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DEDICATED DATA MANAGEMENT SYSTEM FOR UNIVERSITY DIDACTIC PROCESSES

Sławomir KOCZUBIEJ[1], Marzena NOWAKOWSKA[2], Paweł STĄPÓR[3*], Paweł ŚWIETLIK[4]

[1] Kielce University of Technology, Faculty of Management and Computer Modelling; slawomir.koczubiej@tu.kielce.pl, ORCID: 0000-0003-0423-6064
[2] Kielce University of Technology, Faculty of Management and Computer Modelling; spimn@tu.kielce.pl, ORCID: 0000-0002-6934-523X
[3] Kielce University of Technology, Faculty of Management and Computer Modelling; stapor@tu.kielce.pl, ORCID: 0000-0002-2345-1707
[4] Kielce University of Technology, IT Centre; pswietlik@tu.kielce.pl, ORCID: 0000-0002-3970-6620
* Correspondence author

Purpose: The objective of the work is to develop and implement the original concept of Repository of Didactic Processes Data (RDPD) for universities. The task of the Repository is to handle formally organised content in a digital form, covering resources created in connection with didactic processes, and the origin of which is a university community. These data should be: as complete as possible, available on the Internet at any time and easy to find and retrieve, stored in commonly used formats, contain a clear indication of the stored resources, without any costs for the user downloading them.
Design/methodology/approach: The concept of the Repository was developed on the basis of the results of consultations with the academic community – its primary target audience. Comments from the representatives of the Repository future main users were taken into account. An analysis of the existing available repository systems in terms of their functionality, adaptability to the specificity of data, and popularity was carried out in order to select the solution that could be the foundation for RDPD. Then, the following tasks were undertaken in the environment of the selected system: adapting the data schema developed for RDPD, the implementation of the operations of loading, browsing, and searching of data, and user management.
Findings: As a result of research and analyses, DSpace was proposed as the basis for the RDPD system. The logical metadata layers as well as the technical implementation of the proposed Repository in the DSpace system were elaborated.
Practical implications: The implementation of the RDPD system may significantly facilitate and support the university management process.
Originality/value: There are many initiatives regarding institutional repositories within the higher education sector. However, there is no institutional repository dedicated strictly to the storage and management of data generated by university educational processes. The developed repository is the solution to the problem.

Keywords: institutional repository, data management, higher education didactic processes, software customisation, DSpace.

Category of the paper: Conceptual paper, Case study.

1. Introduction

A repository is a type of digital library designed for permanent storage, preservation and sharing of materials in the form of disk files containing resources such as: documents (books, scientific articles, or reports), data from various fields of activity (especially scientific), photographs, graphics (designs, diagrams), computer programs, films, and audio files. The repository content may be originally digital or from a physical medium that has been digitised. Four repository types can be distinguished (Armbruster, Romary, 2010): subject-based repository, research repository, national repository system and, institutional repository IR.

Institutional academic repositories play a special role. Most of them are intended to handle library resources (Kabir Khan, Sheikh, 2022) or to manage information on research works and projects, as well as scientific publications of academics (Hixson, Cracknell, 2007). Academics submit their work to IR for archiving, and the types of materials submitted are generally journal articles and publications in conference proceedings (Ukwoma et al., 2019; Sabharwal, Natal, 2017; Patel, D., Patel, U., 2013). The repositories, apart from storing and providing access to digital resources, are also used to create statistical summaries useful in planning the scientific development of the university and its individual units, and may serve as a platform that brings together the academic community. In a small number of cases, data generated in the didactic processes by the university, faculties, or university employees can also be found, and they basically refer to teaching or learning materials and study programs as well (frequently along with syllabi) (King et al., 2008; Sarker et al., 2010; Asadi et al., 2019). Institutional repositories of the higher education sector, either dedicated to research output or to teaching and learning materials, are usually Open Access, rarely with limited or authenticated access to selected user groups.

In Polish conditions, the solutions used in the management of electronic documents collected, processed and made available to institutional academic repositories were presented in the book of Szafrański (2019). The Polish achievements in the field are relatively rarely presented in literature. Nahodko (2007) discussed the issue relating to the creation of digital libraries and institutional repositories, focusing, however, his attention on the library aspect of the systems. Sapa (2009) considered the same aspect; he presented a study on the functionality of Polish academic libraries in creating, maintaining, and providing free access to e-prints of parent university academic staff. Koperwas et al. (2017) and Rybinski et al. (2017) described

the same university's knowledge base system, implemented at the Warsaw University of Technology. The solution combines the functionality of an institutional repository with the functionality of a current research information system. In the monograph edited by Tadeusiewicz (2021), a digital repository idea was related to the context of distance learning.

To the best of the authors knowledge, there is no publication on repositories relating to resources other than scientific or learning materials, in particular those derived from didactic processes.

The data generated in the university didactic processes are not only teaching materials and study programs. They may also include transcripts of records, theses, orders of authorities, reports for accreditation bodies, study plans, etc. The data can be accessed from various university websites and at different levels of the university website's structure. That is why it is sometimes difficult to find them. In addition, some materials from didactic processes have only a paper form. After fulfilling their role of providing current information, some materials are not kept. The archival value of all such data is significant because they can be used in the organisation of work and university management in the context of educational needs. In particular, they can provide materials and templates necessary for reports and auditing procedures (e.g. accreditation ones). On the basis of archival data on students' performance, it is possible to create summaries, diagnose the situation, or search for signals of disturbances in teaching processes. An insight into past syllabi and study programs enables analysing and tracking development trends in the educational process (e.g. disappearance and creation of study courses or subjects). The study module creators can compare past and current programs or modules in different university units; find gaps, and offer new programs or modules. Taking into account the resulting resources, all such data should be stored in a single institutional repository with a logical and intuitive structure.

