

# Preparing University Heritage for Semantic Data Enrichment

MARINA SALSE ROVIRA, University of Barcelona, Spain

PILAR MATEO BRETOS, University of Barcelona, Spain

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The creation of a virtual museum today must engage with the semantic web and linked data; it cannot be developed independently of the standards that shape its technological environment. The Virtual Museum of the University of Barcelona, launched in 2021, was conceived with these principles in mind, despite the complexity of its collections which encompass numerous and highly diverse forms of material, immaterial, natural, and human heritage, all managed by faculty members alongside their research, teaching, and administrative duties. This paper presents the process of developing the virtual museum, with particular attention to its material cultural heritage component. It begins by describing the data-modelling work, including the creation of a DCMI application profile informed by the CIDOC-CRM conceptual model. This effort required integrating sector-specific controlled vocabularies adapted for a linked-open-data (LOD) environment, as well as producing a data dictionary for collection managers. The article then discusses the data-cleaning and reconciliation procedures carried out to produce manageable data subsets for curators and to prepare the records for future semantic enrichment. The paper concludes by outlining the remaining tasks and upcoming initiatives aimed at enhancing the museum's metadata through semantic technologies.

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## Keywords:

Virtual Museums, Semantic Web, University Heritage, Linked Open Data.

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## 1. PRESENTATION AND CONTEXT

The university heritage, collected over the centuries of history of universities, has been brought together by different sections within them, such as departments, libraries or archives, for teaching, management or research purposes. In some cases, however, especially in art collections, there was a component of pure collecting that testified to the prestige of the universities that acquired it. This was especially true in younger universities, where they began to build collections of fundamentally contemporary art.

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Author's address: Marina Salse Rovira, Department of Library Science, Documentation and Audiovisual Media, University of Barcelona, Melcior de Palau 140, 08014 Barcelona, Spain; Pilar Mateo Bretos, Office of the Vice-Principal for Culture, Memory and Heritage, University of Barcelona, Montalegre 6, 08001 Barcelona Spain; email: (salse, pilimateo)@ub.edu

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The result was a heterogeneous heritage complex, widely distributed among the different units of the university and often underestimated. Many pieces, now of recognized value, lay dormant for years in warehouses, forming what has been called Orphan Collections or Cinderella Collections (De Clerq 2001, Yerbury 2001).

At the turn of the twenty-first century, there was a movement to recover these materials that has its maximum expression in the creation of the UMAC (University Museums and Collections) in 2001 as a subcommittee of the ICOM (International Council of Museums). The University of Barcelona was no stranger to this movement and took steps to achieve recovery and unification (at least virtually) in the Virtual Museum of the UB. The first "version" of this virtual museum was presented in 2010 and was based on the Museum Plus program, which was far removed from the needs of the Semantic Web and LOD, which were still growing but becoming less obscure.

The experience with this software was not very successful. Potential users of the museum had used the system very little due to its complexity. Finally, in 2019, the University of Barcelona launched a project to remodel its virtual museum. This project, which had very clear objectives, including adding our collections to the WS and LOD environment, is the one that we present to you in part here.

## 2. OBJECTIVE

To create a virtual museum prepared for inclusion within the semantic web and the Linked Open Data movement, but with a low learning curve for end users (one of the original problems) and allowing interoperability with other collections. This meant:

- A. Using standard metadata schemes adapted to the semantic web, i.e., ontologized, by creating application profiles to meet the needs of the semantic web.
- B. Using a cataloguing tool that manages the semantic web well and subsequently allows the enrichment processes to be carried out.
- C. Using controlled vocabularies present in a Linked Open Data environment.

## 3. METHODOLOGY

The theoretical basis is found in the stages of the Linked Data processes collected by Van Hooland and Verborg (Van Hooland 2014):

- A. The data to be transferred to the virtual model was modelled, **selecting** a metadata schema and generating an elaborate data dictionary.
- B. The existing data was **cleaned** up to standardize them.
- C. The resulting file was **reconciled** with the controlled vocabularies adapted to the semantic web that had been chosen in the modelling phase.
- D. The semantic **enrichment** phase has not yet been carried out, but the UB data are ready to capture data from other sources. It is important to note that Hooland and Verborg give a very different meaning to semantic enrichment than the one we have applied. They focus on

analysing documents to extract NER (Name Entity Recognition). Here, we apply the concept of semantic enrichment as defined by Agenjo-Bullón and Hernández-Carrascal (Agenjo-Bullón and Hernández-Carrascal 2018, Bullón and Hernández-Carrascal 2022), which seeks to draw data from Linked Data sources to enrich the records.

