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Research Article

Integration, Utilization, and Impact of Open Educational Resources (OER) in Academic Libraries: A Mixed-Methods Empirical Analysis Using Classical and Bayesian Paradigms

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Abstract

Open Educational Resources (OER) have changed the higher education landscape today by providing scalable, low-cost, and legally safe alternatives to traditional, proprietary educational content. The micro-level structural mechanics of institutional uptake of OER, in particular the role of academic libraries and information professionals, have not been explored as much. The micro level of the workings of OER in institutions has been studied less, the roles of academic libraries and information professionals.

This research paper is an extensive empirical study on the inner dynamics influencing OER integration in academic libraries. This study uses a strong sample of N=317 academic librarians and information gatekeepers to examine the multi-faceted connections between organizational awareness, behavioural deployment, content production processes, collaborative sharing projects, infrastructures, individual skill competencies, systematic barriers, and the long-term institutional impacts of OER.

In methodologically terms, this paper applies a well-designed statistical design that links the classical approach to modern Bayesian inference methodology to assess latent constructs. To assess the internal consistency, reliability diagnostics confirmed that our structural instruments had a high internal consistency (Cronbach's α=0.883 for a total of 35 scale items). The Pearson correlation analyses showed an extremely high and very significant positive linear correlation between the pre-existing level of professional OER awareness and the actual administrative use of OER (r=0.736, p<0.001).

Because the structural limitations of the p-value, Bayesian one-sample mean estimations were performed for all operational variables with non-informative diffuse priors, to generate 95% Credible Intervals. Posterior distribution summaries pointed to high performance with fundamental variables (i.e., overall awareness: Posterior Mean=3.6979, and functional use: Posterior Mean=3.4511). At the same time, they revealed high structural drops in advanced execution areas, such as OER-based content creation (Posterior Mean=2.8927) and institutional support/budget policies (Posterior Mean=2.9582).

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KEYWORDS: Open Educational Resources (OER), Academic Libraries, Bayesian One-Sample Mean, Cronbach's Alpha, Pearson Correlation Coefficient, Digital Content Creation, Higher Education Policy.

1. INTRODUCTION

1.1 Background of the Study

This combination of the quick pace of digital technology, changing academic publishing structures and skyrocketing expenses for higher education at global level has combined to present an operational crisis for academic infrastructure.

In this context, OER as a movement came into being as a radical alternative model. According to the UNESCO definition, OER refers to "teaching, learning and research materials that are in the public domain or released under an open license that allows others to freely access, use, adapt and redistribute the materials, with or without restrictions.

1.2 Statement of the Problem:

Although there are clear benefits to the theory behind OER, its use in higher education institutions is inconsistent and disjointed and often hindered by barriers to operation. Others see OER as a technology used to download open, ready-to-use books, without considering the institutional dynamics that will enable a sustainable and creating-friendly open book ecosystem. In addition, previous studies tend to view OER adoption as a simple one-time process, without attention to various organizational components that comprise the adoption process. The study of internal professional awareness and its direct implications for administrative deployment is still in its infancy. A deeper understanding is also needed of the impact of variations in structural infrastructure and institutional polices on advanced processes such as localized digital content production and cross-institutional resource sharing. There are many systems that are caught in a vicious cycle: they see high degrees of conceptual interest in open education, but see relatively low rates of adoption of digital tools, indexing of institutional repositories, and active production of content.

In addition, a large portion of the existing literature on the issue of library-based adoption of OER is descriptive and based on a few qualitative case studies. This lack of hard statistical proof makes it difficult to draw general conclusions.

2. OBJECTIVES

- To assess the internal consistency and structural soundness of multi-item psychometric measures of OP and institutional performance related to professional OER competencies.
- To make a statistical analysis of the strength, direction and significance between the awareness of professional OER and actual use in library services.
- To evaluate posterior probability distributions and 95% Credible Intervals for critical operational areas (e.g., awareness, utilization, content creation, sharing on repository, policy support) to identify areas of institutional underperformance.
- To examine individual frequency distributions of specific items studied (e.g., platform awareness, Creative Commons licensing, reference services, and digital creation tool deployment) for potential practical competency gaps.
- To systematically assess the perceived technical barriers, infrastructural barriers and legal barriers affecting daily operations of OER.
- To create a data-informed framework and suite of recommendations for university administrators, library directors, and higher education policy makers on how to maximize OER investments.

3. LITERATURE REVIEW:

3.1. The Evolving Role of the Academic Library:

The digital revolution has resulted in new positions and units within libraries, yet there is no standard model for digital scholarship support (Corrall & Collister, 2019). Librarians are extending their roles into repository management, hosting, and publishing, while providing consultation on copyright and licensing (Corrall & Collister, 2019). Modern librarianship promotes global thinking and innovation as core foundations, moving toward a multidisciplinary perspective (Essmiller et al., 2019). In this context, librarians are often work with forming and implementing initiatives across of the campus, acting as functional specialists who support users in subject-specific research (Essmiller et al., 2019).

3.2. Benefits and Motivations for OER Adoption: Most of the reasons for OER adoption are rooted in the "access hypothesis": that OER improves learning because students may not otherwise have access to important resources that they would otherwise pay for (Belikov & Bodily, 2016; Hill et al., 2024). Nuviadenu stated in his research that OER can boost students' end-of-course scores and reduce DFW rates for all students (Nuviadenu, 2023). In addition, students have the concept that the users who use OER, encouraging, and creating resources than the faculty who use traditional textbooks (Nuviadenu 2023).

3.3. Barriers to Implementation: The "Production Gap": For library professionals, the challenges are more structural. Research indicates that while many institutions have made strides in offering faculty mini-grants or stipends, OER funding is still seeking wider support as a permanent funded resource (McGowan, 2019). Furthermore, the lack of OEP-related policies remains a critical issue, leading to hesitation and fear regarding the misuse of open licenses (Stagg et al., 2023).

A significant disconnect exists between research and teaching content; many institutions support open access for research outputs but lack a counterpart for learning and teaching content (Stagg et al., 2023). This "policy vulnerability" often leaves OER efforts as "bottom-up" individual initiatives rather than systemic institutional strategies (Veletsianos et al., 2021).

