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Use of Handle in Institutional Repositories and Its Relationship with Alternative Metrics: A Case Study in Spanish-speaking America

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Uso de Handle en repositorios institucionales y su relación con las métricas alternativas: estudio de caso en Hispanoamérica

ABSTRACT

This study investigates the use of persistent identifiers and alternative metrics exposure in Latin American institutional repositories, focusing on 307 repositories from Spanish-speaking countries. Findings reveal that while 82.7% of repositories use the Handle System, only 48% resolve correctly, indicating maintenance challenges. Additionally, a modest presence of alternative metrics is noted, with only 12.1% displaying Altmetric badges and 1.6% exhibiting PlumX badges. Only 29.6% allow the collection of alternative metrics data via Altmetric's bookmarklet tool. Practical solutions emphasize leveraging persistent identifiers and fostering collaboration with altmetric service providers to enhance metric exposure. This research underscores the importance of optimizing repositories for comprehensive research impact assessment, emphasizing both academic recognition and societal relevance. It provides insights for institutions to improve repository efficiency and document the impact of research outputs effectively, contributing to the advancement of open science practices.

KEYWORDS

Institutional Repositories; Handle System; Altmetrics; Persistent Identifiers.

RESUMEN

Este estudio investiga la utilización de identificadores persistentes y la exposición de métricas alternativas en repositorios institucionales latinoamericanos, centrándose en 307 repositorios de países hispanohablantes. Los resultados revelan que, aunque el 82,7% de los repositorios utilizan el Handle System, sólo el 48% se resuelve correctamente, lo que indica problemas de mantenimiento. Además, se observa una presencia modesta de métricas alternativas, ya que sólo el 12,1% exhibe distintivos Altmetric y el 1,6%, PlumX. Sólo el 29,6% permite la recopilación de datos de métricas alternativas a través de la herramienta bookmarklet de Altmetric. Las soluciones prácticas hacen hincapié en aprovechar los identificadores persistentes y fomentar la colaboración con los proveedores de servicios altmetric para mejorar la exposición de las métricas. Esta investigación subraya la importancia de optimizar los repositorios para una evaluación exhaustiva del impacto de la investigación, haciendo hincapié tanto en el reconocimiento académico como en la relevancia social. Aporta ideas para que las instituciones mejoren la eficiencia de los repositorios y documenten eficazmente el impacto de los resultados de la investigación, contribuyendo al avance de las prácticas de ciencia abierta.

PALABRAS CLAVE

Repositorios Institucionales; Handle System; Altmetricas; Identificadores Persistentes.

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Ús de Handle en repositoris institucionals i la seva relació amb les mètriques alternatives: estudi de cas a Hispanoamèrica

RESUM

Aquest estudi investiga la utilització d'identificadors persistents i l'exposició de mètriques alternatives en repositoris institucionals llatinoamericans, centrant-se en 307 repositoris de països hispanoparlants. Els resultats revelen que, encara que el 82,7% dels repositoris utilitzen l'Handle System, només el 48% es resol correctament, cosa que indica problemes de manteniment. A més, s'observa una modesta presència de mètriques alternatives, ja que només el 12,1% exhibeix distintius Altmetric i l'1,6%, PlumX. Només el 29,6% permet la recopilació de dades de mètriques alternatives mitjançant l'eina bookmarklet d'Altmetric. Les solucions pràctiques posen èmfasi a aprofitar els identificadors persistents i fomentar la col·laboració amb els proveïdors de serveis altmetric per millorar l'exposició de les mètriques. Aquesta investigació subratlla la importància d'optimitzar els repositoris per a una avaluació exhaustiva de l'impacte de la recerca, posant èmfasi tant en el reconeixement acadèmic com en la rellevància social. Aporta idees perquè les institucions millorin l'eficiència dels repositoris i documentin eficaçment l'impacte dels resultats de la investigació, tot contribuint a l'avenç de les pràctiques de ciència oberta.

PARAULES CLAU

Repositoris Institucionals; Handle System; Altmètriques; Identificadors Persistents.

1. Introduction and Objectives

The widespread development of institutional repositories has significantly enhanced the dissemination of research outputs and technical documentation, leveraging the diverse array of internet technologies that facilitate and expand distribution channels (Correia & de Castro Neto, 2002; Marsolek et al., 2018; Samzugi, 2017). This growth is underpinned by ongoing research into open science practices across various global contexts, with a notable emphasis on higher education institutions as central actors in advancing these initiatives (Meneses-Placeres et al., 2022; de Filippo & Lascurain-Sánchez, 2023; Nazim & Bhardwaj, 2023). Consequently, institutional repositories are increasingly recognized as a cost-effective and sustainable approach for promoting an open, equitable system of scholarly communication (Bernal & Perakakis, 2023).

As a result of this push for open science, several research studies have focused on evaluating the technical infrastructure of digital library services (Álvarez-Robles et al., 2021; Khatun & Ahmed, 2018; Saldías Kiefer & Reyes-Lillo, 2021), academic journals (Arias-Flores et al., 2020; Park, 2018), or digital repositories from different perspectives (Formanek, 2021; Macgregor, 2020; Njoku et al., 2023).

In line with this trend, the central focus of our research is the implementation of persistent identifiers within institutional repositories. Traditionally, organizations relied on URL hyperlinks to provide access to digitized versions of previously print-based content. However, a significant portion of these hyperlinks have become inactive over time, resulting in broken links and access issues. To address this problem, persistent identifiers (PIDs) were introduced as a robust solution (Hilse & Kothe, 2006). PIDs are fundamental to modern research as they make all elements of an investigation identifiable and accessible both to humans and to automated systems processing large amounts of complex data (de Castro et al., 2023).

Klump and Huber (2017) noted that "persistent identifiers were invented to address challenges arising from the distributed and disorganized nature of the internet, which not only allowed new technologies to emerge but also made it difficult to maintain a persistent record of science" (p. 1). Within the context of institutional repositories, integrating all relevant persistent identifiers associated with a document provides a comprehensive overview of the document's impact, including citations and social engagement. Such holistic metrics offer significant benefits for both the institution and the individual researcher. Persistent identifiers like DOI and Handle are strongly recommended across academic publishing environments, as they enhance the discoverability and traceability of

research outputs (Eve, 2024; Pastor-Ramon et al., 2023; Price & Murtagh, 2020; Wilsdon, 2015).