- E. **Publication.** The data have been published and are available in <https://museuvirtual.ub.edu/> but the enrichment has not yet been carried out, so the exploitation that is being carried out does not yet have a semantic nature.

## 4. RESULTS

### 4.1 Data modelling

In this sense, an important point was to decide which metadata scheme to use, although it was very clear that from the outset we were moving towards an application profile of a generic scheme. The basic problem at this point was that we had collections of very diverse kinds, ranging from those belonging to cultural heritage (fine arts, architecture, library, archive) to those linked to the sciences (botany, zoology, petrology), some of them already with databases previously created with their own metadata schemes. It was therefore clear that there could not be a single metadata scheme valid for all collections, since the characteristics of a petrology collection have little to do with those of art. In addition, it was necessary to:

1. mapping the metadata schemas used locally to the standards of their choice
2. mapping the metadata standards chosen between them to be able to make joint aggregations of the entire collection to aggregators such as Europeana, since one of the main functions of the new system was to prevent the pieces from being locked in local databases.

As of July 2024, only the movable tangible cultural heritage part has been clearly modelled and has been done under the Dublin Core metadata scheme (in its [DCMI Metadata Terms](#) version). For the natural heritage, we want to work using [Darwin Core](#) (Salse Rovira 2024, Salse Rovira et al. 2023), except for the earth science collections for which different possibilities are still being evaluated. Intangible heritage and human heritage have not yet been considered at the metadata level, although they are kept in mind<sup>1</sup>.

DCMI Metadata Terms was selected because it was already adapted to the semantic web and Linked Data and was generic and simple enough to link it to the diversity of existing collections at the University of Barcelona. However, it was very clear that the existing properties were insufficient, which is why we resorted to analyzing the [CIDOC CRM](#) conceptual model in order to select entities and/or properties that provided a minimum management capacity but without complicating the modelled structure, since a basic point for us was that the system was simple and easily self-manageable. The institution does not have full-time cataloguing staff, so the work of documentary description and management is carried out part-time by those responsible for the collections

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<sup>1</sup> The classification of UNESCO (UNESCO 2014) heritage into tangible, intangible and mixed heritage is followed, but adding the category of human heritage to include all those people who have left their mark on the institution.

themselves (generally professors without training in metadata), sometimes helped by fellows or by occasional collaborations in a TFG. Therefore, it could not be a complex data structure.

While the database was being modelled, the program with which it would be implemented was selected. The system chosen was Omeka S, a freely distributed program that adapts to the semantic web and allows the management of Dublin Core records and derived application profiles without problems.

Since the program was already available, a data dictionary was generated to serve as a guide for the different cataloguers. We already have different versions of it that have been modified depending on the needs and the points of improvement detected as it has been applied. The resulting schema combines Dublin Core with its own fields that have been assigned the CURIE metadataesUB. To connect with other catalogues, the `bibo:uri` property, belonging to the [BIBO](#) semantic vocabulary, is used.


Table 1 finally shows the final structure of the metadata schema that was adopted, and Table 2 shows an example of the data dictionary. In shading, metadata considered fundamental.

