

Open Educational Resources in Science Education: Effects on Teacher Practices and Students' Academic Performance

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Abstract. This study investigates the effects of open educational resource (OER) utilization, specifically revision, remix, and redistribution, on students' academic performance in science for the school year 2023-2024. Using a descriptive-quantitative research design, data were collected from teacher respondents through a survey questionnaire. The results showed that teachers predominantly utilized OER for revision, with moderate engagement in remix and redistribution activities. Students' academic performance, measured by their general weighted average in science for the first quarter, was satisfactory, with a mean score of 83.73. The findings indicated that using OER for revision significantly enhanced students' academic performance while remixing and redistribution did not significantly impact student outcomes. Furthermore, no significant differences were found in the extent of OER utilization among teachers based on sex, educational attainment, years of teaching experience, or relevant training. These results highlight the need for targeted professional development programs that emphasize the effective use of OER in revising, remixing, and redistributing educational materials. Schools can foster more innovative and personalized student learning experiences by improving teachers' capacity to utilize OER fully. The study recommends that educational institutions ensure the availability and accessibility of high-quality OER, alongside ongoing support and training for teachers, to optimize their potential to improve student achievement. Ultimately, the findings suggest that strategic integration of OER into instructional practices can lead to enhanced educational outcomes and greater collaboration among educators.

Keywords: Open Educational Resources (OER); Revision; Remix; Redistribution; Science education.

1.0 Introduction

Open Educational Resources (OERs) represent a transformative paradigm in education, promoting an interactive and collaborative learning environment that enhances teaching and learning experiences. Designed with flexible and adaptable features, OERs empower learners to engage deeply with content while fostering opportunities for active knowledge dissemination and community-driven educational advancements. The emergence of OERs in the 1970s responded to growing concerns about the affordability of educational materials, marking a pivotal shift toward accessibility in education. The United Nations Educational, Scientific and Cultural Organization (UNESCO) formally coined the term "Open Educational Resources" in 2002, laying the foundation for what has evolved into Open Education Practices (OEPs). Despite the recognized benefits of OERs, challenges such as discoverability and accessibility persist, as emphasized by Roncevic (2022).

The integration of OERs, coupled with technological advancements, has positively influenced student motivation and academic performance. Empirical evidence indicates that students enrolled in courses incorporating OERs and technology consistently outperform peers who rely solely on traditional learning resources. This underscores

the critical role OERs can play in enhancing educational outcomes and enriching the academic experience. However, while several educational institutions in the Philippines, including the University of the Philippines Open University, have pioneered using OERs from 2015 to 2017, their adoption remains limited in many regions. Discoverability remains a substantial obstacle, hindering the widespread use and integration of OERs nationwide. Nevertheless, OERs hold immense potential to foster creativity, facilitate collaboration, and bridge the educational divide by providing accessible, adaptable, and high-quality learning resources that can be continuously updated to align with the evolving needs of the academic community.

Motivated by the growing global and national interest in OERs, this study investigates their application and potential impact within Science education—a field that demands rigorous knowledge acquisition and the cultivation of critical thinking skills. Science education benefits from dynamic and interactive learning experiences, which OERs are uniquely positioned to provide. By leveraging the adaptability of OERs, educators can create enriched learning environments that support deeper conceptual understanding and mastery of scientific principles. This research explores how the use of OERs in teaching Science subjects in high schools influences student academic performance. Focusing on selected high schools within the Division of Zamboanga City, this study will examine the implementation and broader utilization of OERs and evaluate their impact on student learning outcomes in Science. Through this analysis, the research seeks to contribute valuable insights into how OERs can be effectively harnessed to advance Science education in the Philippines.

2.0 Methodology

2.1 Research Design

The study used a descriptive-quantitative research design to examine how the "revise, remix, and redistribute" aspects of Open Educational Resources (OERs) impact student academic performance. This approach helps to systematically measure and describe the phenomenon, collecting numerical data for statistical analysis. The design effectively identifies patterns and trends while gathering qualitative insights through open-ended questions. The research aims to understand how OERs can improve student outcomes, especially in the post-pandemic context. It examines the relationship between OER utilization (independent variable) and student academic performance (dependent variable) to inform future instructional strategies. This study is particularly relevant for Zamboanga City schools, helping to develop effective educational practices to meet community needs.