4. RESEARCH METHODOLOGY

4.1. Research Design

In this study, an empirical non-experimental quantitative research design is adopted, with an extensive, structured cross sectional survey instrument. The complexity of the integration of OER into the institutions is the reason that a classical approach to inferring hypotheses is combined with a Bayesian

approach. This is a statistical approach that combines two paradigms with different analytical benefits. In addition to the classical measures of verification, Bayesian analysis can be used to estimate the parameters directly and to obtain highly accurate Credible Intervals even in the case of non-informative priors. This can circumvent common misinterpretations that are part of a strict p-value cut off interpretation paradigm.

4.2. Population and Sampling Frame

This research is targeted at academic librarians, information managers, institutional repository managers, and university stakeholders of open education. A comprehensive sampling frame was created to encompass a representative sample of higher education institutions ranging from large research universities to smaller, regionally-based institutions. N=317 valid, completed surveys were collected. There were no missing data in the data set and list wise deletion analysis showed that 100% of the recorded cases were valid for a full statistical processing. This clean sample will have high degree of statistical power and reduce the non-response bias.

A brief introduction to statistical methods of analysis.

There was a strict multi-stage approach to the processing of the collected primary data, carried out with the software package IBM SPSS Statistics:

Scale Reliability Analysis: Cronbach's Alpha coefficient (α) was computed for all 35 scale items to assess the internal consistency and stability of the measure.

• **Pearson Bivariate Product-Moment Correlation:** Performed to mathematically measure the linear association and direction of the composite scores of professional awareness and actual behavioural utilization as well as determine the significance level.

• **Bayesian One-Sample Mean Estimation:** Carried out to characterize the posterior distribution for each core construct mean. Both variance and mean values were assumed to have diffuse (non-informative) priors, which let the data inform the posterior estimates. Posterior modes, posterior means, posterior variances and formal 95% Bayesian Credible Intervals (Equal-Tailed Lower and Upper Bounds) were obtained.

Descriptive Central Tendency and Dispersion Diagnostics: Item-level Means, Medians, Modes, Standard Deviations and Ranges for accurate responses in groups.

Relative Frequency Distribution Analysis: Used categorical percentage calculations to gain actionable and practical information from the data in distinct areas of the variable.

5. Formulating research hypotheses in a statistical manner:

OER is of tremendous significance for library services.

Hypothesis 1: predicts that those who are aware of OER the more they will use them. Library practitioners need to be aware of OER. Use them a lot.

Hypothesis 2: is about the support that institutions give to Open Educational Resources. This is not sufficient to sustain production of content and OER usage to a large extent ($\mu < 3.5$).

Hypothesis 3: says that librarians know about Open Educational Resources. They are not very good at making digital content, managing repositories and following copyright rules. They know about Open Educational Resources. They need to learn more about how to use them.

Hypothesis 4: Users know about Open Educational Resources but they do not use them much in their daily work.

Hypothesis 5: There are problems that stop institutions from serving Open Educational Resources. These problems include not support unclear rules about copyright and bad digital infrastructure.

Hypothesis 6: says that librarians want to learn more about Open Educational Resources. They do not get enough training. There is a gap between what they want to learn and what they actually learn.

Hypothesis 7: For sharing Open Educational Resources the institutions do not work together enough. They should use repositories and networks to share resources.

Hypothesis 8: says that using Open Educational Resources can have a good impact, on institutions in the long term. It can help people access resources and make library services better which is what information professionals think. Open Educational Resources are very important for academic library services and people should use them more.

6. Empirical Data Analysis and Statistical Diagnostics:

6.1. Bayesian One-Sample Mean Parameter Estimations:

To examine the data without dependent on traditional way, use a Bayesian one-sample mean analysis for all eight core variables. Using diffuse, non-informative priors, the calculation did the exact posterior distributions and constructed true 95% Bayesian Credible Intervals.

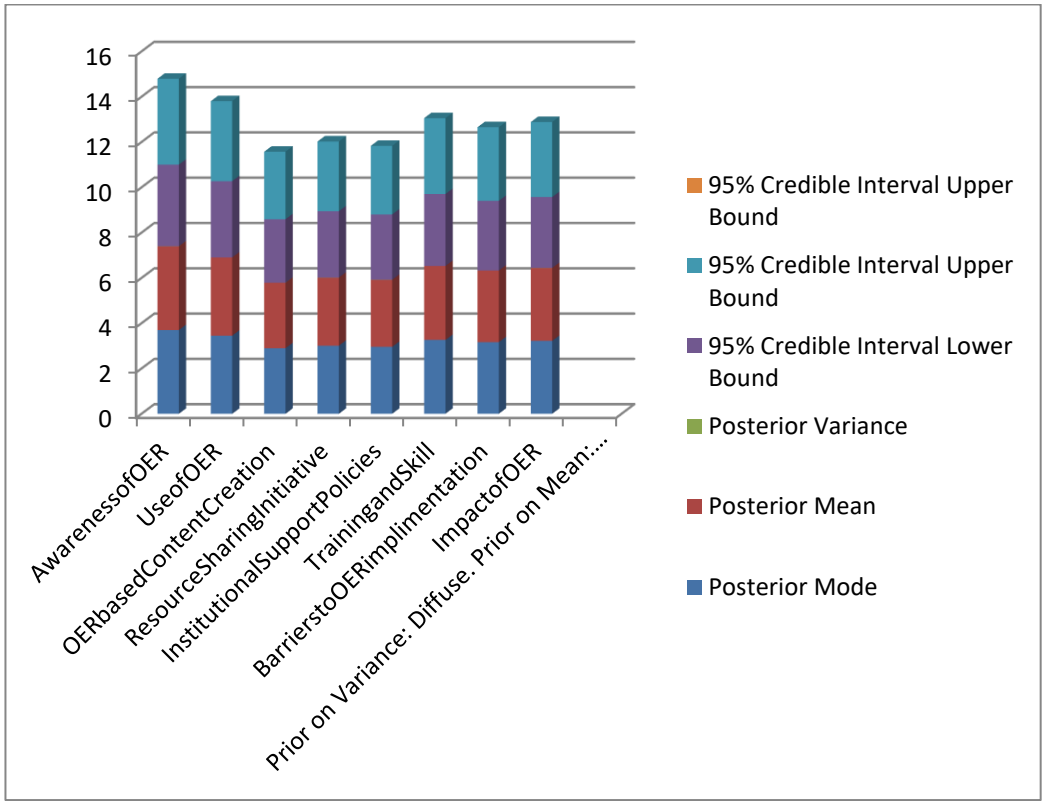

Chart 1: Posterior Distribution Characterization for One-Sample Mean

Bayesian posterior elements discover the important structural trends and depicture direct operating boundaries of different institutions.