This ability of persistent identifiers to enhance content discoverability brings us to the secondary focus of this discussion: metric exposure. Through their sophisticated infrastructure and metadata capabilities, institutional repositories can serve as valuable metrics sources, facilitating the comprehensive quantification of institutional output (Bruns & Inefuku, 2016). Depending on how the data is structured, this capability could even allow for nuanced analysis and segmentation of data by faculties, disciplines, or other relevant categories (Aman, 2020). Additionally, repositories can provide detailed insights into the visibility of their collections by tracking views and downloads, metrics that often correlate with increased citation rates (Antelman, 2017; Eysenbach, 2006; Gargouri et al., 2010). Such metrics interest a broad range of stakeholders within the repository ecosystem.

Furthermore, these metrics can be augmented by third-party sources, such as web analytics, citation databases, and altmetric tools. To effectively integrate repositories with external sources and accurately monitor the dissemination of publications, it is crucial to link bibliographic metadata with persistent identifiers (Iriarte et al., 2011).

Altmetric tools, developed to aggregate and analyze alternative metrics data resulting from the dissemination of scholarly content on social media and other digital platforms, can be effectively integrated into institutional repositories and various scholarly communication systems. These metrics complement traditional usage statistics, such as views and downloads, by providing additional insights into the broader impact of research outputs. Altmetrics are valuable for authors, repository administrators, and academic institutional managers, offering a nuanced perspective on the visibility and influence of scholarly work beyond conventional citation metrics (Konkiel & Scherer, 2013).

Providing comprehensive usage, impact, and alternative metrics for grey literature housed within institutional repositories enables authors to document the influence of their research outputs and gain insights into their readership and engagement with their content. Similarly, these metrics assist repository managers in demonstrating the value of broadening access to the institution's research outputs, highlighting the benefits of increased visibility and reach (Aman, 2020). In addition, both traditional usage and download metrics, as well as altmetrics, can help end users of repositories gain insight into the impact of each document.

Building on the aforementioned context, this study aims to assess the adoption of persistent identifiers within institutional repositories in Latin America. It focuses on the integration of PIDs with altimetric tools (e.g., Altmetric, PlumX), citation metrics from platforms like Google Scholar and Dimensions, and traditional usage metrics such as views and downloads. The study also explores the potential of the Handle System to enhance metric integration within these repositories.

This research also evaluates how repositories expose their metrics and proposes a checklist of essential features that institutional repositories should implement to effectively display a range of metrics, thereby maximizing the visibility and impact of their documents. By examining the current use of the Handle System, the study provides insights and practical recommendations for improving metric presentation and analysis, ultimately enhancing the visibility and impact assessment of hosted documents.

To provide conceptual context for the aforementioned objectives, it is essential to distinguish institutional repositories from other systems. Institutional repositories are purpose-built infrastructures within universities, organizations, and research institutions which are typically managed by library professionals. By enabling the aggregation, curation, dissemination, and long-term preservation of digital scholarly outputs, these repositories provide essential information services both within and beyond their host institutions. Operating within a structured, open-access, and interoperable framework, institutional repositories ensure the efficient management and accessibility of research contributions for the institution's community (Barrueco et al., 2021).

The primary objectives of an institutional repository are to capture, preserve, and disseminate the intellectual output of an institution. Members' scholarly contributions are stored within the repository, allowing the institution to showcase its research production and impact (Crow, 2002). Increased visibility of an institution's research enhances its potential for academic and social impact and elevates its prestige and influence within broader scholarly and societal contexts.

Repositories store and disseminate a wide range of materials and document types. In addition to formal publications made available under the open-access framework, they also provide access to grey literature, which, due to its non-traditional distribution channels, is often only accessible through the repository itself. The content housed within repositories includes journal articles, bibliographic references, conference and workshop papers, theses and dissertations, protocols, reports, working papers, books, chapters, datasets, learning objects, software, patents, and more. Most of these materials are non-commercial, with grey literature in particular serving as a key resource for the scholarly community (Ferreras-Fernández et al., 2016).

The amount of bibliographic data available within a repository can vary depending on the institution's cataloging policy, as the level of detail and metadata included is determined by institutional preferences and needs. As previously mentioned,

a repository's metadata infrastructure is a key feature that distinguishes it as not only a storage solution but also a significant source of metrics (Hurrel, 2023). This robust metadata framework enables repositories to provide valuable insights into the reach and impact of the content they house, enhancing their role in the scholarly ecosystem.

However, to enhance the metadata infrastructure and transform it into a robust metrics tool, the use of persistent identifiers is essential. The Handle System, a decentralized infrastructure developed by the Corporation for National Research Initiatives (CNRI), is widely implemented in repositories, particularly those operating with DSpace, though its applicability extends to various repository types. A key feature of the Handle System is its provision of persistent URLs, which ensure that institutional records remain consistently and reliably accessible even in the event of domain changes or structural modifications to the repository. This functionality is critical for maintaining data integrity and accessibility over time.

In addition to its intrinsic advantages, the Handle System can be leveraged by third-party services and is used by companies such as Altmetric to analyze reach and impact on social media and other platforms.

On the other hand, the Digital Object Identifier (DOI) serves as the primary identifier recognized by various altmetric tools. Within the Altmetric framework, documents that lack a DOI but are assigned alternative identifiers, such as PMID or ArXiv, can still trigger altmetric data retrieval via the "Altmetric It" feature. Regarding the Handle System, while Altmetric acknowledges its role as a persistent identifier, practical application reveals that assessing the impact of a document identified solely by the Handle System requires additional integration. Specifically, this includes the use of Altmetric badges, the incorporation of Altmetric's application programming interfaces (APIs), or the exploration of the institutional Handle root via the Altmetric Explorer platform (see example: https://www.altmetric.com/details/handle/20.500.13003/18664).

To access these integrations, repository managers should first register with handle.net to obtain a prefix for their institutional repository. Once registered, it is essential to notify Altmetric that the repository is active to allow for tracking and detection of activity associated with institutional records. The cost of this process is minimal, especially considering the significant benefits it provides. If a document lacks a DOI, PMID, or ArXiv ID, the persistent identifier assigned by the Handle System offers an alternative means to measure its impact. As of early 2024, the annual cost for obtaining a Handle prefix is fifty US dollars, a small investment for the ability to assign this identifier to all records within the repository.