*Table 1. Properties used to describe the pieces of the Virtual Museum*

Dublin Core Properties	UB Metadata Properties (mainly adapting CIDOC CRM)	BIBO properties
<code>dcterms:accrualPeriodicity</code>	<code>dcterms:identifying</code>	<code>bibo:uri</code>
<code>dcterms:abstract</code>	<code>dcterms:instructionalMethod</code>	
<code>dcterms:accessRights</code>	<code>dcterms:isFormatOf</code>	
<code>dcterms:alternatives</code>	<code>dcterms:isPartOf</code>	
<code>dcterms:accrualPolicy</code>	<code>dcterms:isReferencedBy</code>	
<code>dcterms:audience</code>	<code>dcterms:isReplacedBy</code>	
<code>dcterms:accrualMethod</code>	<code>dcterms:isRequiredBy</code>	
<code>dcterms:educationLevel</code>	<code>dcterms:isVersionOf</code>	
<code>dcterms:bibliographicCitation</code>	<code>dcterms:language</code>	
<code>dcterms:conformsTo</code>	<code>dcterms:license</code>	
<code>dcterms:contributor</code>	<code>dcterms:mediator</code>	
<code>dcterms:coverage</code>	<code>dcterms:medium</code>	
<code>dcterms:creator</code>	<code>dcterms:provenance</code>	
<code>dcterms:date</code>	<code>dcterms:publisher</code>	
<code>dcterms:dateAccepted</code>	<code>dcterms:references</code>	
<code>dcterms:available</code>	<code>dcterms:relationship</code>	
<code>dcterms:dateCopyrighted</code>	<code>dcterms:replaced</code>	
<code>dcterms:created</code>	<code>dcterms:requires</code>	
<code>dcterms:issued</code>	<code>dcterms:rights</code>	
<code>dcterms:modified</code>	<code>dcterms:rightsHolder</code>	
<code>dcterms:dateSubmitted</code>	<code>dcterms:source</code>	

dcterms:valid	dcterms:spatial	
dcterms:description	dcterms:subject	
dcterms:extent	dcterms:tableOfContents	
dcterms:format	dcterms:temporary	
dcterms:hasFormat	dcterms:title	
dcterms:hasPart	dcterms:type	
dcterms:instructionalMethod		
dcterms:isFormatOf		
dcterms:isPartOf		
dcterms:isReferencedBy		
dcterms:isReplacedBy		
dcterms:isRequiredBy		
dcterms:isVersionOf		
dcterms:language		
dcterms:license		
dcterms:mediator		
dcterms:medium		
dcterms:provenance		
dcterms:publisher		
dcterms:references		
dcterms:relationship		
dcterms:replaced		
dcterms:requires		
dcterms:rights		
dcterms:rightsHolder		
dcterms:source		
dcterms:spatial		
dcterms:subject		
dcterms:tableOfContents		
dcterms:temporary		
dcterms:title		
dcterms:type		

Table 2. Example of the data dictionary, specifically of the Materials property

Field/Property Name	MATERIALS
Definition	Materials used in the creation of the item.
Data types	Text
Forcing	Not
Repeatable	Yes
Controlled language	Yes
Controlled language on which it depends	List of terms taken from Thesaurus of Art and Architecture (gencat.cat) and available in the Omeka software drop-down menu.
Predefined term	--
Specific data entry instructions	<p>1. Select the most appropriate term from the list. Try to make them relevant materials and affect a large part of the item. NOTE: you can consult the values of the drop-down list in the Appendix.</p> <p>2. In case you have several options, try to choose the most specific term possible. For example, if you have a white gold necklace, use the term white gold, not just gold.</p> <p>3. If the term does not appear in the list, you can consult the original thesaurus Thesaurus of Art and Architecture (gencat.cat) to see if the term exists. If you cannot find it or it is not translated, consult its English version (<a href="https://www.getty.edu/research/tools/vocabularies/aat/">https://www.getty.edu/research/tools/vocabularies/aat/</a>) or its Spanish version (Tesauro de Arte &amp; Arquitectura   <a href="http://aatespanol.cl">aatespanol.cl</a>). You can propose the translated term or the new term to <a href="mailto:museuvirtual@ub.edu">museuvirtual@ub.edu</a> in order to incorporate it, if necessary, into the list of accepted terms.</p> <p>If you have different materials, enter each of them separately by clicking on  <input type="button" value="Afegeix un valor"/> it each time you want to add a new material.</p>
OMEKA field on which it depends	metadadesubmaterials

During the data modelling process, decisions were made regarding the controlled languages that needed to use certain properties. It was crucial to ensure that these tools were adapted to Linked Open Data (LOD) to prepare the data for subsequent semantic enrichment. Table 3 shows the chosen languages, the properties they affect, and the reasons for their selection.

