Table 5 reveal that teachers generally face low barriers in accessing and utilizing Open Educational Resources (OER), though some challenges remain. Teachers indicated that finding quality OER for science subjects poses only a moderate challenge, reflected in a weighted mean of 3.52 and a standard deviation of 3.04. This suggests that while there are some difficulties in identifying high-quality resources, these challenges are not significant enough to hinder OER use in the classroom. With a weighted mean of 4.00, teachers recognized that accessing OER may require specific digital skills that are often lacking in their schools. However, the relatively low rating implies that while gaps in digital literacy do exist, they are not viewed as major barriers to accessing OER and could likely be addressed through additional training.

Teachers rated internet access as a very low barrier, with a weighted mean of 4.48. This indicates that most teachers do not see internet connectivity as a significant obstacle to using OER, suggesting that the majority of schools have adequate resources for OER use. The weighted mean of 3.62 reflects that a lack of training or skills in effectively incorporating OER into science teaching is a moderate barrier. While some teachers may feel unprepared to integrate OER into their existing curriculum, this challenge is manageable and could be alleviated through professional development opportunities.

Overall, the findings suggest that teachers experience low to very low barriers when accessing OER in science education. The results highlight opportunities for enhancing OER access by focusing on targeted training to improve digital literacy, addressing copyright concerns, and providing clearer guidance on integrating OER into existing curricula.

Thematic Analysis of Teacher Responses

Greatest Barriers to OER Adoption (Quantitative Data)

In the quantitative analysis presented in Table 5, teachers reported several perceived barriers to the adoption of Open Educational Resources (OER). These barriers included challenges in finding quality OER (weighted mean: 3.52), a lack of specific digital skills (weighted mean: 4.00), limited internet access (weighted mean: 4.48), and insufficient training to effectively incorporate OER (weighted mean: 3.62). While these barriers were rated as moderate or low, they remain significant enough to impede OER adoption in science classrooms. Supporting quotes from participants highlighted these issues: "I struggle to download large OER files or access certain websites because our internet connection is unreliable and slow, especially during peak hours," and "Many of my students don't have stable internet access at home, so even if I use OER in class, they can't review them outside of school."

Qualitative Responses: Supporting the Quantitative Findings

Teachers frequently identified insufficient internet access and outdated technology as significant barriers to their work. This observation aligns with the quantitative finding that limited internet access is a major obstacle, reflected in a weighted mean of 4.48. They explained how slow or unreliable internet connections and old devices hindered their ability to access download or effectively utilize Open Educational Resources (OERs). This is consistent with the higher quantitative ratings related to connectivity issues.

Additionally, teachers pointed out the lack of digital skills among themselves and their students. This corresponds with the quantitative finding that accessing OER requires specific digital skills, evidenced by a weighted mean of 4.00.

Teachers emphasized the need for training in digital tools to help them navigate OER platforms more effectively and incorporate these resources into their teaching. Concerns about copyright and licensing issues were also prominent in the open-ended responses. Teachers expressed uncertainty regarding the legal use, sharing, or adaptation of OERs. This concern reflects a moderate barrier identified in the quantitative data, with a weighted mean of 3.86, indicating that legal issues impede the full adoption of OERs.

Effective Strategies for Overcoming Barriers (Qualitative Data)

Teachers emphasized the importance of training in locating and evaluating Open Educational Resources (OERs), particularly in digital literacy and technology integration. This need is supported by quantitative data showing a lack of training, with a weighted mean of 3.62. They expressed a desire for more structured and accessible professional development opportunities to help them better incorporate OERs into their teaching practices. To address barriers to accessing OERs, teachers suggested upgrading technology and improving internet access. This recommendation aligns with the quantitative finding that limited internet access poses a significant challenge, indicated by a weighted mean of 4.48. Teachers urged schools and districts to invest in better infrastructure, including reliable Wi-Fi and modern devices, to facilitate effective use of OERs in the classroom.

Additionally, teachers recommended fostering collaborative networks within schools or districts to share OERs and best practices. This approach supports peer collaboration and resource sharing, which could help mitigate challenges related to finding quality materials and developing the skills necessary to use them effectively. Moreover, teachers advocated for schools to provide curated lists of verified OERs that align with curriculum standards and maintain high quality. This strategy would address concerns about locating high-quality OERs, which had a weighted mean of 3.52, and streamline the process for teachers to integrate these resources into their lessons without spending excessive time searching for credible materials.