In contrast, some altmetric providers, such as PlumX, primarily track data from repositories managed within their Pure

Criteria	Description
Is the repository operational?	We checked whether the repository is still active and if it contains documents by visiting its URL.
Does the repository have a Handle?	We checked whether the Handle identifier is in the records, present in the URL, or in the metadata.
Does the repository have the Altmetric badge for its records?	We checked for the presence of the Altmetric badge in the repository records.
Does the repository have the PlumX badge for its records?	We checked for the presence of the PlumX badge in the repository records.
Does the repository have the Dimensions badge for its records?	We checked for the presence of the Dimensions badge in the repository records.
Does the repository have a Google Scholar badge for its records?	We checked for the presence of a badge that allows access to citation statistics in Google Scholar.
Does the repository allow for obtaining metrics using the "Altmetric it" bookmarklet?	Using the Altmetric bookmarklet[1], an application added to the browser, we checked whether the repository allows the button to operate and, in an optimal case, capture metrics through this tool. For testing purposes, we tried to find records with a DOI because this tool only works on PubMed, arXiv, or pages containing a DOI.
Are the repository records identifiable in the Altmetric Explorer tool using a persistent identifier?	Using the Altmetric Explorer[2], we performed advanced searches using the "scholarly identifiers" field by adding the repository Handle and verifying that the tool could recognize it.
Does the repository show other metrics about its records?	We checked whether the repository records show other metrics, such as the number of views, downloads, or other information about their usage.
In case the repository has a Handle, is it resolved correctly?	Using the Handle validator[3], we checked whether the Handle is correctly configured and if the tool can resolve the link. When entering the Handle, the system must take the indicated record, or, if it is not operational, it shows an error.

1. https://www.altmetric.com/solutions/free-tools/bookmarklet/
2. https://www.altmetric.com/explorer/
3. https://hdl.handle.net/

Table 1. Criteria for evaluating persistent identifiers and metrics in repositories. Source: Own elaboration.

repository system. However, PlumX also offers a solution for repositories outside the Pure system by providing a templated script (https://plu.mx/developers/widgets/). This enables repositories, regardless of their underlying infrastructure, to integrate PlumX altmetric data by embedding the appropriate script into their records, thereby expanding their capacity to track and present altmetric information.

Building on the relationship between persistent identifiers and metrics exposure, this study examines how Latin American institutional repositories incorporate both elements. The goal is to provide a comprehensive analysis and propose guidelines for the technical optimization of these repositories, enhancing their capacity to manage and showcase metrics associated with scholarly outputs.

2. Methodology

2.1. Data collection

We employed a multi-stage analytical approach to identify and analyze the institutional repositories of Spanish-speaking countries in Latin America. In the initial stage, we conducted individual searches in OpenDOAR. The search was restricted to repositories located in Spanish-speaking Latin American countries which included content categories such as "Journal Articles," "Books, Chapters and Sections," and "Datasets." After replicating this search for each Latin American country (excluding Brazil), 378 repositories that met these criteria were identified. The search query used is outlined below:

> *Repository Type matches any of "Institutional" AND Content Types matches any of "Journal Articles", "Books, Chapters and Sections", "Datasets" AND Countries and Regions matches "COUNTRY NAME".*

In the second stage, we employed a web scraping tool, Octoparse, to systematically extract data from OpenDOAR. This tool enabled us to retrieve essential information from the identified repositories, including their names, URLs, associated countries, and the software platforms used for their development.

In the third stage, we organized the data extracted from OpenDOAR into a spreadsheet. We then added ten additional fields to assess whether each repository possessed certain specific characteristics. For each criterion, repositories that met the requirements were marked with "Yes," while those that did not were marked with "No." The criteria used for this assessment are outlined in Table 1.

Finally, after completing the data collection and verification processes using the designated tools, all relevant information was consolidated into a single spreadsheet, creating a uniform dataset for analysis. Although the initial analysis began with 378 repositories, the final analysis included 307 repositories. The exclusions were due to various reasons, including website unavailability, repositories used by journals solely for content management, journals employing the Open Journal Systems that were mistakenly categorized as repositories, and repositories containing no documents.

2.2. Analysis

We conducted a descriptive analysis of the collected data, focusing on variables such as the repository's country of origin and the software platform it employs. This analysis provided an overview of how Latin American repositories utilize persistent identifiers, specifically the Handle System, and whether they incorporate alternative metrics within their interfaces. Additionally, we explored the relationship between different repository platforms and their capacity for identifier integration and metrics exposure.

2.3. Results

As mentioned previously, only 307 repositories were included in the evaluation, and 71 did not meet the requirements for the analysis. Table 2 shows this information with the country

Country or Territory	Repositories included in the final sample	Repositories excluded from the final sample	TOTAL
Argentina	64	3	67
Bolivia	1	0	1
Chile	12	2	14
Colombia	87	9	96
Costa Rica	7	0	7
Cuba	5	5	10
Ecuador	12	6	18
El Salvador	6	1	7
Guatemala	1	0	1
Honduras	1	1	2
Mexico	28	4	32
Nicaragua	3	3	6
Panama	8	0	8
Paraguay	2	1	3
Peru	59	33	92
Puerto Rico	0	1	1
Uruguay	6	2	8
Venezuela	5	0	5
TOTAL	**307**	**71**	**378**
TOTAL %	**81,2%**	**18,8%**	**100%**

Table 2. Latin American repositories in OpenDOAR and their inclusion in the sample per country. Source: Own elaboration.

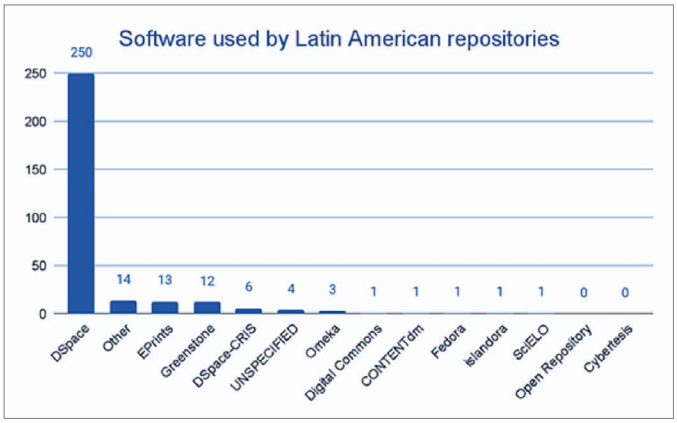

Figure 1. Software used by Latin American repositories. Source: Own elaboration.

variable added. Note: though OpenDOAR contains a significant number of Peruvian repositories, many of them are unavailable.