6.1.1. Awareness of OER had the highest overall score with a posterior mean and mode of 3.6979. The width of its 95% C.I. (3.6047 to 3.7912) indicates that we are 95% certain that the actual population mean for the professional awareness is greater than the neutral level

6.1.2. The construct Use of OER is very similar to the posterior mean of 3.4511 with a 95% Credible Interval of [3.3690, 3.5332] for this mean. This is a clear progression from baseline awareness to general reference and library-collection service.

6.1.3. In the construct OER based Content Creation, there is an operational drop, which is sharp, in the Advanced Production Drop-off (Hypothesis II Verification): The mean for the posterior distribution was also depressed at 2.8927, and the 95% Credible Interval was entirely contained within the interval 2.8031 to 2.9824. This meant that the entire 95% CI was lower than the midpoint of the neutral score, 3.50, and the null hypothesis (H02) was rejected and the alternative hypothesis (H12) was accepted. The statistic highlights a large disconnects in the overall operations of libraries: they're content to use OER, but they're not yet at the point of making them or adapting them.

6.1.4. The Policy and Budget Vulnerability Domain: This production drop off is directly related to the deficiencies of Institutional Support Policies. This construct was reported with a low posterior mean of 2.9582 with its 95% Credible Interval entirely below the neutral value (2.8868 to 3.0297). This discovery is not an isolated one; it is due to weak institutional policies, non-existent strategic roadmaps and small budgets allocated to their creation.

Descriptive and frequency analysis of the items was conducted within each module to gain insight into the drivers behind these wider construct trends

6.2. tem-Level Descriptive Analysis and Frequency Diagnostics:

6.2.1. Module B: Evaluation of Awareness Dynamics:

The structural parameters for components of professional awareness are summarized below:

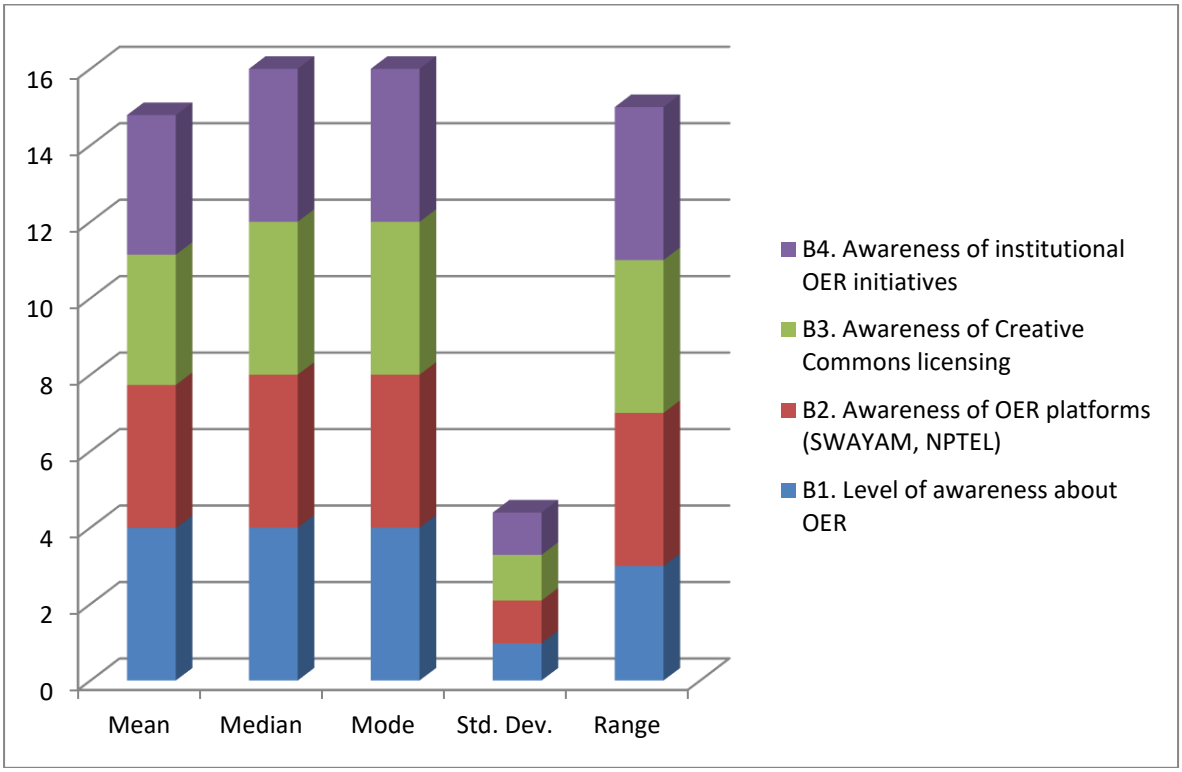

Chart 2: Awareness of OER

- For B1 (Overall OER Awareness Level) a combined 77.6% of respondents rated themselves as either "Good" (43.5%) or "Excellent" (34.1%). This indicates some baseline knowledge with the open model.
- For B2 (Platform Awareness) a strong majority (68.8%) selected "Good" (42.0%) or "Excellent" (26.8%). This indicates support for the major national digital repository architectures.
- However, B3 (Creative Commons Licensing Literacy) performance is considerably down. Among the respondents a total of 17.4% rated their knowledge as "Excellent" and a combined 45.1% rated their knowledge as “Average” (24.6%) “Below average” (9.8%) or “Extremely Poor” (10.7%).