However, often these controlled vocabulary tools are not presented complete to the cataloguer but simply a selection of terms is used to simplify the process. We will see this in the sections on cleaning and reconciliation.

Table 3: Value standards adapted to Linked Data and used in the UB Virtual Museum

Properties	Vocabulary used	Reason
metasub:sorting	Nomenclature 4.0	Classification tool adapted to LOD and very valid for a wide variety of heritage environments
dcterms:type	Art and Architecture Thesaurus (facet objects)	Tool recommended by CDWA (Categories for Description of Works of Art) in its facet of objects to respond to the needs of this property
dcterms:subject	VIAF (people and entities) THUB (Thesaurus of the University of Barcelona), for subjects.	VIAF because of its comprehensiveness (now it also incorporates links to Wikidata) and THUB because it is the thesaurus of the Library of the University of Barcelona and has recently been adapted to LOD. It was aligned with the subjects of the CRAI UB catalogue and was sufficiently exhaustive in terms of subjects.
dcterms:creator dcterms:contributor dcterms:publisher	VIAF	For its completeness (now it also incorporates Wikidata)
dcterms:temporary	THUB	Same reasons as above
metasub:materials	Art and Architecture Thesaurus	Recommended by standards such as CDWA (Categories for Description of Works of Art)
dcterms:Language	ISO 639 (lexvo.org)	Provides language coding adapted to ISO 639 <sup>o</sup> language codes

## 4.2 Cleaning and reconciliation

During the modelling and definition of the data within the Omeka S programme, preparations were made for the ingestion of the dataset from the former Virtual Museum of the UB. This preparation involved three main tasks:

1. **Clean the data** with *Open Refine*, homogenizing them for a correct reconciliation. A total of 2115 records were cleaned. Cleaning up meant homogenizing the contents of a certain field (terms, accents, upper and lower case, elimination of spaces).
2. **Reconcile the data** already cleaned with the controlled languages defined in the data dictionary. For this reason, additional columns were created with *OpenRefine* that had the purpose of starting to locate the controlled vocabularies and their permanent URIs. Figure 1, shows a screenshot of this task being performed
3. **Create subsets in many of the controlled** languages to prevent the excess of terms from becoming a problem for cataloguers. This was an important element as we didn't want cataloguers to face a steep learning curve to become familiar with the tools. The goal was to enable them to choose from a reduced set of terms quickly. The system has worked quite well, and if cataloguers need a term that is not in Omeka, they can request of the Office of the Vice-Principal for Culture, Memory and Heritage, the body responsible for the project, to register it. In this process the term will be adapted to the corresponding controlled language. In Figure 2

we can see one of these subsets (specifically dterms:type) ready for ingestion in Omeka and, in Figure 3 how they are integrated into the cataloguing within the Omeka application.

dcterms:identifier	dcterms:PartOf	metadadesub:colegespecifica	dcterms:title	dcterms:accrualMethod	metadadesub:desacat	dcterms:publisher	dcterms:subject	IRI THUB
FFUB-0001	Instrument científic / Física		Teodolit	Desconegut	No	F. SARTORIUS	Òptica	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/9010550563020706
FFUB-0002	Instrument científic / Física		Quadrant solar declinat	Desconegut	No	Desconegut	Astronomia	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706
FFUB-0003	Instrument científic / Física		Heliógraf solar equatorial	Desconegut	SI	R. Fuess	Astronomia	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706
FFUB-0004	Instrument científic / Física		Espectroscopi de cua d'escripi	Compra directa	No	GRUBB	Òptica	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/9010550563020706
FFUB-0005	Instrument científic / Física		Nivell amb plomules	Desconegut	No	Desconegut	Mesura	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505511406706
FFUB-0006	Instrument científic / Física		Heliofot	Desconegut	No	RICHARD FRERES	Astronomia	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706
FFUB-0007	Instrument científic / Física		Albany per a senyals horaris	Desconegut	SI	ATELIERS DUCRETET E. ROGER	Astronomia	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706
FFUB-0008	Instrument científic / Física		Màquina de càlcul electromecànica	Desconegut	No	Morse	Electrònica	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706
FFUB-0009	Instrument científic / Física		Albany per a senyals horaris	Desconegut	No	Telefunken	Astronomia	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706
FFUB-0010	Instrument científic / Física		Receptor de senyals horaris	Desconegut	No	E. Ducretet	Astronomia	https://vocabulari.crai.cs.ub.edu/thub/conceptthub/90105505496300706

Figure 1. Reconciliation operations of controlled properties relating subject: from original subject (1) to a controlled vocabulary subject (2).