As previously mentioned, it is important to clarify that the repositories excluded from the analysis were removed because the URL was unavailable, they functioned as journals or utilized journal management software, or they contained no documents. Table 2 allows us to describe the final sample according to each repository's origin.

From this point forward, we will focus exclusively on the data from the 307 repositories included in the analysis. Among these, DSpace emerges as the most widely used repository software in Latin America, accounting for 81,4% of the sample (Figure 1). The remaining repositories are developed using other systems, such as Eprints or Greenstone, though their prevalence is notably lower. This highlights the dominant presence of DSpace across the region.

Upon evaluation of the 307 repositories in the sample, we found that 254 (82,7%) utilize the Handle System. This prevalence is consistent with the dominance of DSpace, which is closely integrated with the Handle System. Specifically, 244 of the DSpace-based repositories (97,6%) use the Handle System, with only six exceptions. Figure 2 illustrates the proportion of Handle System usage by country. Our analysis shows that the Handle System is widely adopted across several Latin American countries, with Colombia leading both in the number of repositories and in the extensive use of the Handle System as a persistent identifier—82 repositories in Colombia use the Handle System, compared to 54 in Peru. In contrast, repositories in Guatemala and Nicaragua do not utilize the Handle System. Puerto Rico is not represented in the graph, as it does not have any repositories included in the sample.

To assess whether the Handle assigned to each repository can be resolved using the tool provided by handle.net, we focused exclusively on the 254 repositories that utilize this identifier. It is important to note that to verify whether the Handle resolves correctly, we took a record from each repository and tested it using the Handle validation tool (https://hdl.handle.net/).

Following this testing phase, our analysis revealed that records from only 48% of the repositories could be resolved via the tool. For the remaining 52% of institutions, the sample record did not pass the validation test. The primary reasons for this discrepancy include institutions failing to pay the fifty US

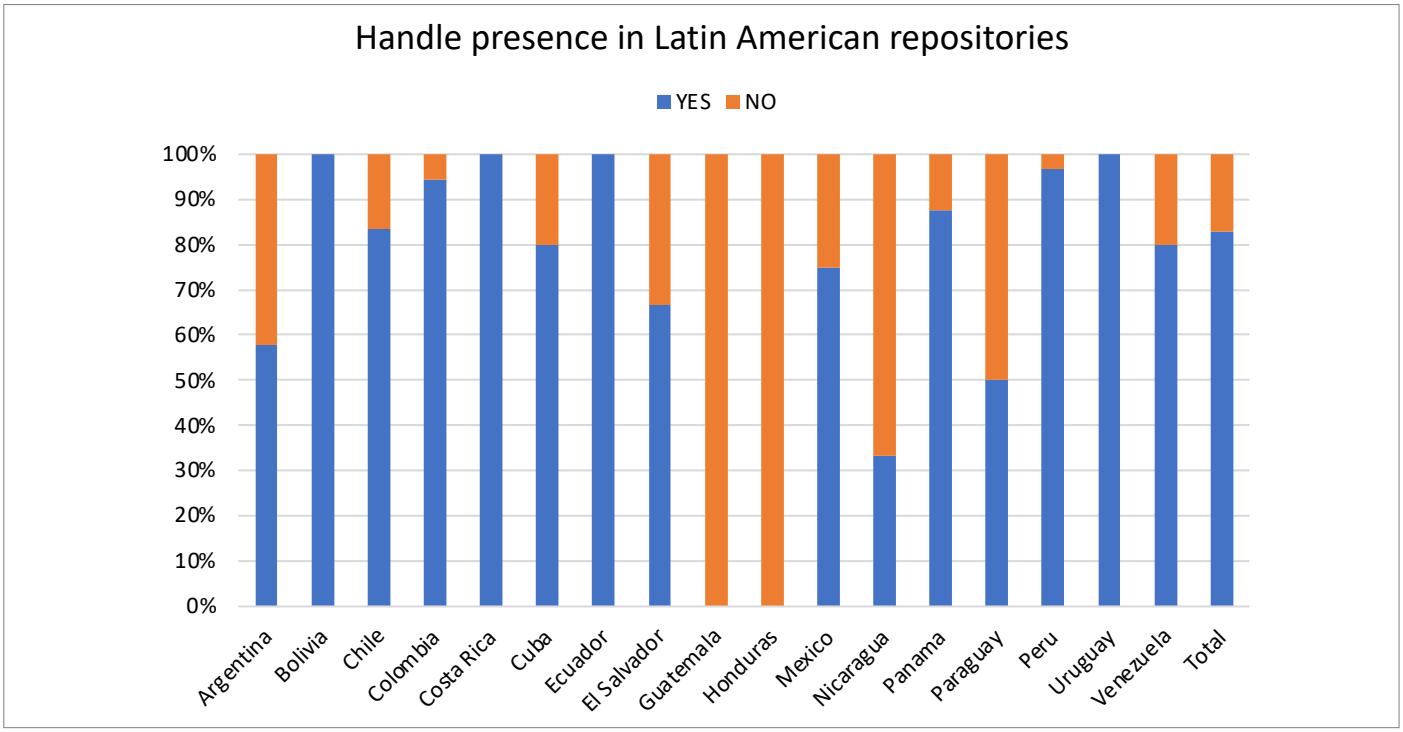

Figure 2. Handle presence in Latin American repositories. Source: Own elaboration.

dollar annual fee, using a self-generated prefix to configure the Handle, or not renewing the service.

Figure 3 incorporates the country variable into the analysis, revealing that the adoption of Handle subscriptions is not widespread across Latin American countries. And, in countries where the percentage of resolvable Handles is high, there are typically only a small number of repositories included in the sample. For instance, El Salvador and Paraguay each have only a few repositories—four and one, respectively—and all have implemented the Handle System with the annual subscription. Notably, Guatemala and Honduras are not represented in the data, as their repositories do not utilize the Handle System.

In general, DSpace is the most widely used software for setting up institutional repositories in Latin American countries. It facilitates the integration of the Handle System as a persistent identifier. However, over half of these repositories do not subscribe to the Handle service, preventing them from fully realizing the benefits of persistent identifiers. Instead, many institutions generate autonomous prefixes, often using simple sequences such as "123456789," "001," or the institution's acronym.

Additionally, some institutions retain a vestige of their past Handle subscription in the URL prefix, but these are no longer resolvable, suggesting that the service has not been renewed. This indicates that, while these repositories may have initially subscribed to the Handle System, they have since allowed their subscription to lapse.