This shows that there is a gap in intellectual property literacy, as professionals may be conceptually present in the OER movement but face challenges in dealing with legal aspeof OER

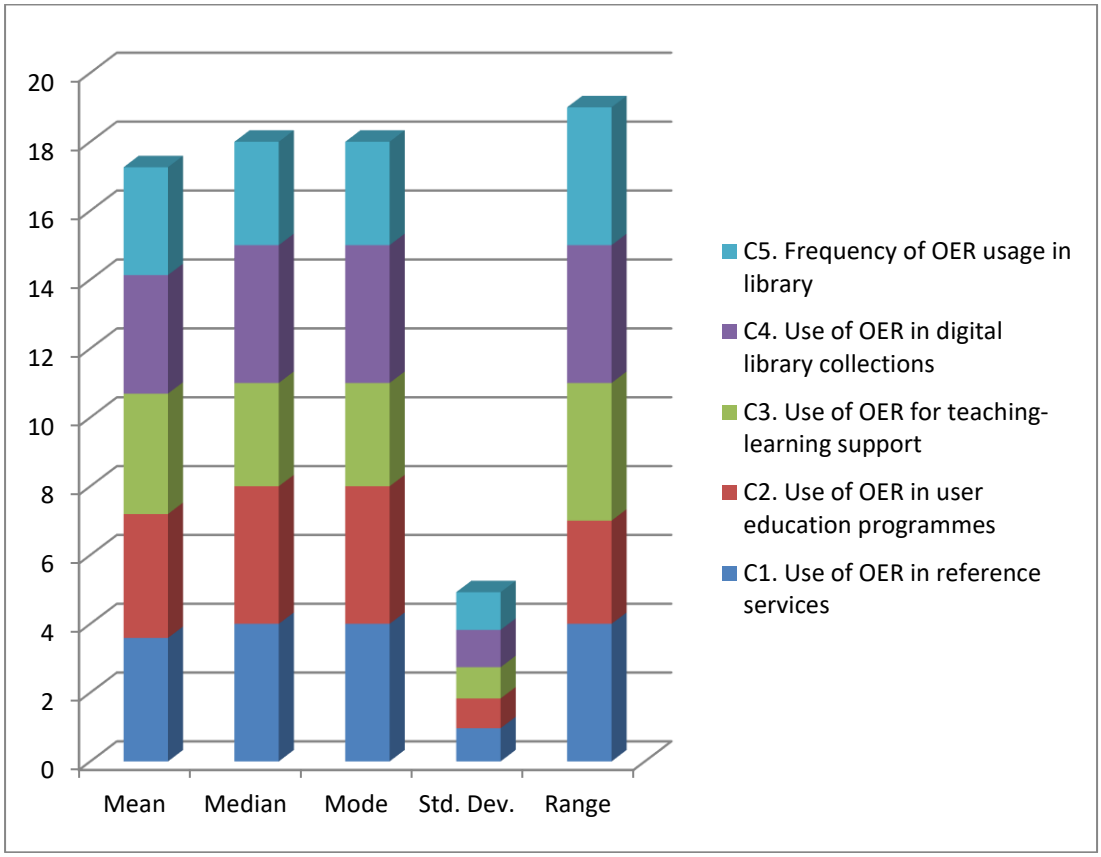

Chart 3: Use of OER

C1 (Reference Services Integration): This research has moderate adoption with 56.2% of the sample respondents reporting at "Good" (38.5%) or "Excellent" (17.7%).
This is consistent with the finding that librarians are often directing users to open access materials during reference sessions.
C2 (User Education Programmes): Reports a distribution, with 53.7% in the top tiers, "Good": 37.9%, "Excellent": 15.8%. This means that OER is actively promoted in information literacy workshops.

C5 (Daily Frequency of Usage): Identifies a performance constraint. The mode is an "score of 3" with a low mean of 3.13. Overall 70.0% of the sample (encompassing 42.3% “Average”, 22.4% “Below Average” and 5.4% “Extremely Poor”) report using the library regularly as “Average”, “Below Average” or “Extremely Poor”. This indicates that although OER are used in workshops they are not yet an integral part of independent library research.

6.2.3. Module D: Analysis of Content Creation Workflows:

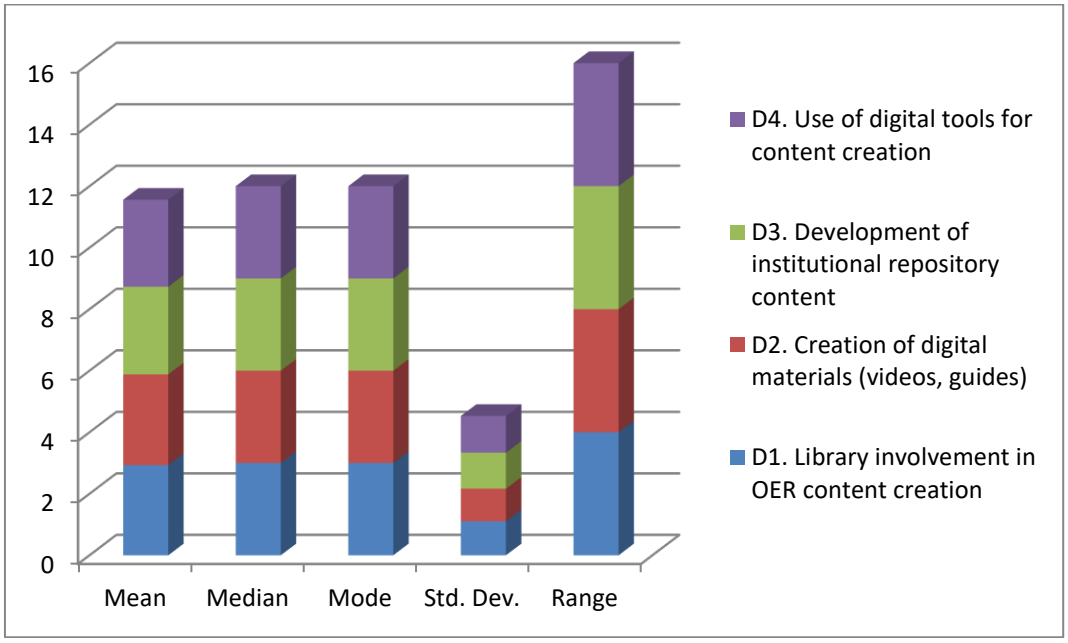

Chart 4: OER-based content creation

Detailed distributions across these items also show that there are systemic deficits:

There are high numbers of responses that are at or below average (67.8%) in D1 (Active Content Creation Involvement). This translates to many libraries not producing at the level at which they should be.

D3 (Institutional Repository Content Development): 72.9% of libraries say they are average to -existent.

This chart indicates that a lot of libraries aren't doing a job on creating content for their institutional repositories. In fact, there are significant skill gaps, with 78.9% of professionals stating that this is because due to lack skills. This means that many professionals do not have the skills they need to use tools for content creation. These diagnostics document an operating fact.