Tipus	AAT URI Tipus
Accessori de càmera	http://vocab.getty.edu/page/aat/300022662
Adhesiu (artefacte d'informació)	http://vocab.getty.edu/page/aat/300207379
Aeròmetre	http://vocab.getty.edu/page/aat/300195760
Aiguafort (intaglio)	http://vocab.getty.edu/page/aat/300041365
Aiguafort al vernís tou (obra visual)	http://vocab.getty.edu/page/aat/300041376
Aiguatinta (obra visual)	http://vocab.getty.edu/page/aat/300041366
Aixada (eina agrícola)	http://vocab.getty.edu/page/aat/300024329
Alambí	http://vocab.getty.edu/page/aat/300197358
Albarel	http://vocab.getty.edu/page/aat/300198823
Àlbum (llibre)	http://vocab.getty.edu/page/aat/300026695
Altaveu	http://vocab.getty.edu/page/aat/300250653
Amperímetre	http://vocab.getty.edu/page/aat/300196271
Ampliadora	http://vocab.getty.edu/page/aat/300022711
Ampolla	http://vocab.getty.edu/page/aat/300045627
Ampolla de vi	http://vocab.getty.edu/page/aat/300045639
Anunci (publicitat)	http://vocab.getty.edu/page/aat/300213187
Aparell mèdic de raigs X	http://vocab.getty.edu/page/aat/300427332
Arpa (cordófon)	http://vocab.getty.edu/page/aat/300042047
Artefacte de mesurament de la llum	http://vocab.getty.edu/page/aat/300195756
Artefacte de mesurament d'electricitat	http://vocab.getty.edu/page/aat/300195711
Artefacte experimental (electricitat)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (electroestàtica)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (electromagnetisme)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (geofísica)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (hidrodinàmica)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (hidroestàtica)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (magnetisme)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (mecànica)	http://vocab.getty.edu/page/aat/300312057
Artefacte experimental (pressió atmosfèrica)	http://vocab.getty.edu/page/aat/300312057
Artefacte sonor (equip)	http://vocab.getty.edu/page/aat/300433424
Aspirina (Medicament)	http://vocab.getty.edu/page/aat/300404881
Astrofotografia (obra visual)	http://vocab.getty.edu/page/aat/300134468
Audiòmetre	http://vocab.getty.edu/page/aat/300196286

Figure 2. Appearance of the selected terms after cleaning and reconciliation. Ready for intake in Omeka. In this case, the controlled languages of the `dcterms:type` fields are displayed.

4. **Keep the controlled vocabulary complete** (Figure 4) only for the consultation of highly variable elements, such as the author or the subject. Only in these cases, users have been specifically trained to consult the vocabulary. This has a button that activates the resource allowing the user to select the term from the full list

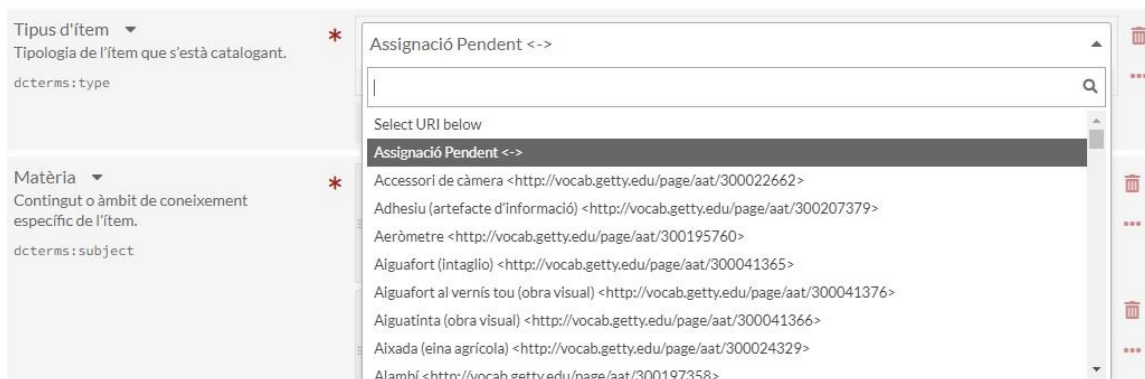


Figure 3. Appearance that the terms have in Omeka once ingested.