Another one of our goals was to examine the relationship between the Handle System and metrics exposure. To explore this connection, we analyzed whether the Altmetric Explorer tool could recognize the identifiers associated with each repository by taking at least one record from each repository and using it in the Altmetric tool to get some metrics. This test was applied exclusively to the 254 repositories that utilize the Handle identifier.

The findings reveal that 53,9% of Handles are successfully recognized by the Altmetric platform, indicating that a substantial proportion of Handles remain unrecognized by this tool (see Table 3).

This suggests potential limitations in integrating the Handle System with altmetric tracking platforms. Possible reasons for this lack of recognition include inadequate configuration of the Handle System or insufficient communication with altmetric tracking providers to ensure that repositories are properly registered and that their identifiers are detected. These factors could hinder the visibility and impact measurement of institutional content.

Although the Altmetric.com documentation indicates that the platform recognizes the Handle System as a standard identifier for tracking, our analysis found that Altmetric Explorer does not provide metrics for these identifiers. However, it is possible to collect data on their recognition. Specifically, Altmetric Explorer recognizes Handles with numeric prefixes but fails to recognize those with alphanumeric prefixes.

Nevertheless, these Handles do not display associated metrics directly even when recognized. While this was not the primary focus of this study, a possible explanation is that the repositories' domains have not been registered with Altmetric.com,

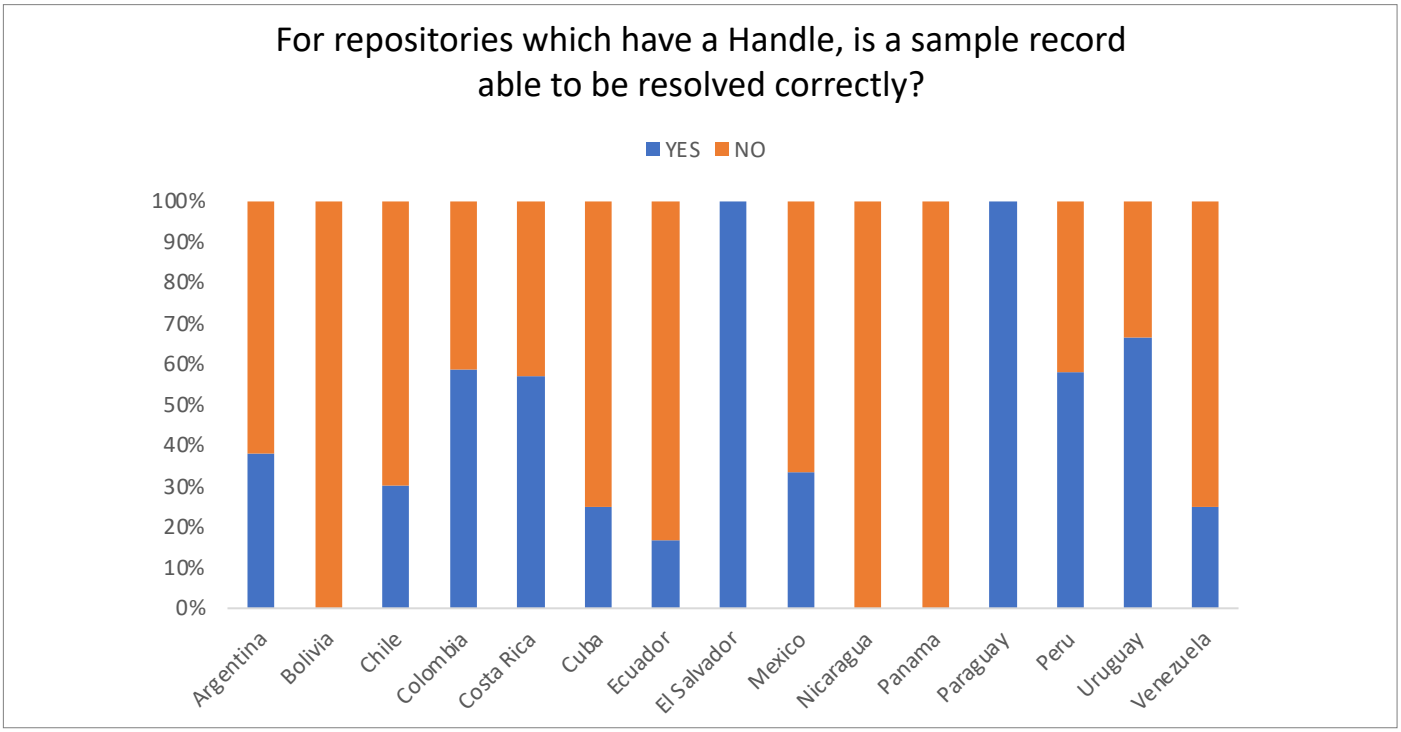

Figure 3. For repositories which have a Handle, is a sample record able to be resolved correctly? Source: Own elaboration.

Country or Territory	Altmetric recognizes the handle identifier	Altmetric does not recognize the handle identifier	TOTAL
Argentina	17	20	37
Bolivia	1	0	1
Chile	9	1	10
Colombia	70	12	82
Costa Rica	7	0	7
Cuba	0	4	4
Ecuador	5	7	12
El Salvador	4	0	4
Guatemala	0	0	0
Honduras	0	0	0
Mexico	13	8	21
Nicaragua	1	0	1
Panama	6	1	7
Paraguay	1	0	1
Peru	1	56	57
Puerto Rico	0	0	0
Uruguay	0	6	6
Venezuela	2	2	4
TOTAL	**137**	**117**	**254**
TOTAL %	**53,9%**	**46,1%**	**100%**

Table 3. Do the repository records recognized by the Altmetric Explorer tool use a persistent identifier? Source: Own elaboration.

Country or Territory	Allows 'Altmetric it'	Does not allow 'Altmetric it'	TOTAL
Argentina	11	53	64
Bolivia	0	1	1
Chile	2	10	12
Colombia	29	58	87
Costa Rica	2	5	7
Cuba	2	3	5
Ecuador	4	8	12
El Salvador	0	6	6
Guatemala	0	1	1
Honduras	0	1	1
Mexico	10	18	28
Nicaragua	2	1	3
Panama	4	4	8
Paraguay	2	0	2
Peru	18	41	59
Puerto Rico	0	0	0
Uruguay	4	2	6
Venezuela	1	4	5
TOTAL	**91**	**216**	**307**
TOTAL %	**29,6%**	**70,4%**	**100,0%**

Table 4. Does the repository allow metrics to be obtained using the "Altmetric it" bookmarklet? Source: Own elaboration.

as per its documentation. Alternatively, metrics may be accessible through other methods, such as tracking the institutional Handle root via the Altmetric Explorer or using the URL (https://www.altmetric.com/details/handle/20.500.13003/18664).