The majority of academic libraries work in a 'consuming' fashion. Do not create their own digital educational resources that create multi-media learning objects or curate comprehensive internal open content, but they do provide indexing of platforms and guide students to existing resources.

6.2.4. Module E: Resource Sharing and Repository Dissemination Channels:

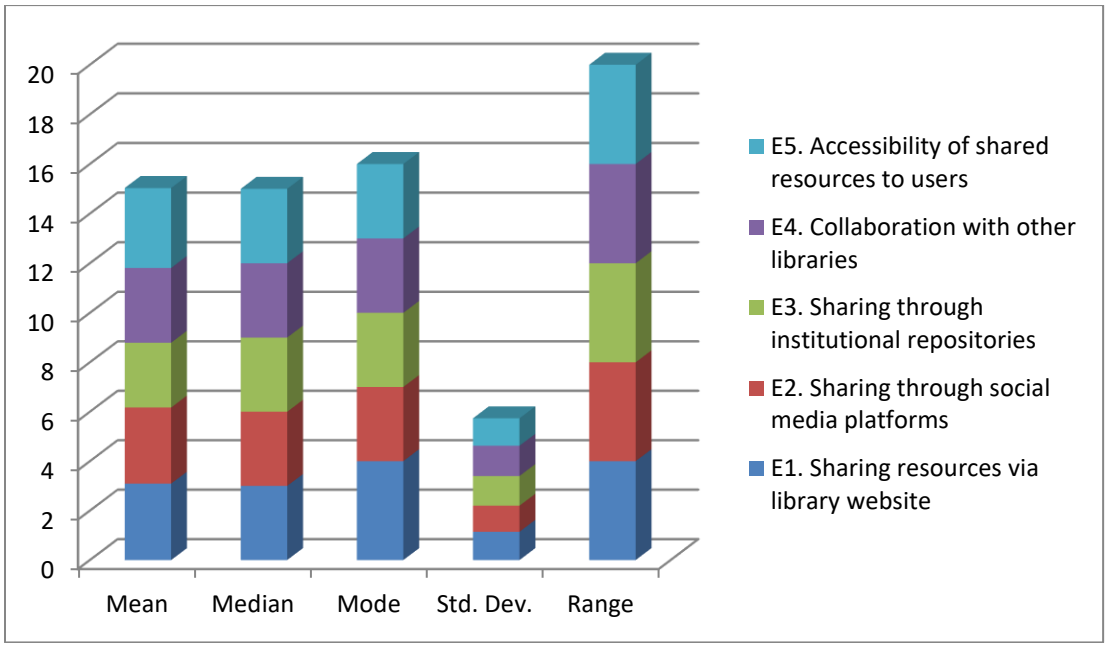

Chart 5: Resource sharing initiative

When examining the frequency tables, it is obvious that there is structural imbalance, that is: For E1 (Library Website Indexing) performance is displayed.
That is, libraries are already doing a job on the distribution of resources via their websites. Sharing through institutional repositories, however, is not so efficient for E3.

The data for E4 (Inter-Library OER Collaboration) is divided evenly in the middle. This indicates that libraries are not working together to the extent that they can.

6.2.5. Module F: Institutional Support, Infrastructure and Budget Infrastructures:

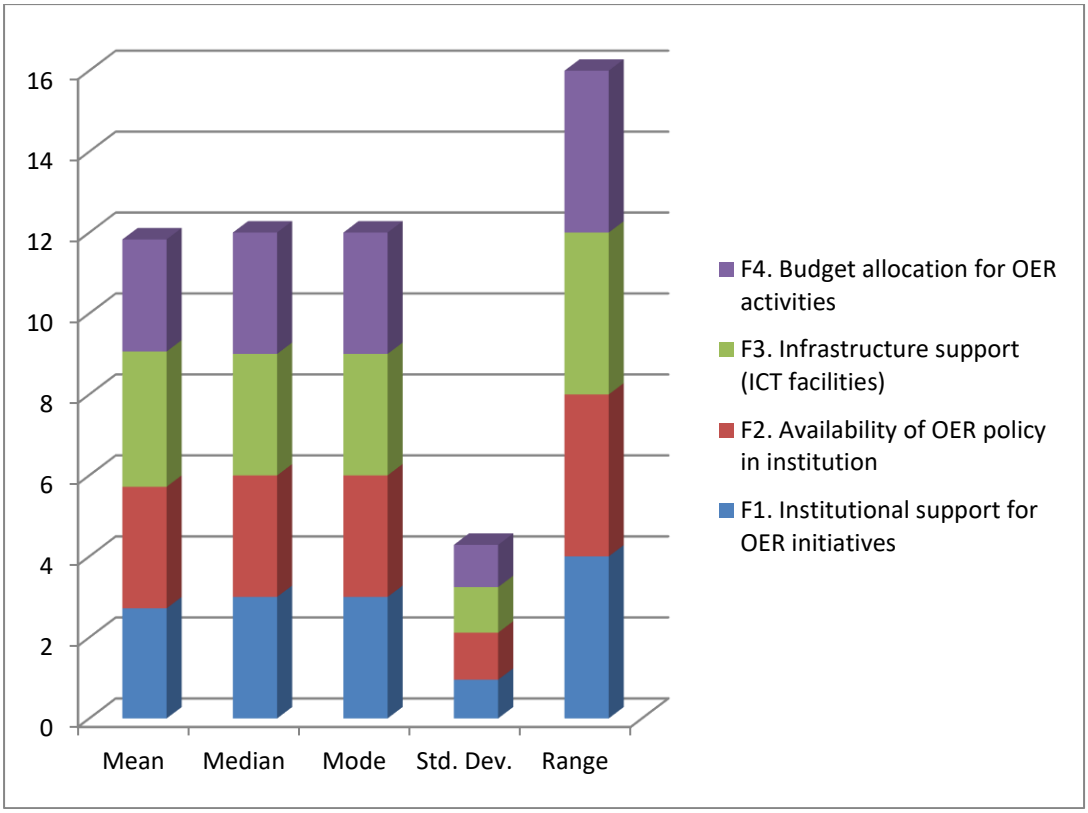

Chart 6: Institutional support policies

F1 (Direct Institutional Administrative Backing): This implies that a number of institutions are not offering assistance for OER projects.