### 4.3 Enrichment

With this work done, the necessary relationships have already been established to semantically link different data sets. The next phase involves:

1. **Selecting the data** to be used to enrich the records from the selected Linked Data sources. For example, in the case of the Getty thesaurus, terms in other languages could be captured and incorporated into the description. In the case of VIAF, concepts such as the works created, nationality, and links to Wikidata, to enrich biographic data could be selected.
2. **Capturing the desired information.** The methods of capture can be diverse. The two main ones would be:
  - a. Working with *OpenRefine* to capture the data we want (from the URIs) and transfer it to Omeka S in specific fields prepared for this purpose;
  - b. Capturing the data from the *SPARQL endPoint* of the Linked Data resources and then ingest them into Omeka.
3. **Reconditioning the interfaces** to display the captured data and, where appropriate, use them as filter tools in the search.

### 4.4 Publication

The (new) MVUB was published at the end of 2021 and can be consulted at <https://museuvirtual.ub.edu/>. There is still a lot of work to be done and, for the time being, the results

(Figure 4 and 5) do not yet reflect all the work that has been done to add semantic content to the records. However, it does provide a more than approximate idea of the breadth and variety of the collections.

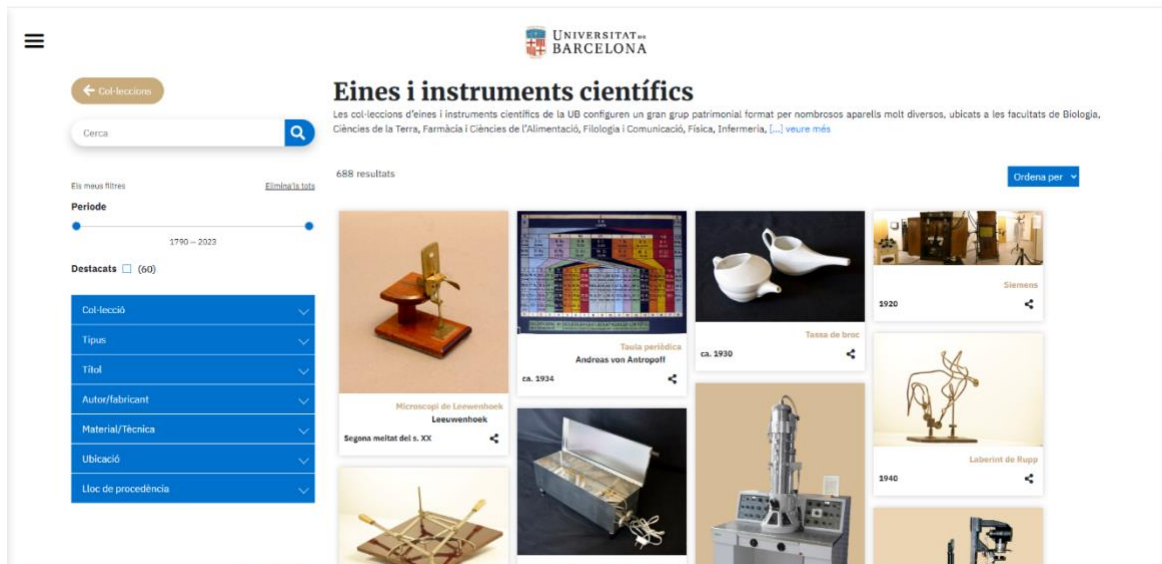


Figure 4. Appearance of the Collection of Scientific Tools and Instruments.



Figure 5. Current appearance of an MVUB item description.

