The Importance of Persistent Identifiers: The Vision of Latindex

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Abstract

Persistent identifiers (PIDs) are crucial for safeguarding content against loss resulting from changes to URLs (Uniform Resource Locators). They ensure the permanent accessibility and citability of articles and facilitate interoperability between systems. PIDs also enhance the transparency and traceability of scientific output, both of which are essential aspects in the digital age. Latindex promotes editorial quality standards in line with non-commercial open access and attaches particular importance to free PIDs. This is based on the principle that access to knowledge should be free and open, especially in regions where economic resources are limited. This article provides an overview of the use of PIDs in Latin America, drawing on data from Latindex and the DOAJ (Directory of Open Access Journals). It discusses the initiative developed in Argentina to provide scientific journals with an ARK (Archival Resource Key), which is a free persistent identifier. The ARK is a relevant alternative to the widely used DOI (Digital Object Identifier), which many Latin American journals cannot afford due to its cost.

Introduction

Persistent identifiers (PIDs) are a vital part of managing digital information, especially in academic, scientific and cultural fields. They are characterised by guaranteed persistence, which ensures that the reference to the resource remains unchanged, even if its physical location changes. PIDs guarantee the uniqueness of the relationship by assigning a unique identifier to each resource, thereby avoiding ambiguity or duplication. PIDs also incorporate resolution systems that dynamically refer to the current version of the resource, and they are often linked to descriptive metadata that enriches their context.

Their practical importance lies in the following characteristics:
- They promote open science and reproducibility by enabling the accurate and verifiable citation of all digital output.
- They enable interoperability between heterogeneous systems by connecting infrastructures through universal standards.
- They also support long-term digital preservation, ensuring continuous access to essential resources.

In Latin America, publishers lack the resources to access the DOI (the most widely used PID) due to its cost. The annual subscription fee of £275 (US dollars) and the additional cost of £1 per DOI are unaffordable for Latin American journals, which generally operate on a non-commercial model and do not generate revenue from article processing or journal sales.

This article provides an overview of PIDs, including their key features and functions, as well as the evaluation criteria. It introduces the primary PID systems and, in particular, examines the advantages and limitations of using ARK versus DOI, justifying the preference for ARK in low-resource contexts. It presents a quantitative analysis of PID usage in Latin America based on data collected from DOAJ and Latindex Catalogue 2.0, both of which cover a significant proportion of Latin American scientific journals. The article also analyses the conditions for using PIDs in different indexing systems. Finally, it presents a case study examining the history and technical development of ARK in Argentina, concluding with the advantages of its large-scale adoption in the region.

Characterisation of PIDs and evaluation criteria

PIDs (Persistent Identifiers) are unique digital references assigned to resources, such as articles or data. They guarantee permanent and accurate access, solving critical problems such as the fragility of traditional web links and the lack of standardisation in citations. They are essential because they form the backbone of a reliable digital infrastructure. They ensure persistence (they do not change even if the resource is moved), uniqueness (they eliminate ambiguity) and dynamic resolution (they redirect to the current location where the resource is hosted). This enables verifiable scientific citations, long-term preservation, interoperability between systems, attribution of authorship and transparent rights management. These features are fundamental to the integrity, traceability and sustainable access of knowledge.

PIDs provide mechanisms for the unambiguous, permanent and functional identification of objects, constituting an essential infrastructure for the representation, formalisation, circulation and operationalisation of scientific knowledge (Wittenburg, 2019). They facilitate the formal and unambiguous referencing of artefacts of all kinds — including abstract constructs, physical entities, people, institutions, and components of communication media — ensuring that every component of the scientific system can be identified, represented, and utilised. This process facilitates the reuse, citation, and socialisation of outputs, tools, and results (Authier & Ferreyra, 2023).

Ideally, PIDs should meet the following criteria:
• Sustainability: the ability to be technically, organisationally and economically sustainable.
• Technical interoperability is a technological design that is compatible with available network infrastructures, automated service delivery mechanisms, and digital resource description standards.
• Technological neutrality: characteristics that enable it to operate independently of specific underlying technologies or other constraints (e.g. proprietary or restrictive data, metadata or services).
• Legal reliability: the ability to avoid legal obstacles, such as access restrictions or service blockages.
• Functional portability: the ability to be used in different contexts and on different media.
• Scope: applicable to different entities, e.g. digital objects, physical objects or parts of objects.
• Documentation: providing users with a set of documents explaining the implementation conditions.
• Sovereignty: operating according to a transparent governance model.
• Robustness: benefit from a proven, scalable architecture.
• Diachronic interoperability: possess characteristics that enable articulation with evolving infrastructures.