F2 (Formal Written OER Institutional Policy): 71.0% of institutions do not have a proactive open policy ecosystem. This indicates that there is a lack of institutional plans on OER, in many cases.

6.2.6. Module G: Technical Competency Profiles and Training Requirements

The statistics tracking skills and training needs are detailed below:

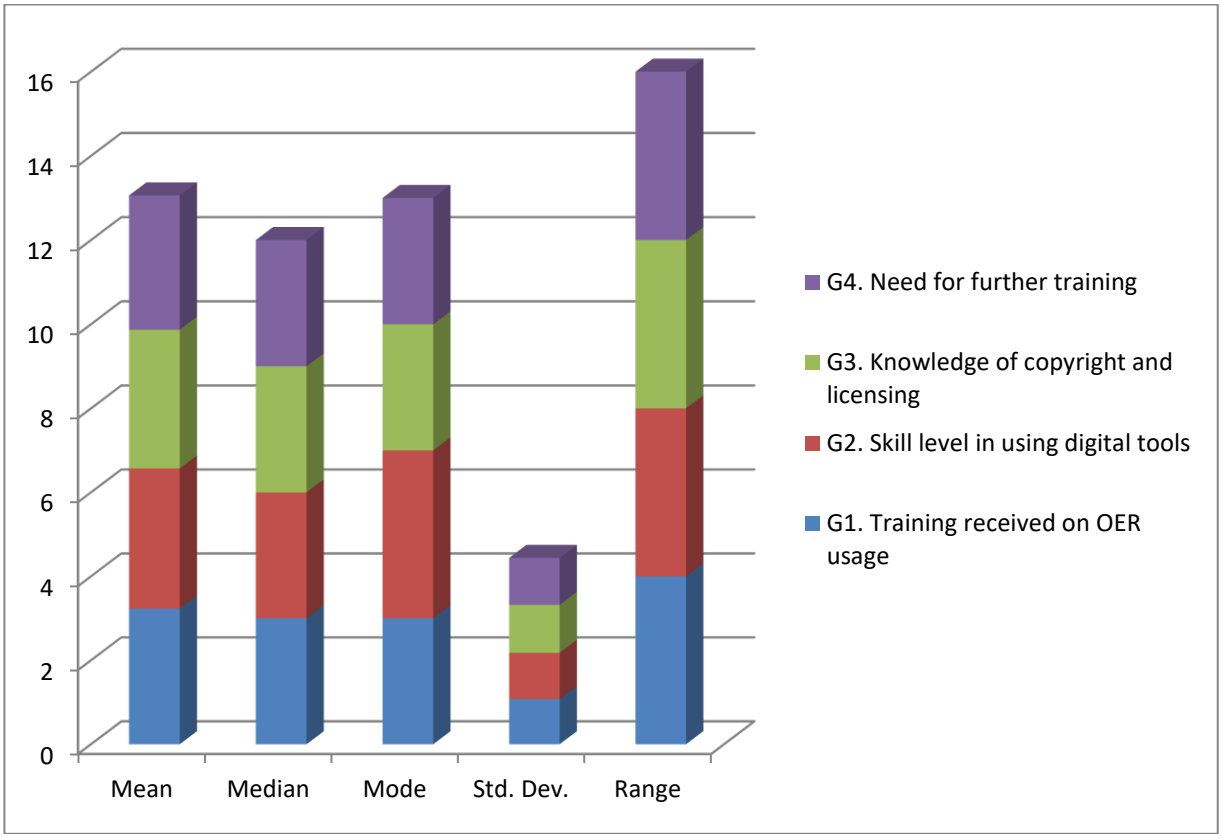

Chart 7: Training and skill

A 47.6% of the sample rate their technical proficiencies as "Good" or "Excellent" in G2 (Digital Tool Skill Level). For G3 (Knowledge of Copyright and Open Licensing Mechanics), the mode however, returns to 3. This translates to a lack of understanding of copyright and licensing among many professionals as they should have.

This legal and technical gap is why there was a response pattern for G4 (Identified Need for Training). This is a significant 72.9% of respondents who say there is an average to high level of demand for targeted professional development. This demonstrates that there is a need to know more about OER by many practitioners.

6.2.7. Module H: Analysis of Systemic Operational Barriers:

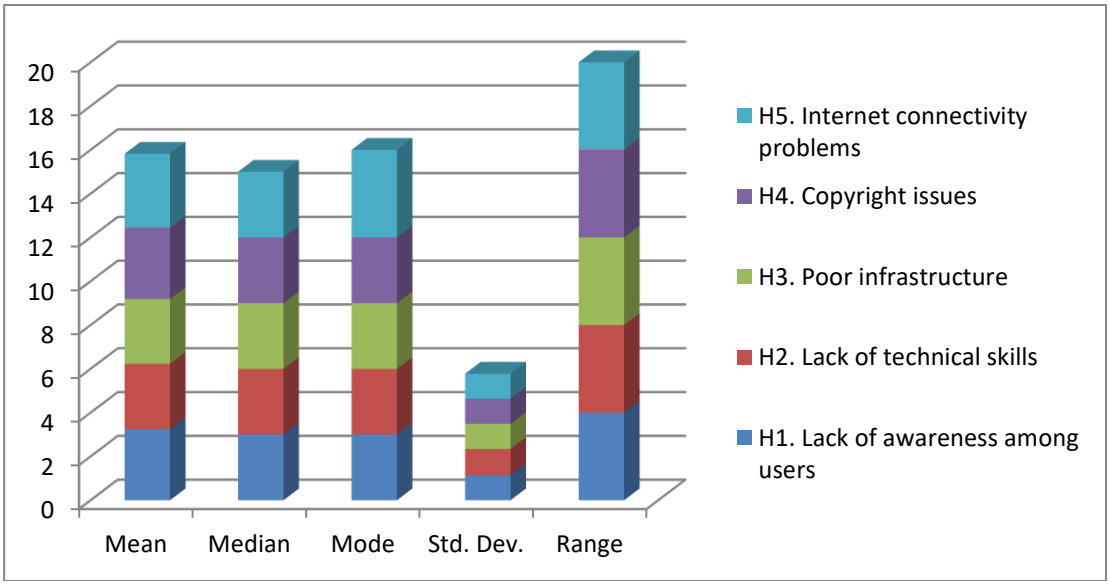

Chart 8: Barriers to OER implementation

- H1 (Lack of Awareness): There are also other signs of disconnection. The lack of student and faculty awareness was identified by 42.6 percent as an operational barrier, and 43.9 percent said ambiguous copyright concerns were a major administrative barrier.
- H4 (Copyright issues): Unstable Internet Connectivity: 48.6% cite this ongoing infrastructure challenge. As a result, many libraries are experiencing sluggish internet speeds.