## 5. CONCLUSIONS AND CHALLENGES FOR THE FUTURE

The MVUB is a real entity, consultable and ready to grow, but it still has a long way to go. It is prepared for a future where it will no longer be isolated but will integrate with other datasets. The team at the Office of the Vice-Rector for Culture, Memory, and Heritage of the UB, along with its collaborators, have projects in mind such as:

1. Integration with other datasets such as [Catalónica](#), [Hispana](#) or [Europeana](#)
2. Semantic enrichment of the data and creation of retrieval tools based on this semantic enrichment.
3. Integration of science collections: data modelling, cleaning, reconciliation and enrichment.

## REFERENCES

- Agenjo-Bullón, Xavier, and Francisca Hernández-Carrascal. 2018. "Registros de autoridades, enriquecimiento semántico y Wikidata." *Anuario ThinkEPI*12: 361–372. <https://doi.org/10.3145/THINKEPI.2018.61>.
- . 2022. "Sobre el enriquecimiento semántico de materias en un entorno Linked Open Data." *Anuario ThinkEPI*16. <https://doi.org/10.3145/thinkepi.2022.e16a17>.
- de Clercq, Steven W. G. 2001. "Uniting Forces: The European Network and National Collaborative Projects." In *Managing University Collections*, 85–103. Paris: Organisation for Economic Co-operation and Development.
- Salse Rovira, Marina. 2024. *La documentació del patrimoni universitari en contextos no museu: Propostes per a la seva organització i descripció a partir de les col·leccions de la Universitat de Barcelona*.
- Salse Rovira, Marina, Nuria Jornet-Benito, Javier Guallar, Pilar Mateo Bretos, and Josep Oriol Silvestre-Canut. 2023. "Universities, Heritage, and Non-Museum Institutions: A Methodological Proposal for Sustainable Documentation." *International Journal on Digital Libraries* (October): 1–20. <https://doi.org/10.1007/s00799-023-00383-0>.
- UNESCO. 2014. "Heritage." In *Culture Indicators for Development*, 109–140. Paris: UNESCO.
- Van Hooland, Seth. 2014. *Linked Data for Libraries, Archives and Museums: How to Clean, Link and Publish Your Metadata*. London: Facet Publishing.
- Yerbury, Di. 2001. "The Cinderella Collections: An Australian Fairy Story." In *Managing University Museums: Education and Skills*, 55–68. Paris: Organisation for Economic Co-operation and Development.

## APPENDICES

### A.1 General Guidelines

1. Save as you go and backup your file regularly.
2. Do not work on files that are saved in a cloud directory. To avoid problems such as MS Word crashing, please only work on files that are saved locally on your machine.

3. Equations should be created with the built-in Microsoft® Equation Editor included with your version of Word. (Please check the compatibility at <http://tinyurl.com/lzny753> for using MathType.)
4. Please save all files in DOCX format, as the DOC format is only supported for the Mac 2011 version.
5. Tables should be created with Word's "Insert Table" tool and placed within your document. (Tables created with spaces or tabs will have problems being properly typeset. To ensure your table is published correctly, Word's table tool must be used.)
6. Do not copy-and-paste elements into the submission document from Excel such as charts and tables.
7. Footnotes should be inserted using Word's "Insert Footnote" feature.
8. Do not use Word's "Insert Shape" function to create diagrams, etc.
9. Do not have references appear in a table/cells format as it will produce an error during the layout generation process.
10. MS Word does not consistently allow the original formatting to be modified in the text. In these cases, it is best to copy all the document's text from the specific file and paste into a new MS Word document and then save it.
11. At times there are font problems such as "odd" stuff/junk characters that appear in the text, usually in the references. This can be caused by a variety of reasons such as copying-and-pasting from another file, file transfers, etc. Please review your text prior to submission to make sure it reads correctly.

## A.2 Preparing Graphics

1. Accepted image file formats: TIFF (.tif), JPEG (.jpg).
2. Scalable vector formats (i.e., SVG, EPS and PS) are greatly preferred.
3. Application files (e.g., Corel Draw, MS Word, MS Excel, PPT, etc.) are NOT recommended.
4. Images created in Microsoft Word using text-box, shapes, clip-art are NOT recommended.
5. IMPORTANT: All fonts must be embedded in your figure files.
6. Set the correct orientation for each graphics file.

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