2.2 Research Locale

The study was conducted in Zamboanga City, focusing on selected public schools during the 2023-2024 school year. It aimed to examine the profiles of teacher respondents, including their sex, educational attainment, years of teaching experience, relevant training, and their students' academic performance. Specifically, the study analyzed the teachers' utilization of Open Educational Resources (OER) based on David Wiley's 5R framework, focusing only on revising, remixing, and redistributing. The selected schools included School A, located 16.9 kilometers west of the city center, with 1,735 students and 74 teachers; School B, situated on R.T. Lim Boulevard, with 5,776 students and 216 teachers; School C, 5.1 kilometers from the city center, with 6,759 students and 256 teachers; School D, 5.9 kilometers from the city proper, enrolling 3,108 students and employing 104 teachers; School E, located 47 kilometers from the city center on the East Coast, with 1,556 students and 66 teachers; and School F, 23 kilometers from the city, serving 1,980 students and 87 teachers. A School Principal IV or II manages each school. This diverse sample of schools provides a comprehensive view of how OER utilization impacts student academic performance across different educational settings in the city.

2.3 Research Participants

The total population of teacher-respondents in the six selected schools in Zamboanga City for this study is 215. Based on a 5% margin of error and a 95% confidence interval, a minimum sample size of 137 teachers was determined. The teachers were randomly selected from the target population across the six schools. These teachers were chosen regardless of their sex, age, educational attainment, years of teaching experience, or any other demographic factors. The selection process aimed to ensure a diverse representation of teachers regarding their professional background and their utilization of Open Educational Resources (OERs).

2.4 Research Instrument

The research utilized a researcher-developed survey questionnaire structured into three sections. Part I collected demographic information about the teacher-respondents, including their sex, educational attainment, years of teaching experience, and relevant training. Part II focused on the teachers' utilization of Open Educational Resources (OERs), specifically examining how they "revise," "remix," and "redistribute" educational materials. This section used a four-point Likert scale, ranging from "Not at all" to "To a great extent," to measure the extent of engagement with each of these OER practices. Part III gathered data on student academic performance, primarily on grades, to assess the relationship between the teachers' OER practices and the student's academic outcomes. By linking the teachers' revision, remixing, and redistribution of OERs to students' academic performance, the survey aimed to explore the potential impact of these OER practices on student success and achievement in the classroom.

2.5 Data Gathering Procedure

The data-gathering procedure involved recruiting teacher respondents who were available and willing to participate in the study. The selection of participants was facilitated through a combination of random selection and established connections within the school community. To ensure a representative sample, the researcher contacted potential respondents using various methods, including social media postings, email invitations, and face-to-face visits. Upon confirming the respondents' participation, the researcher distributed the questionnaires during their free time to avoid disrupting their teaching schedules. Before completing the questionnaires, clear and straightforward instructions were provided to the respondents to ensure they understood the purpose and structure of the survey. The researcher was available to address any questions or concerns on the spot, ensuring that participants felt comfortable and confident in providing accurate responses. Each respondent was informed of the study's purpose and allowed to provide informed consent before participating. The survey was administered face-to-face to foster a more personal and interactive environment, allowing for better clarification of instructions and ensuring data accuracy.

2.6 Ethical Considerations

This research adhered strictly to ethical guidelines to safeguard the rights and well-being of all participants. Participation was entirely voluntary, with respondents free to withdraw from the study at any point without any consequence or penalty. The researcher took all necessary measures to prevent physical, social, or emotional harm, prioritizing the comfort and safety of the participants throughout the research process. Ethical approval for this study was obtained from the Institutional Ethics Committee of Zamboanga Peninsula Polytechnic State University. Confidentiality and anonymity were rigorously maintained, with all collected data securely stored and accessible only to authorized personnel. The dignity and respect of the teacher respondents were upheld, and the research was conducted with the utmost integrity and transparency. Additionally, findings were reported honestly, with stringent measures to avoid plagiarism and research misconduct. The study was carried out in strict compliance with ethical standards to ensure the results' reliability, validity, and accuracy.

3.0 Results and Discussion

3.1 Utilization of Open Educational Resources

In terms of Revision

Table 1 shows how teacher respondents use open educational resources (OER) in terms of revision. The highest mean score of 3.37 was for the statement, "adjusting the level of difficulty from the downloaded science reading materials to match the learning styles of my students," with a description of "strongly agree" and interpreted as "highly utilized." This means teachers are modifying the difficulty of science materials to fit students' learning styles better, which can improve engagement and outcomes.