A good persistent identifier must be unique and immutable, and must be reliably linked to the resource in question via robust infrastructure. It should be associated with essential descriptive metadata (e.g. author, provenance and licence) and operate according to clear management and preservation policies. It should also be supported by a stable financial model and implemented using open standards to guarantee interoperability. Institutional support is essential to guarantee longevity, regardless of technological, organisational and political changes, in order to avoid obsolescence and ensure perpetual access.

The main PID systems

In the world of identifiers, the following systems are considered fundamental.

ISSN (International Standard Serial Number)
The ISSN was created in 1975. It is assigned by national agencies, of which there are currently 96 members. These agencies are responsible for identifying continuing resources published in their country, assigning them an ISSN, registering them in the international database managed by the International Centre and publishing the data. If a country does not have a national agency, the International Centre in Paris, France, assigns ISSNs to publications.

DOI (Digital Object Identifier)

A DOI (Digital Object Identifier) is a unique identifier assigned to a physical, digital or abstract object. Designed for use by both humans and machines, it uses an alphanumeric system to permanently and uniquely identify documents such as scientific articles, publications and books, as well as any other type of content. Developed in 1997 using the technical infrastructure of the Handle system created by the Corporation for National Research Initiatives (CNRI) in the United States, it has been managed by the International DOI Foundation (IDF) since 1998. Since 1998, the DOI system has been managed by the International DOI Foundation (IDF), a non-profit organisation based in the US that operates internationally. The adoption of the DOI has been pivotal in the academic and publishing worlds. It is currently the most widely used persistent identification system.

Handle

Handle is a persistent identifier resolution system that was developed by the CNRI in 1994. Its purpose is to assign and manage unique, persistent references to digital objects, regardless of their location or format. Adopted as the technological basis for the DOI system in 1997, the Handle system continues to underpin it. Since 2014, the Handle system has been coordinated globally by the DONA Foundation, which is based in Geneva, Switzerland.

CONICET (Consejo Nacional de Investigaciones Científicas y Técnicas), Argentina's digital repository, uses Handle. CONICET Digital makes the scientific output of CONICET researchers available for free and open access. Both documents and datasets are compatible with Handle. CONICET opted for the Handle system for economic reasons, as it is less expensive than the DOI system. These are the same reasons that motivated the creation of the ARK-CAICYT identifier (see below).

ARK (Archival Resource Key)

ARK was created by John Kunze at the University of California in 2002. To date, 1,100 organisations have allocated 8.2 billion ARKs. ARKs are decentralised, open-source, conventional and free PIDs that can be operational within 48 hours. They can be used to identify any digital, physical or abstract object. This could include objects that do not yet exist, but which need to be referenced from those currently being created. Examples include a link from a draft article to a dataset in preparation or an archived digital letter to a research instrument currently being compiled.

ORCID (Open Researcher and Contributor ID)

ORCID is an international non-profit organisation that is funded through grants from its member organisations. ORCID provides researchers with a free identifier that they own and control. ORCID enables researchers to be distinguished from one another in cases of homonymy, for example. It can be linked to a researcher's professional information, including affiliations, grants received, publications and peer reviews. It can also interoperate with different platforms to share information with other systems, allowing the author to be recognised for all their contributions while saving data alignment resources and reducing the risk of errors.

The International Federation of Library Associations and Institutions (IFLA) recognises several identifier systems that are useful to the library community, including the Persistent Uniform Resource Locator (PURL), the Digital Object Identifier (DOI), the Handle System, the Archival Resource Key (ARK) and the International Standard Serial Number (ISSN) (IFLA, 2021).

PIDs are essential tools in institutional repositories as they facilitate the long-term preservation of scientific content and improve its visibility and accessibility. Implementing them is considered good practice in the context of open science and interoperability. Several studies have emphasised the importance of aligning these strategies with national initiatives and developing coordinated infrastructures (Knudsen, 2025).

Which identifier is better for scientific publications: ARK or DOI?