We also examined whether repositories support the collection of alternative metrics data through the Altmetric.com bookmarklet, 'Altmetric it!'. This bookmarklet, which can be added to browsers such as Chrome, Firefox, or Safari, allows users to retrieve metrics for a publication by visiting the record with a single click.

In our analysis, we considered all 307 repositories in the sample, including those that use the Handle System and those that do not. We selected a record from each repository to conduct this test, prioritizing those with a DOI in their metadata. We then used the Altmetric bookmarklet to attempt data extraction from these records.

Our findings show that 'Altmetric it!' functions in only 29,6% of repositories, while it is not operational in 70,4% (Table 4). A key factor contributing to this limitation is that many repositories either fail to assign DOIs to their articles or do not incorporate existing DOIs into their records. To improve the functionality of this tool, we recommend that repositories enhance their metadata by incorporating DOIs and integrating the Altmetric API. This would enable more comprehensive tracking and visibility through alternative metrics tools.

We examined at least one record from each repository regarding metric exposure to determine if the interface provides access to any metric form.

Our analysis reveals that repositories generally offer limited metric exposure within their records. Specifically, only 12,1% of repositories display the Altmetric badge, 1,6% present the PlumX badge, and 0,7% show the Dimensions badge (Table 5). In contrast, 14,0% provide direct access to Google Scholar citation metrics via a link in the title, with Colombia standing out, as 41,4% of its repositories offer such access. Lastly, metrics related to views and downloads, categorized as "other metrics," are the most displayed, with 54,7% of repositories providing this information publicly.

Country or Territory	Altmetric	PlumX	Google Cites	Dimensions	Other metrics
Argentina	6,3%	0,0%	7,8%	0,0%	29,7%
Bolivia	0,0%	0,0%	0,0%	0,0%	0,0%
Chile	25,0%	0,0%	0,0%	0,0%	0,0%
Colombia	26,4%	5,7%	41,4%	2,3%	73,6%
Costa Rica	14,3%	0,0%	0,0%	0,0%	85,7%
Cuba	20,0%	0,0%	0,0%	0,0%	20,0%
Ecuador	0,0%	0,0%	0,0%	0,0%	50,0%
El Salvador	16,7%	0,0%	0,0%	0,0%	100,0%
Guatemala	0,0%	0,0%	0,0%	0,0%	100,0%
Honduras	0,0%	0,0%	0,0%	0,0%	100,0%
Mexico	3,6%	0,0%	0,0%	0,0%	46,4%
Nicaragua	0,0%	0,0%	0,0%	0,0%	33,3%
Panama	0,0%	0,0%	12,5%	0,0%	75,0%
Paraguay	0,0%	0,0%	0,0%	0,0%	100,0%
Peru	5,1%	0,0%	1,7%	0,0%	61,0%
Puerto Rico	No data	No data	No data	No data	No data
Uruguay	0,0%	0,0%	0,0%	0,0%	50,0%
Venezuela	0,0%	0,0%	0,0%	0,0%	60,0%
TOTAL %	**12,1%**	**1,6%**	**14,0%**	**0,7%**	**54,7%**

Table 5. Does the repository show metrics about its records? Source: Own elaboration.

4. Discussion

During the data collection process, it was observed that a considerable proportion of institutional repositories from Spanish-speaking Latin American countries utilize the Handle System for assigning persistent identifiers to their records. However, many of these repositories either fail to configure their Handle URLs correctly or do not maintain their subscription to the Handle System. Consequently, they forfeit the advantages of a fully operational persistent identifier, thereby diminishing its potential to provide reliable access and enhance the discoverability of their digital scholarly assets.

Furthermore, only 29,6% of the analyzed repositories enable the "Altmetric it" bookmarklet to retrieve altmetric data for their records. This free tool, provided by Altmetric, functions optimally when the repository employs identifiers such as DOI, PMID, or ArXiv, and when the repository is properly configured. However, even in cases where these identifiers are present, some repositories lack the necessary API integration, thereby hindering the "Altmetric it" bookmarklet from successfully tracking and displaying altmetric information. As a result, the potential impact of these records remains underreported and less visible, limiting the automatic assessment of their reach and influence.

Beyond examining the adoption of the Handle System in institutional repositories from Spanish-speaking countries, this study also assessed the extent to which alternative metrics are directly accessible from the repository records. The analysis revealed that only 12,1% of repositories display Altmetric data, while a mere 1,6% provide PlumX metrics. Additionally, 14,0% of repositories include links to Google Scholar citations, and only 0,7% feature Dimensions citation data. These low figures indicate a clear opportunity for enhancement, suggesting that many institutional repositories in the region could benefit from better integration of altmetric tools to increase the visibility and impact of their scholarly content.

Such metrics data can be seamlessly embedded into institutional repositories using the freely available integration codes provided by Altmetric and PlumX. Moreover, repository managers and librarians play a crucial role in optimizing this process by maintaining open lines of communication with these altmetric service providers. If a specific resource is not detected or tracked, contacting Altmetric or PlumX can facilitate the necessary adjustments, ensuring proper configuration and accurate visibility of the repository's metrics data. This proactive approach can enhance the repository's impact assessment capabilities and foster greater scholarly engagement.

A key challenge identified with repositories utilizing the Handle System is the lack of recognition of repository records by Altmetric. This issue often leads to discrepancies where the same document is disseminated across multiple chan-

nels, such as through a journal's webpage using a DOI and via the repository using the Handle URL. This duplication complicates the tracking of altmetrics, potentially underreporting the document's impact. To mitigate this issue, it is critical for repository managers to establish communication with Altmetric and properly configure the Altmetric API, thereby ensuring that all identifiers are recognized and integrated effectively.

Our findings indicate significant opportunities for optimizing institutional repositories in Spanish-speaking Latin American countries. Using the Handle System validator, we observed that over half of the repositories do not have their persistent identifiers correctly configured. This assessment was conducted by testing a representative record from each repository using the Handle validation tool to check proper resolution.

Therefore, ensuring the correct implementation and maintenance of the Handle identifier is a key area for improvement. Furthermore, enriching repository metadata by incorporating additional persistent identifiers, such as DOIs or PMIDs, could significantly enhance discoverability, interoperability, and the overall quality of metadata.