Research by Al-Harthi (2020) and Kaur et al. (2019) supports this, showing that OER use boosts student engagement and performance. The lowest mean score of 3.05 was for the statement, "altering downloaded templates into science daily lesson plans," with a description of "agree" and interpreted as "moderately utilized." While teachers are modifying templates for lesson planning, this indicates they are still becoming more comfortable using technology for planning, which could enhance lesson effectiveness and student engagement.

Studies by the NCES and AERA show that students using technology are more engaged and perform better, suggesting that teachers' use of technology in lesson planning can positively impact student success.

Table 1. Utilization of open educational resources in terms of revision

Indicator	Mean	Verbal Description	Interpretation
1. Modifying resources such as the capsulized self-learning empowerment toolkit to align with my teaching better.	3.36	Strongly Agree	Highly Utilized
2. Adapting science investigatory projects to reflect my students' current research and best practices.	3.20	Agree	Moderately Utilized
3. I will adjust the difficulty level of the downloaded science reading materials to match my student's learning styles.	3.37	Strongly Agree	Highly Utilized
4. Altering downloaded templates into science daily lesson plans.	3.05	Agree	Moderately Utilized
5. Translate the content of science articles, journals, or news into another language to meet the needs of my students.	3.18	Agree	Moderately Utilized
Overall Mean	3.23	Agree	Moderately Utilized

In terms of Remix

Table 2 shows the extent of open educational resource (OER) utilization among teacher respondents regarding remixing. The highest mean score of 3.45 was for the statement, "reproducing worksheets from various sources," with a description of "strongly agree" and interpreted as "highly utilized." This indicates that teachers often remix worksheets from different sources, showing greater awareness of the benefits of OER. They are actively using these resources to create engaging and effective learning materials, highlighting the growing role of OER in education. Khan et al. (2020) also found that teachers increasingly use OER to remix worksheets, supporting this trend. The lowest mean score of 3.07 was for the statement, "remixing background music for my class presentations," with a description of "agree" and interpreted as "moderately utilized."

Table 2. Utilization of open educational resources in terms of remix

Indicator	Mean	Verbal Description	Interpretation
1. Reproducing worksheets from various sources.	3.45	Strongly Agree	Highly Utilized
2. Remixing background music for my class presentations.	3.07	Agree	Moderately Utilized
3. Downloading and remixing the content of science lessons from websites.	3.21	Agree	Moderately Utilized
4. Modifying downloaded powerpoint presentations for my science classes.	3.29	Strongly Agree	Highly Utilized
5. Remixing the illustrated scientific concepts into infographics.	3.15	Agree	Moderately Utilized
Overall Mean	3.24	Agree	Moderately Utilized

This suggests that some teachers remix background music for presentations, but it is not as widely practiced. Teachers could consider incorporating background music remixing into their teaching strategies to engage students and improve the learning experience. Research from Yap and Tan (2020) and Smith (2019) supports this, showing that remixing music can enhance student engagement and create a more interactive learning environment. These findings suggest that remixing background music can be an effective tool for improving student engagement and learning.

In terms of Redistribute

Table 3 shows how teachers use open educational resources (OER) for redistribution. The highest mean score of 3.32 was for "sharing links of science learning platforms with other educators," indicating that teachers often share these resources with their peers.

Table 3. Utilization of open educational resources in terms of redistribution

Indicator	Mean	Verbal Description	Interpretation
1. Sharing links to science learning platforms with other educators.	3.32	Strongly Agree	Highly Utilized
2. Making original science resources available to the public.	2.97	Agree	Moderately Utilized
3. Using open licenses that allow the easy sharing of resources.	3.09	Agree	Moderately Utilized
4. Providing attribution and credit to the creators of science learning materials	3.24	Agree	Moderately Utilized
5. I administer copies of science reading materials to my students so they can replicate them or keep them for themselves.	3.29	Strongly Agree	Highly Utilized
Overall Mean	3.24	Agree	Moderately Utilized

This promotes collaboration among educators and helps provide equal access to educational resources for students. Al-Harthi (2020) supports this, noting that teachers actively share OER, leading to better teaching practices. The lowest mean score of 2.97 was for “making original science resources available to the public,” showing that while some teachers share their resources with the public, it is less common. This practice can encourage more people to engage in scientific activities like experiments or citizen science projects. Research from the National Science Foundation (NSF) and the American Association for the Advancement of Science (AAAS) supports this, showing that making science resources available increases public interest and understanding of science.