The DOI offers numerous advantages. It provides a unique and immutable identifier that guarantees the long-term persistence and accessibility of digital resources. It also facilitates the citation of sources and the creation of links to documents, improving the visibility and traceability of research. It also offers associated metadata providing detailed information about the resource, such as the author, title and publication date. This helps improve interoperability between systems and information retrieval. However, there are also limitations and disadvantages, including the cost of assigning and maintaining identifiers and dependence on foreign organisations for administration and problem resolution. As a US-based foundation, it cannot be assigned to countries subject to US sanctions. Iran is an example of a country that has been forced to develop its own identification system for its scientific articles (Teymourikhani and Akbari-Daryan, 2015), as has Cuba (Alfonso Manzanet, 2020).

Why should ARK be used instead of a DOI to identify scientific publications? Firstly, non-commercial open-access scientific journals (diamond model) often struggle to obtain funding, and the main advantage of ARK is that it is free.
With ARK, identifiers can be created without metadata, or even before a digital object exists. The identifier can be kept private while the data and metadata evolve. An additional identifier can be assigned, such as a DOI or Handle. The ARK protocol also allows for the creation of shorter identifiers as it supports the use of both upper- and lowercase letters to form denser strings. Furthermore, the use of a PID with an open structure aligns with the values of most Latin American scientific organisations. Finally, if the context changes and the journal receives funding, DOIs can be retrospectively assigned to articles already identified by ARKs.

Survey on the use of PIDs in Latin America

To determine the use of PIDs by Latin American journals, the authors conducted a survey based on data from the Directory of Open Access Journals (DOAJ) and Latindex Catalogue 2.0.

The DOAJ is an online directory providing access to high-quality, open-access, peer-reviewed journals. All of its data is available free of charge. It was chosen as a source because of its global

coverage, prestige and the ability to download journal records in their entirety. As of November 2023, the DOAJ contained information on 17,602 journals published in 80 languages from 130 countries. Around 40% of these journals used DOIs. Fewer than 1% used other identifiers, such as ARK, Handle or PURL. The remaining 60% did not use any persistent identifiers.

This study conducted by the DOAJ reflects the marginal use of PIDs other than DOI. The second most widely used PID is Handle, which costs less than DOI. However, only 49 journals use it, representing 0.27% of the total. In third place is ARK, which does not incur any costs for journals but requires them to implement their own resolver. Only 16 journals use it (0.09%). In fourth place is PURL, used by only 4 journals (0.03%).

Catalogue 2.0 is a selective database within the Latindex system. Journals must comply with a methodology based on 38 quality criteria to be included in the Catalogue. One of these criteria (criterion 36) refers to the use of unique resource identifiers (URIs). While not a requirement, including this criterion encourages its adoption by publishers and enables the progress of using digital tools in indexed journals to be assessed.

The Catalogue 2.0 data was obtained via advanced database searches and extracted in CSV format. All the Latin American journals included in the catalogue were identified and compared with those that comply with criterion 36. Table 1 shows that 72% of the Catalogue 2.0 journals use a PID, compared to 60% of DOAJ journals. Analysis of the data from both databases by country reveals that countries with a larger number of registered journals generally have a lower compliance rate. Conversely, countries with a smaller number of journals in both systems, such as Honduras, Panama and Uruguay, demonstrate high levels of PID adoption.

In the case of Argentina, the use of PIDs is comparable on both platforms, with values slightly above 50%. Another recent study showed that 67 Argentine journals used ARK (Authier & Ferreyra, 2023).

Brazil is an important player, ranking third in terms of journals indexed in DOAJ and first in Latindex. While the compliance rate with the PID usage criterion is close to 60% in DOAJ and 80% in Latindex for Brazilian journals, it should be noted that the number of Brazilian journals registered in DOAJ is significantly higher.

Another notable country, Cuba, is struggling to cover the costs of agency membership, such as that of Crossref, which requires payments in foreign currency. Combined with the budgetary constraints faced by Cuban journals, this results in a low PID adoption rate: only 11% of Cuban journals in DOAJ and 5% in Latindex use a PID.

It is not possible to identify the type of PID used by the 1,894 Latindex Catalogue 2.0 journals that meet criterion no. 36. However, given that the DOAJ data shows that PIDs other than DOIs are used only marginally, it is likely that the same is true for Latindex journals. To illustrate this, we examined the results of a 2022 study of 195 Mexican journals in Catalogue 2.0 (Alonso Gamboa and Reyna Espinosa, 2022). The study concluded that all of the journals using PIDs used only the DOI and made no mention of other PIDs.