There is also a clear opportunity to enhance metrics exposure, both directly on repository interfaces and indirectly through integration with external tools. To address this, it is recommended that repositories ensure proper configuration to support the 'Altmetric it' bookmarklet, which enables the display of alternative metrics on individual records. Additionally, repository managers should engage proactively with altmetric services like Altmetric and PlumX to facilitate and verify seamless integration, including the implementation of metric badges within the repository interface.

In addition, specific measures should be taken for repositories utilizing the Handle System to guarantee that altmetric providers correctly identify records. This requires homologating identifiers, such as DOIs and Handles, to avoid discrepancies and ensure consistent recognition.

Moreover, while a significant proportion of repositories already display basic usage metrics (e.g., views and downloads), there is potential for broader adoption of this practice. Encouraging more institutions to share usage statistics publicly could further enhance the visibility and impact of their digital assets, contributing to a more comprehensive metrics ecosystem in Latin American repositories.

Finally, this study's limitation is its reliance on external data from OpenDOAR and repository websites, which lacks insight into internal management challenges. Future research could include surveys or interviews with repository managers to explore issues like financial or technical barriers affecting the maintenance of Handle System subscriptions. This would provide a deeper understanding of implementation inconsistencies and areas for improvement.

5. Conclusions

Despite notable progress in developing institutional repositories, many remain in their early or rudimentary stages. This study provides an in-depth analysis of the current state of institutional repositories in Spanish-speaking Latin American countries, examining a diverse range of content types, including journal articles, books, book chapters, sections, and datasets. Particular emphasis is placed on using Persistent Identifiers (PIDs), focusing on the Handle System, which is commonly employed in repository infrastructures.

In the contemporary context, institutional repositories play a vital role in preserving and disseminating information produced by organizations. It is essential, particularly for public institutions, to leverage their potential and prioritize their comprehensive development and implementation.

We propose the following checklist to enhance the visibility and impact of documents stored within the repository.

- Emphasize the adoption of the Handle System as the preferred persistent identifier, which necessitates the formal registration of the Handle prefix and ensuring that each record is correctly resolved through the Handle validator tool.
- If the institution's software does not support this identifier, consider assigning a DOI, even though the Handle System is more cost-effective. This approach is particularly important for documents not receiving DOIs from external sources, especially those of significant documentary value, such as doctoral theses, technical reports, and working papers.
- Display all available persistent identifiers (DOI, PMID, ArxiV, Handle, etc.) on the records.
- Enable tracking by various altmetrics providers, including Altmetric, PlumX, Google Scholar, and Dimensions. Verify whether these tools are currently monitoring the repository; if not, the repository administrators should contact the providers to facilitate inclusion in their tracking systems.
- Facilitate the public display of usage metrics, including views and downloads, to enhance transparency for repository users and to enable the identification of the most frequently accessed documents.
- If the institution has a subscription, present traditional metrics from Web of Science or Scopus through the badge integration.

Although the importance of alternative metrics is widely acknowledged, their integration within institutional reposito-

ries remains limited. While many researchers recognize the value of these metrics in offering a societal perspective on research impact, institutions and authors frequently underestimate the significance of increasing visibility for their scholarly outputs. Failure to leverage all available altmetrics represents a missed opportunity, particularly since configuring these metrics is typically straightforward and cost effective.

While PlumX may not automatically detect Handle System URLs or certain other URL types, this limitation offers an opportunity for collaboration between the tool and institutions. By incorporating repository URLs alongside other identifiers, such as DOI and PubMed, particularly for articles, institutions can enhance the dissemination of research outputs and provide a more comprehensive assessment of their impact.

We recognize the essential role of persistent identifiers (PIDs) such as DOI, PMID, and arXiv in facilitating altmetrics analysis. Utilizing a comprehensive range of identifiers allows institutions to gain a broader perspective on research impact, particularly for non-traditionally published materials, such as grey literature. Ensuring the proper configuration of institutional repositories is crucial for maximizing the potential of these emerging metrics.

Considering the growing emphasis on social impact by science funding agencies, institutional repository managers—particularly those within universities and publicly funded organizations—are encouraged to prioritize altmetrics. This focus extends beyond enhancing visibility and aligns with the broader social responsibility of science dissemination, reflecting the increasing expectation that research outcomes contribute to societal advancement.

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Declaration of authorship contributions

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References

Álvarez-Robles, T., Osuna, Y. A. O. & Rodríguez, F. J. Á. (2021). UX Evaluation on digital libraries-oriented websites with blind people. *Investigación Bibliotecológica, 35*(89), 169-194. https://doi.org/10.22201/IIBI.24488321XE.2021.89.58451

Aman, V. (2020). Institutional repositories and bibliometrics. In R. Ball (Ed.), Handbook of bibliometric indicators: Measuring impact in research and education (pp. 455-462). De Gruyter Saur. https://doi.org/10.1515/9783110646610-041

Antelman, K. (2017). *Do Open-Access Articles Have a Greater Research Impact? College & Research Libraries, 65*(5), 372-382. https://doi.org/10.5860/crl.65.5.372

Arias-Flores, H., Calle-Jimenez, T., Sanchez-Gordon, S. & Nunes, I. L. (2020). Contributions to Improve Accessibility and Usability of Academic Journal Management Systems. Case Study: OJS. *Advances in Intelligent Systems and Computing, 1207 AISC*, (pp. 259-264). https://doi.org/10.1007/978-3-030-51369-6_35

Barrueco, J. M., Rico Castro, P. & Bonora Eve, L. V. (2021). *Guía para la evaluación de Repositorios institucionales de Investigación*. Crue, Universidades Españolas, Red de Bibliotecas REBIUN. https://repositoriorebiun.org/handle/20.500.11967/809

Bernal, I. & Perakakis, P. (2023). No-pay publishing: Use institutional repositories. *Nature, 619*(7971), 698-698. https://doi.org/10.1038/d41586-023-02315-z

Bruns, T. & Inefuku, H. W. (2016). Purposeful Metrics: Matching Institutional Repository Metrics to Purpose and Audience. In B. B. Callicott, D. Scherer & A. Wesolek (Eds.), *Making Institutional Repositories Work* (pp. 213-234). Purdue University Press. https://doi.org/10.2307/j.ctt1wf4drg.21