Table 4 summarizes teachers' use of open educational resources (OER) in terms of revision, remixing, and redistributing. Teachers were found to moderately utilize OER for these purposes, meaning they are somewhat adjusting and sharing resources but not extensively. This suggests that teachers primarily use OER for personal teaching and learning rather than for creating or remixing new content. This could be due to limited knowledge or skills in effectively using OER for content creation and remixing. Al-Harthi (2020) also notes the need for training to help teachers maximize OER in these areas, supporting more innovative and collaborative use of resources.

Table 4. Summary of the extent of utilization of open educational resources

Indicators	Mean	Interpretation
Revise	3.23	Moderately Utilized
Remix	3.24	Moderately Utilized
Redistribute	3.24	Moderately Utilized
Over-All Mean	3.23	Moderately Utilized

3.2 Academic Performance of the Students

Table 5 shows the students' Science performance for the 1st quarter of School Year 2022-2023, with an average score of 83.73, rated as “Satisfactory.” This indicates that students perform well in science, suggesting that the school’s curriculum and learning environment effectively support their success. Research by Smith (2021) and Jones (2020) supports the idea that a supportive environment and effective teaching strategies lead to better academic outcomes. Thus, the students' satisfactory performance reflects positively on the school’s efforts in science education.

Table 5. Academic performance of the students in science

Indicator	Mean	Verbal Description
General Weighted Average Grade	83.73	Satisfactory

3.3 Impact of Using Open Educational Resources

Table 6 explores the impact of using open educational resources (OER) specifically for revising, remixing, and redistributing students' academic performance in science. The results show that only "revise" ($B = -0.411$, $t = -2.514$, $p < 0.013$) has a significant favorable influence on academic performance, indicating that students benefit when teachers use OER to modify materials to suit their needs. However, "remix" ($B = 0.222$) and "redistribute" ($B = 0.008$) do not show any significant effect on academic performance. These findings suggest that teachers can maximize the academic benefits of OER by focusing on revision, while remixing and redistributing materials may not impact student outcomes in science as effectively.

Table 6. Multiple regression analysis with academic performance as outcome variable

Predictor	Beta Coefficients	R2	F	t-value	p-value	Interpretation
Revise	-0.411			-2.514	0.013	Significant
Remix	0.222	0.060	1.319	1.354	0.179	Not Significant
Redistribute	0.008			0.073	0.942	Not Significant

3.4 Difference in OER Usage

In terms of Sex

Table 7 presents the comparison of OER usage between male and female teachers, showing no significant difference in mean scores (male: $M = 17$, $SD = 0.41822$; female: $M = 93$, $SD = 0.39547$; $t(108) = 1.070$, $p = 0.287$). This result suggests that male and female teachers utilize open educational resources equally, indicating no gender-based disparity in OER usage. As a result, the null hypothesis, stating no significant difference in OER usage by

gender, is accepted. This implies that both genders have similar access to and utilization of OER, making gender-neutral policies appropriate for promoting OER use. This finding aligns with studies by Kaur et al. (2020) and Al-Hazza et al. (2019), which found no significant gender difference in OER usage among teachers.

Table 7. T-test results on the teachers' extent of utilization of oer according to sex

Sex	N	Mean	SD	T	df	p-value	Interpretation
Male	17	3.33	0.418	1.070	108	0.287	Not Significant
Female	93	3.22	0.395				

In terms of Educational Attainment

Table 8 shows the mean OER utilization scores based on teachers' educational attainment. Teachers with a bachelor's degree had a mean score of 3.19 (SD = 0.39), master's units scored 3.24 (SD = 0.42), master's degree holders scored 3.25 (SD = 0.34), those with doctorate units scored 3.84 (SD = 0.17), and doctorate holders scored 3.02 (SD = 0.11). There was no significant difference in OER utilization across these groups ($F(4, 105) = 1.556$, $p = .192$). Thus, the null hypothesis—stating no significant difference in OER utilization based on educational attainment—is accepted. This suggests that teachers utilize OER similarly, regardless of their educational level, providing equal access to resources for teachers and students alike. Studies by Al-Harthi (2020) and Al-Harthi et al. (2019) support these findings, indicating that educational attainment does not significantly impact teachers' use of OER.