Country	Directory of Open Access Journals (DOAJ)		Latindex (Catalogue 2.0)	
	Total number of journals	With PID (percentage)	Total number of journals	With PID (percentage)
Argentina	379	54	528	53
Bolivia	8	100	14	71%
Brazil	1,646	55	365	83
Chile	166	57	213	89
Colombia	433	58	134	96
Costa Rica	76	72	99	80
Cuba	123	11	77	5
Ecuador	98	78	319	69
El Salvador	7	71	14	43
Guatemala	3	67	22	59
Honduras	4	100	11	100
Mexico	215	62	386	73
Nicaragua	13	61	23	83
Panama	5	80	37	95
Paraguay	28	82	22	64
Peru	126	75%	240	91
Puerto Rico	4	100	10	30
Dominican Republic	8	88	16	69
Uruguay	33	88	54	94
Venezuela	41	71	32	47
TOTAL	**3,423**	**60**	**2,616**	**72**

Table 1. List of Latin American journals with PIDs in the DOAJ and Latindex catalogues (2025)

Indexing systems and PIDs

As part of this study, the authors analysed the use of PIDs as an inclusion criterion in various indexing systems, including: Latindex Catalogue 2.0, Redalyc, DOAJ, Dialnet, SciELO, and Núcleo Básico de Revistas Argentinas (CAICYT-CONICET). The results of this analysis are summarised in Table 2.

SciELO is the only indexing service that requires the use of a PID. In the Crossref DOI metadata submitted by journals, the link to the full text must contain the SciELO URL in addition to other URLs, to ensure access. Multilingual articles require different DOIs for each version and the Crossmark element must be used to register each new version. In accordance with Crossref guidelines for displaying DOIs, the DOI must be specified in the XML and PDF versions of the files. All preprints have a DOI and a Crossref record, ensuring interoperability and visibility within the global information flow. In SciELO Data, when a dataset is created, Dataverse identifies its preliminary version as a draft. This version immediately receives a DOI, which is registered and activated once the dataset is published. This DOI will be distinct from the article's DOI because they are considered different objects, which are therefore separately citable and manageable.

Latindex, Redalyc and DOAJ consider the use of PIDs to be an inclusion criterion and encourage their use; however, none of these systems make them mandatory. In contrast, Dialnet and the Argentine Core Journal Index (NBRA) make no mention of PIDs, as shown in Table 2.

Therefore, most of these services do not require the use of PIDs, as the DOI — the most widely used identifier — involves an investment that many Latin American journals cannot afford. This is why alternatives such as ARK are essential. These allow articles published in Latin American journals to increase their visibility and accessibility, be found by academic search engines, be linked to different repositories, and generally be integrated into the international scientific community where PIDs are already the norm.

Indexer	Citation/Suggestion	Mandatory
Latindex (Catalogue 2.0)	*36. Use of uniform resource identifiers*. All published articles must use *uniform resource identifiers*	Non
	(URI), for example identifiers such as Handle, Digital Object Identifier (DOI) or Archival Resource Key (ARK).	
Redalyc	*5.9 Digital Resource Identifier (DRI)/CAV*. All articles must have a digital object identifier (DOI, Handle, etc.).	No
DOAJ	Articles must use persistent identifiers. The most commonly used are DOI, ARK or Handle. All permalinks must function correctly.	No
Dialnet	No	No
SciELO	Yes	Yes
Core group of Argentine journals (NBRA)	No	No

Table 2. Use of the PID as a criterion for including journals in indexing systems

Case study: ARK-CAICYT in Argentina

Latin America has been a pioneer in implementing open access. In response to requests from Argentine scientific publishers who were experiencing serious difficulties in acquiring Digital Object Identifiers (DOIs), the Argentine Centre for Scientific and Technical Information (CAICYT), which is part of the Argentine National Scientific and Technical Research Council (CONICET), launched a pilot project in 2018. The aim of this project was to create an infrastructure for assigning unique, permanent and free identifiers to articles.

ARK was chosen as it is one of the identifiers recognised by IFLA and can be assigned not only to scientific articles, but also to images, texts, data sets and research tools.