Summary of Thematic Analysis and Cross-Verification

The qualitative responses provide valuable context and practical examples that enhance the quantitative findings. They support the key barriers identified in the survey, including limited internet access, lack of digital skills, technology infrastructure challenges, and legal concerns. The strategies suggested by teachers such as improved training, upgraded technology infrastructure, and collaborative networks closely align with the areas highlighted in the quantitative data that require attention. Overall, these qualitative insights clarify the specific challenges teachers encounter and offer concrete suggestions for overcoming these obstacles. This reinforces the quantitative results and underscores the areas where targeted interventions could improve OER adoption in science education.

Limitations and Future Research

Sample Size. The study's sample size may be relatively small or geographically limited, which means that the findings might not be fully representative of all teachers or schools. If the research was conducted in a specific school, it may fail to capture the broader challenges and strategies encountered by teachers in other areas.

Self-Reported Data. The study relies heavily on self-reported data from teachers, which could introduce biases, such as social desirability bias.

Technological Access. The study likely included schools with varying levels of technological access and infrastructure, potentially leading to inconsistent responses. Some teachers may have access to advanced technology, while others may be using outdated equipment and slow internet connections, resulting in differing perceptions of the barriers to OER adoption.

Lack of Longitudinal Data. The study appears to be cross-sectional, capturing data at a single point in time rather than over an extended period.

Focus on Science Education. The study specifically examines science education, which may not fully represent the challenges faced by teachers in other subject areas. Different disciplines may have unique OER needs or barriers related to content complexity, curricular standards, or resource availability.

Focus on Teacher Perspectives. The study primarily gathers data from teachers, omitting the perspectives of students, and school leaders. These stakeholders may possess different experiences or insights regarding the adoption of OERs and the associated barriers.

Future research could address these limitations by including a more diverse sample, utilizing longitudinal data, and exploring the perspectives of a broader range of stakeholders.

CONCLUSION

This study underscores the significant barriers to adopting Open Educational Resources (OER) in science education and identifies strategies to facilitate their broader implementation. The findings reveal that while teachers generally feel prepared to integrate OER into their classrooms, challenges such as inadequate internet access, outdated technology, insufficient digital skills, and concerns regarding copyright and licensing hinder effective implementation. Institutional support, including training and technical assistance, is crucial for overcoming these obstacles. Teachers have expressed a need for improved infrastructure, professional development opportunities, and clearer guidance on legal issues to fully leverage OER in their teaching practices. The study recommends that schools prioritize enhancing technological infrastructure and providing ongoing support to educators, including curated lists of quality resources and access to training. Addressing these challenges could significantly increase the use of OER in science education, promoting greater resource equity and access to high-quality materials for both educators and students. Furthermore, the study emphasizes the importance of a multi-faceted approach that combines institutional support, teacher readiness, and technological advancements to ensure the successful integration of OER in science classrooms.

RECOMMENDATIONS

Based on the study's findings, the following recommendations aim to address the identified barriers and

facilitate the adoption of Open Educational Resources (OER) in science education:

1. Educational institutions should invest in upgrading their technology infrastructure, ensuring reliable internet access, and providing modern devices for both teachers and students.
2. Ongoing professional development should be offered to teachers, focusing on digital literacy, OER search and evaluation, and effective integration of OER into the curriculum.
3. Clear guidelines and resources must be provided to help teachers navigate the copyright and licensing aspects of using OER.
4. Schools should curate and offer access to a selection of high-quality, curriculum-aligned OER that teachers can easily incorporate into their lessons.
5. Collaboration and knowledge-sharing among educators should be encouraged to foster a culture where teachers regularly exchange OER resources and strategies for implementation.
6. Schools need to take a more proactive role in promoting OER adoption by providing institutional support for teachers, which could include incentives, recognition, or dedicated time for OER integration.
7. Future research should investigate the long-term effects of OER adoption in science education and examine how different educational contexts influence the effectiveness of OER strategies.

ACKNOWLEDGEMENT

The researcher would like to express her deepest gratitude to everyone who contributed to the successful completion of this paper. To her professor for his encouragement and constructive feedback throughout the research process. To her colleagues and peers for their insightful discussions and support, which enriched the quality of the work. To her family for their unwavering support and understanding. This is a collective testament to all your contributions. And finally, to God Almighty who provided her with knowledge and wisdom to accomplish her work with dedication and passion.

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