Table 8. ANOVA results on the teachers' extent of utilization of oer according to educational attainment

Educational Attainment	N	Mean	SD	F	df	p-value	Interpretation
Bachelor's Degree	27	3.192	0.392	1.556	4105	0.192	Not Significant
Masters with units earned	63	3.243	0.418				
Master's Degree	14	3.245	0.335				
Doctorate with units earned	2	3.840	0.169				
Doctorate	4	3.020	0.105				

In terms of Teaching Experience

Table 9 shows that teachers' utilization of open educational resources (OER) varies based on years of teaching experience. Teachers with five or fewer years scored highest ($M = 3.41$, $SD = 0.37$), while those over 31 years had the lowest mean score ($M = 2.98$, $SD = 0.41$). A significant difference was found in OER utilization among groups based on teaching experience ($F(3, 103) = 4.015$, $p = .001$). Thus, the null hypothesis is rejected—that no significant difference exists in OER utilization by years of teaching experience. These findings suggest that teachers with fewer years of experience may be more open to using new resources, while those with more extended experience may be more resistant. Studies by Smith (2020) and Jones (2021) support this, indicating that less-experienced teachers tend to embrace OER and other new technologies more readily. This insight can guide educators when introducing new resources, as newer teachers may be more receptive to change.

Table 9. ANOVA results on the teachers' extent of utilization of oer according to the number of years in teaching

Educational Attainment	N	Mean	SD	F	df	p-value	Interpretation
5 and below	19	3.412	0.366	4.015	3103	0.001	Significant
6-10	32	3.260	0.357				
11-15	15	3.477	0.432				
16-20	12	3.203	0.299				
21-25	10	3.028	0.382				
26-30	6	3.000	0.203				
31 and above	16	2.982	0.414				

In terms of Training Attended

Table 10 shows that teachers' utilization of open educational resources (OER) does not significantly vary based on the number of relevant training sessions attended. Mean scores across training groups (ranging from 5 or fewer sessions to 31 or more) showed slight variation, with no significant difference in OER utilization ($F(6, 103) = 0.411$, $p = 0.870$). This supports the null hypothesis that training quantity does not significantly impact OER use among teachers, suggesting that teachers can effectively utilize OER regardless of training level. This underscores the importance of providing teachers with support and guidance, as studies by Al-Harthi and Warschauer (2018) and

Kukulska-Hulme and Shield (2008) found that access to professional development and technical support enhances teachers' ability to utilize OER effectively.

Table 10. ANOVA results on the teachers' extent of utilization of oer according to the number of relevant training

Relevant Training	N	Mean	SD	F	df	p-value	Interpretation
5 and below	36	3.288	0.4136	0.411	6103	0.870	Not Significant
6-10	30	3.214	0.3549				
11-15	21	3.171	0.4400				
16-20	8	3.360	0.3615				
21-25	4	3.160	0.5685				
26-30	2	3.180	0.2545				
31 and above	9	3.160	0.4331				

4.0 Conclusion

This study emphasizes revising, remixing, and redistributing Open Educational Resources (OER) to enhance teaching effectiveness. While teachers primarily use OER to retain resources, revising, remixing, and redistributing are utilized to a lesser extent. The findings suggest that teachers are not fully leveraging the potential of OER to modify, adapt, and share resources in ways that could foster more personalized, collaborative, and dynamic learning environments. By revising OER to meet specific teaching needs, remixing resources for diverse educational contexts, and redistributing these resources for broader access, educators can enhance both the quality of teaching and student learning experience. Therefore, it is crucial for educational institutions to encourage and support teachers in embracing these practices, ensuring that OER is not only retained but also effectively revised, remixed, and redistributed to maximize their impact on education. Future research could investigate strategies for training and supporting teachers in these OER practices and explore the long-term educational outcomes of comprehensive OER integration. Additionally, studies could examine the impact of OER usage on student engagement and learning outcomes across various disciplines and educational settings, providing a more holistic understanding of the benefits and challenges associated with OER adoption.

5.0 Contributions of Authors

The authors indicate equal contribution to each section. The authors reviewed and approved the final work.

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7.0 Conflict of Interests

The authors declare no conflicts of interest about the publication of this paper.

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