Project history

The project timeline is as follows:

- 2018: technical design and software development.
- 2019: prototype released and online management platform developed.
- 2022: user management software released.
- 2023: new users are added to the system, bringing the total number of journals to 108, with 3,600 ARKs assigned.
- 2025: A project to extend the service to the whole of Latin America is presented to Invest in Open Infrastructure (IOI).

The ARK-CAICYT application is based on the adaptation of a generic URL resolver, which enables configurable patterns to be used in URL labels. It uses the HashIds (now Sqids) algorithm to generate unique identification strings. The current technical requirements are as follows:Apache HTTP server (mod_rewrite enabled);
- MySQL version 5.0 or higher;
- PHP scripting language version 5.3.2 or higher (mysqli and curl extensions installed and enabled).

CAICYT manages the Argentine ISSN Centre, which allocates unique identifiers to Argentine serial publications. As part of this development, we have chosen to link the ARK standard to the ISSN standard as follows :

- The scientific journal contacts CAICYT, which assigns the journal a user account and password to access the URL (1) service.
- Once validated, the user accesses a page displaying the list of ISSNs and associated journals.
- By clicking on the name of one of the journals in the list, the publisher can access a screen entitled 'List of resources associated with this ISSN' and a form for adding a new resource.
- This screen has two sections: a form for adding a new resource/article and associating it with the current ISSN; and a list of resources already associated with this ISSN. In the 'Resource URL' field, the URL of the journal article must be entered without modification. The publisher then validates the operation by generating an ARK for the resource. After a few moments, the page refreshes and displays the newly generated ARK for this URL below the entered URL.

The terms of use for the ARK-CAICYT service are as follows:

- The journal must be scientific or technical in nature.
- It must have an ISSN issued by the Argentine National Centre.
- It must have an ISSN for the online version. If it does not have one, it can be obtained from CAICYT.
- It must be available online at the time of application for inclusion in the project, with its final URL.
- The online version must have been in existence for at least two years.
- The journal must have a dedicated official or institutional website.
- It must adhere to open access principles.
- Digital journals must not be made available as a single PDF file, but must include at least a table of contents and separate articles in separate PDF files.
- The editorial managers and members of the scientific committee must provide an email address.
- The journal must also have an external evaluation system for articles.

By June 2025, the ARK-CAICYT system had assigned 137 scientific journals and 5,210 ARK identifiers.

It is also worth mentioning that, in 2023, the dARK project began to be developed in Brazil under the auspices of L Referencia (2) and IBICT (Instituto Brasileiro de Informação em Ciência e Tecnologia), based on the same ARK identifier and with a similar objective to that of ARK-CAICYT (Segundo et al., 2023).

Conclusion: the potential of ARK in Latin America

PIDs have transformed scientific communication in journals by providing stable and sustainable access to articles, enabling more accurate citation and referencing, and ensuring long-term preservation and availability.

John Kunze's text, published on the official ARK website blog, addresses ten myths about PIDs (Kunze, 2021). One of these myths is that 'PIDs must be centralised', a statement which J. Kunze believes to be unfounded. Any PID with a single core after the host domain name in the URL is permanent. However, if it can be taken over by other domains, it cannot persist, as its resolution is linked to a domain. No domain name or protocol is eternal.

The Argentine experience has shown that a PID can be implemented at no cost to research, and the project now includes more than a hundred scientific journals that meet all the technical requirements of international standards. Regarding the recommendations for the interoperable platform project for Argentine journals, CAICYT is focusing on PIDs as the building blocks of the platform.

Over 60% of the Latin American journals indexed in the DOAJ and Latindex catalogues already use PIDs, primarily DOIs. However, ARK can be seen as a sustainable and effective alternative. ARK-CAICYT serves as an example and impetus for open science in Argentina during its development. This model could be replicated in other Latin American countries and beyond with minimal investment from governments.

The growing importance of PIDs in open science has sparked renewed interest in understanding the level of knowledge researchers have about their use, as well as their technical implementation. While PIDs are essential for ensuring traceability, visibility, and the connection between research objects and individuals, there are still questions about researchers' understanding of them. Studies highlight significant differences in understanding depending on discipline and role. They emphasise the importance of implementing more targeted training and awareness strategies to effectively integrate PIDs into digital research environments (MacGregor, Lancho-Barrantes & Pennington, 2023).

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