Correia, A. M. R. & de Castro Neto, M. (2002). The role of eprint archives in the access to, and dissemination of scientific grey literature: LIZA - a case study by the National Library of Portugal. *Journal of Information Science, 28*(3), 231-241. https://doi.org/10.1177/016555150202800305

Crow, R. (2002). *The case for institutional repositories: A SPARC position paper*. https://ils.unc.edu/courses/2015_fall/inls700_001/Readings/Crow2002-CaseforInstitutionalRepositoriesSPARCPaper.pdf

de Filippo, D. & Lascurain-Sánchez, M. L. (2023). La implicación de España en actividades científicas sobre ciencia abierta. Análisis de proyectos y publicaciones científicas. *Revista Española de Documentación Científica, 46*(2), https://doi.org/10.3989/redc.2023.2.1970

de Castro, P., Herb, U., Rothfritz, L. & Schöpfel, J. (2023). *Building the plane as we fly it: The promise of persistent identifiers.* Zenodo https://doi.org/10.5281/zenodo.7258286

Eve, M. P. (2024). Digital Scholarly Journals Are Poorly Preserved: A Study of 7 Million Articles. *Journal of Librarianship and Scholarly Communication, 12*(1). https://doi.org/10.31274/jlsc.16288

Eysenbach, G. (2006). Citation Advantage of Open Access Articles. *PLOS Biology, 4*(5), e157. https://doi.org/10.1371/journal.pbio.0040157

Ferreras-Fernández, T., García-Peñalvo, F., Merlo-Vega, J. A. & Martín-Rodero, H. (2016). Providing open access to PhD theses: Visibility and citation benefits. *Program, 50*(4), 399-416. https://doi.org/10.1108/PROG-04-2016-0039

Formanek, M. (2021). Solving SEO issues in DSpace-based digital

repositories. *Information Technology and Libraries, 40*(1). https://doi.org/10.6017/ITAL.V40I1.12529

Gargouri, Y., Hajjem, C., Larivière, V., Gingras, Y., Carr, L., Brody, T. & Harnad, S. (2010). Self-Selected or Mandated, Open Access Increases Citation Impact for Higher Quality Research. *PLOS ONE, 5*(10), e13636. https://doi.org/10.1371/journal.pone.0013636

Hilse, H.-W. & Kothe, J. (2006). *Implementing Persistent Identifiers: Overview of Concepts, Guidelines and Recommendations*. Consortium of European Research Libraries.

Hurrell, C. (2023). Research Assessment Reform, Non-Traditional Research Outputs, and Digital Repositories: An Analysis of the Declaration on Research Assessment (DORA) Signatories in the United Kingdom. *Evidence Based Library and Information Practice, 18*(4). https://doi.org/10.18438/eblip30407

Iriarte, P., de Kaenel, I., Krause, J. B. & Magnenat, N. (2011). Exploiting and improving institutional repositories for bibliometrics. *CERN workshop on Innovations in Scholarly Communication (OAI7)*. https://archive-ouverte.unige.ch/unige:23065

Khatun, A. & Ahmed, S. M. Z. (2018). Usability testing for an open-source integrated library system: A task-based study of the Koha OPAC interface. *Electronic Library, 36*(3), 487-503. https://doi.org/10.1108/EL-03-2017-0049

Klump, J. & Huber, R. (2017). 20 Years of Persistent Identifiers – Which Systems are Here to Stay? *Data Science Journal, 16*(0). https://doi.org/10.5334/dsj-2017-009

Konkiel, S. & Scherer, D. (2013). New opportunities for repositories in the age of altmetrics. Bulletin of the American Society for Information Science and Technology, 39(4), 22-26. https://doi.org/10.1002/bult.2013.1720390408

Macgregor, G. (2020). Enhancing content discovery of open repositories: An analytics-based evaluation of repository optimizations. *Publications, 8*(1), 1-17. https://doi.org/10.3390/publications8010008

Marsolek, W. R., Cooper, K., Farrell, S. L. & Kelly, J. A. (2018). The Types, Frequencies, and Findability of Disciplinary Grey Literature within Prominent Subject Databases and Academic Institutional Repositories. *Journal of Librarianship and Scholarly Communication, 6*(1), eP2200. https://doi.org/10.7710/2162-3309.2200

Meneses-Placeres, G., Reinaldo, L. A. Á. & Rivero, M. O. M. (2022). Revisión de las Prácticas de Ciencia Abierta en América Latina y el Caribe. *Revista Cubana de Transformación Digital, 3*(1), 1-15. https://rctd.uic.cu/rctd/article/view/159/75

Nazim, M. & Bhardwaj, R. K. (2023). Open access initiatives in European countries: Analysis of trends and policies. *Digital Library Perspectives, 39*(3), 371-392. https://doi.org/10.1108/DLP-06-2022-0051

Njoku, I. S., Njoku, B. C., Chukwu, S. A. J. & Ravichandran, R. (2023). Fostering Cybersecurity in Institutional Repositories: A Case of Nigerian Universities. *African Journal of Library Archives and Information Science, 33*(1), 1-21. https://www.ajol.info/index.php/ajlais/article/view/247643

Park, M. (2018). SEO for an open access scholarly information system to improve user experience. *Information Discovery and Delivery, 46*(2), 77-82. https://doi.org/10.1108/IDD-08-2017-0060

Pastor-Ramon, E., Rovira, C., Santillán-García, A. & Codina, L. (2023). *DOI y visibilidad de publicaciones académicas: El caso de las revistas españolas de enfermería*. Repositorio Digital UPF. https://repositori.upf.edu/handle/10230/55836

Price, R. & Murtagh, J. (2020). An Institutional Repository Publishing Model for Imperial College London Grey Literature. *Serials Librarian, 79*(3-4), 349-358. https://doi.org/10.1080/0361526X.2020.1847737

Saldías Kiefer, L. & Reyes-Lillo, D. (2021). Evaluación de usabilidad de sitios web de bibliotecas de universidades públicas chilenas a partir del método SIRIUS. *e-Ciencias de la Información 11*(1). https://doi.org/10.15517/eci.v11i1.41476

Samzugi, A. (2017). The role of institutional repositories in promoting grey literature in academic libraries in Tanzania. *University of Dar Es Salaam Library Journal, 12*(2), 3-21. https://www.ajol.info/index.php/udslj/article/view/184574

Wilsdon, J. (2015). *The Metric Tide: Independent review of the role of metrics in research assessment and management*. SAGE Publications Ltd. https://doi.org/10.4135/9781473978782

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