* H5 (Unstable Internet Connectivity): A majority of 48.6% identify this as an ongoing infrastructure issue. This means that many libraries are having trouble with their internet connection.

6.2.8. Module I: Evaluation of Perceived Long-Term Institutional Impact

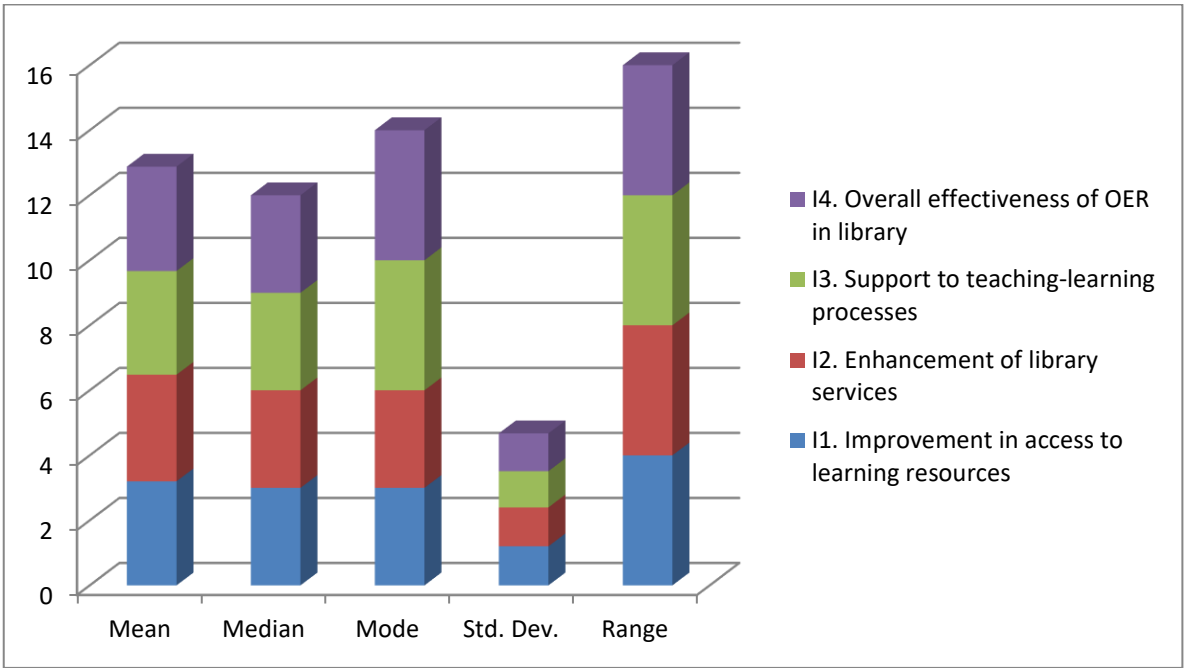

Chart 9: Impact of OER

- The final outcome metrics across these impact measures indicate long-term trends:
- For I1 (Improved Resource Access) a combined 43.5% rate the impact as "Good" or "Excellent". This confirms that OER is helping to improve access to learning resources.
- For I2 (Enhancement of Library Services) 45.2% report positive shifts. This proves that OER is helping to enhance library services.
- For I3 (Support to Teaching-Learning Processes) a significant 42.9% report an impact. This shows that OER is helping to support teaching and learning.
- For I4 (Overall Effectiveness of OER in Library) a substantial 44.2% rate the effectiveness as "Good" or "Excellent". This confirms that OER is having an impact, on libraries.
- For the perceived effectiveness, which is called I4 people think the model is really good. A total of 43.2 percent of people think the whole model is very effective. Some people think it is good which is 28.7 percent and some people think it is excellent which is 14.5 percent. This shows that information professionals think the open education model is very useful. They like it even though there are problems with money and policies. The open education model is a part of what they want to do in the future for the library. The open education model is important, for the future of the library.

Comprehensive Psychometric Reliability Assessment:
As we can see, there were 317 valid cases (no cases were excluded).

Here are the details:

Case Status	N	%
Valid Cases	317	100
Excluded Cases	0	0
Total Cases	317	100

The descriptive statistics for the 35-item scale were as follows: Scale Mean (112.23), Scale Variance (302.842), Standard Deviation (17.402), and Number of Items (N of Items) (35). Looking at the Reliability Statistics table, the value labelled Cronbach's Alpha is the internal consistency of this set of 35 individual scale items. A Cronbach's alpha value greater than 0.70 is generally considered acceptable and a value greater than 0.80 indicates very good internal consistency. Scale Mean is 112.23 Scale Variance is 302.842 Std. Deviation is 17.402 and N of Items is 35.

6.3. Bivariate Correlation Analysis:

To test Hypothesis Set, a bivariate Pearson product-moment correlation analysis was performed to measure the relationship between Awareness of OER and Use of OER.
The resulting correlation matrix is presented below:

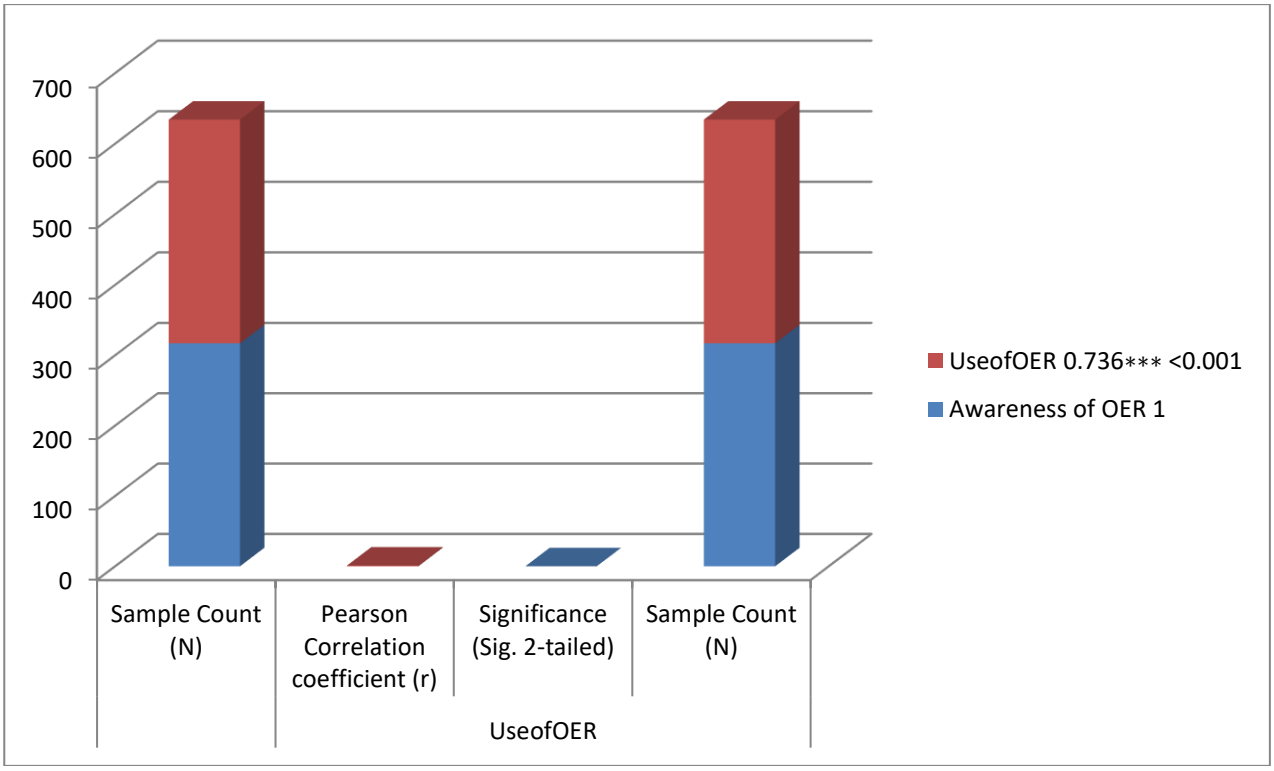

Chart 10: Correlation is significant at the 0.001 level (2-tailed).

Note that the correlation is highly significant at the 0.001 level.
The data shows a positive linear correlation between professional OER awareness and actual service utilisation:

- r=0.736, p<0.001 [cite: 2, 3]
- Because the significance value is below our standard threshold, we reject the null hypothesis and accept the alternative hypothesis. This confirmation reveals that professional awareness is a linear predictor of actual OER use.
- The coefficient of determination shows that 54.17% of the variance in library OER utilization is explained by the variance in professional awareness scores.
- This strong statistical link proves that any institutional strategy aiming to increase OER use must start by improving librarians' baseline technical awareness and professional literacy.

7. DISCUSSION AND SYNTHESIS OF EMPIRICAL FINDINGS

This tests, Bayesian distribution parameters and item-level frequencies reveal a picture of how OER functions inside academic libraries. We could address a fundamental question of how the translation of knowledge into practice occurs. That clear segmentation between consumption and production is illustrated in a pathway that the Bayesian posterior mean analysis reveals: Awareness of OER leads to Standard Utilisation, which leads to Active Content Creation. Librarians cannot deploy, index or advocate for tools they do not understand. This divide is illustrated in the pathway: Awareness of OER leads to Standard Utilisation, which leads to Active Content Creation.

So, Awareness of OER (3.6979) →,
Standard Utilisation (3.4511) →
Active Content Creation (2.8927)

Such a dramatic structural drop-off suggests not a lack of interest in the field, but rather a shortage of opportunities to continue to work within it. Librarians report solid baseline technical skills and a desire for more advanced training. They are craving an environment with institutional policy support. They're doing the "open" that they can. But they aren't able to move to the next level of creating original digital content. A striking percentage of respondent's report that their institutions completely lack a written OER policy framework and are forced to operate without any dedicated funding lines. The result is to keep libraries that are eager to build open ecosystems stuck in a passive storage mode, without the official support or financial backing to move forward. In addition to other hurdles internet connectivity though even the lingering confusion over copyright law has contributed to the snail's pace.

Data-Driven Strategic Recommendations:

8.1 Formalizing Institutional Policy Frameworks and Dedicated Budgets

Higher education department must extract the policy of using open educational resources illegibility that slows down the acceptance of OER in institutions. When government generate the OER policies that explicitly integrate open content action into the institution's strategic master plan. This policy must be linked to a non-transferable budget allocation for the institutional libraries

8.2 Creative Commons Legal and Copyright Training: Because general awareness is strong but legal licensing confidence is low institutions should move away from generic professional development workshops. Libraries should invest in targeted training programs focusing exclusively on the application of Creative Commons rules, copyright exceptions and open licensing attribution mechanics. This specialized training will give librarians the clarity they need to confidently adapt, remix and publish content without worrying about compliance issues.

8.3 Digital Infrastructure and Content Creation: To close the gap in content creation librarians need to update their technical infrastructure. This means upgrading repositories to support advanced metadata harvesting and seamless inter-library data sharing. Libraries should also provide staff for digital content creation work and establish clear operational goals for producing localized digital resources.

8.4 Designing Coordinated Inter-Library Open Networks: To move past isolated ad-hoc sharing practices library systems should lead the development of regional and national inter-library consortia built specifically around open resources.

9. CONCLUSION

This empirical study gives a data-driven insight into the internal components that influence Open Educational Resources in current university libraries. The study combines the evaluations with Bayesian posterior inference to trace the links among professional competences, institutional impediments and operational results. The data results reveal that while information professionals have created a base of awareness and have been effective in integrating OER into routine library practice, their progress faces a considerable hurdle with active digital content creation and sophisticated repository building. This drop-off is the result of a structural deficit: a pervasive lack of established institutional policies, unambiguous copyright guidelines and devoted financial assistance.

This research suggests that an open educational system cannot be built on private interest. If the higher education system continues to view OER absolutely as a repository-based project rather than as a basic strategic compulsory, the results of use of technology will be disappointing. The data-driven of this research advice that higher education department break through these obstacles. This structural focal point will allow educational institution libraries to go from being consumers of digital resources to becoming active centre for collaborative knowledge generation, fully realizing the effective of open education to encourage equity f knowledge and academic success.

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