The authors undertook the task of building a repository of data derived from the didactic processes for Kielce University of Technology (KUT), Poland, as part of the KMD project entitled "National Data Warehouse. Universal infrastructure for storing and sharing data as well as for efficient processing large data volumes in HPC, Big Data, and artificial intelligence models", Intelligent Development Operational Program, Agreement: POIR.04.02.00-00-D010/20-00. Work on the Repository of Didactic Processes Data system began in April 2021.

The objective of the work is to develop and implement the original concept of Repository of Didactic Processes Data (RDPD) for universities. Work on the Repository began in April 2021. The repository's resources are intended to provide information that is valuable to university stakeholders of various types: university authorities, academic teachers, and administration. Therefore, these data should be: as complete as possible, available on the Internet at any time and easy to find and retrieve, stored in commonly used formats, contain a clear indication of the stored resources, without any costs for a user downloading them. The methodology employed in the work covers conceptual and technical stages of the project. In the conceptual stage, the Repository data structure was elaborated and the analysis of the

existing repository systems in order to select the solution that could be the foundation for RDPD was carried out. In the technical stage, key elements of RDPD installation and configuration, the metadata structure, RDPD data and users management were implemented. While working on the system, the principle was that the content stored in the institutional repository is both accumulated and maintained indefinitely (Crow, 2002).

2. Institutional university repository systems

There are many repository systems available on the market that universities can use. They are both free and commercial software. A list of university repositories can be found on the OpenDOAR institution's website (OpenDOAR, 2021). The service is the product of a joint project between the University of Nottingham (UK) and Lund University (Sweden). It is currently managed by the University of Nottingham. The system defines the following repository categories (available through *Advanced Search*): *Repository Type* (5 values; among them: *Institutional*), *Software Name* (the software used to create the repository; 32 values), *Content Types* (11 values; among them: *Learning Objects*), *Subjects* (8 values). In July 2021, 5,079 academic repositories were registered by OpenDOAR, and most of them were classified into more than one category. Practically, all 5,068 systems have been assigned to the institutional repository type.

Figure 1 shows the frequency of each content type in a group of institutional academic repositories. Figure 2 illustrates the global popularity of the software used to create repositories. The classifications considered in OpenDOAR can hardly be matched with the tasks and content intended for RPDP. It seems that with the assumed functionality of the Repository, *Learning Objects* is the closest in terms of content type. According to OpenDOAR, there were 785 academic institutional repositories offering the Learning Objects content type (July 2021). The scale of software usage to build such repositories is shown in Figures 3 and 4, respectively, in the world (total number of classified repositories $N = 785$) and in Poland (total number of classified repositories $N = 18$).

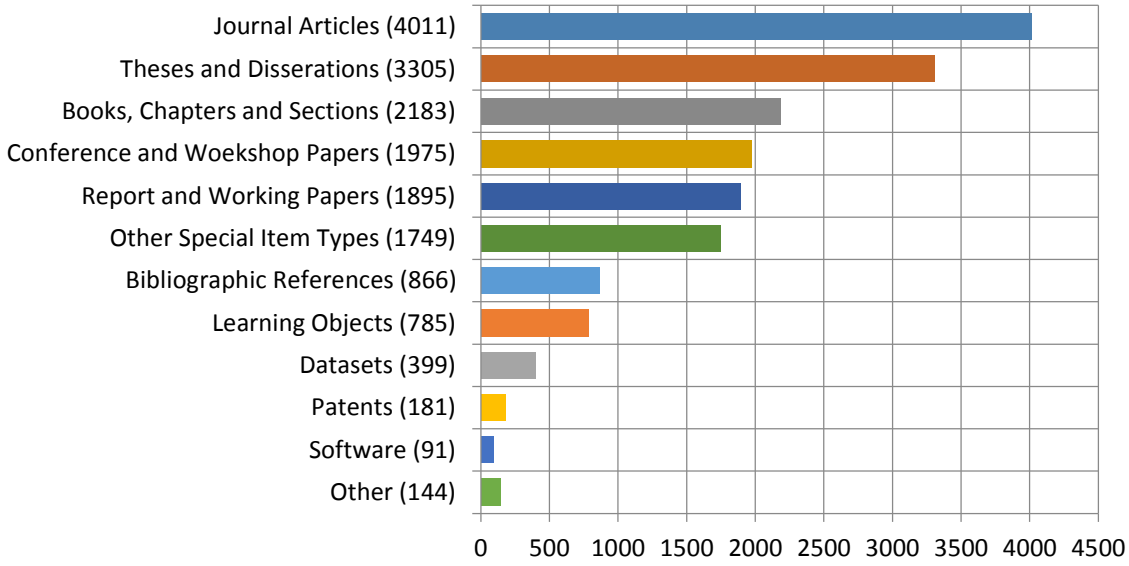

Figure 1. The frequencies of thematic content in academic institutional repositories.
Source: OpenDOAR.

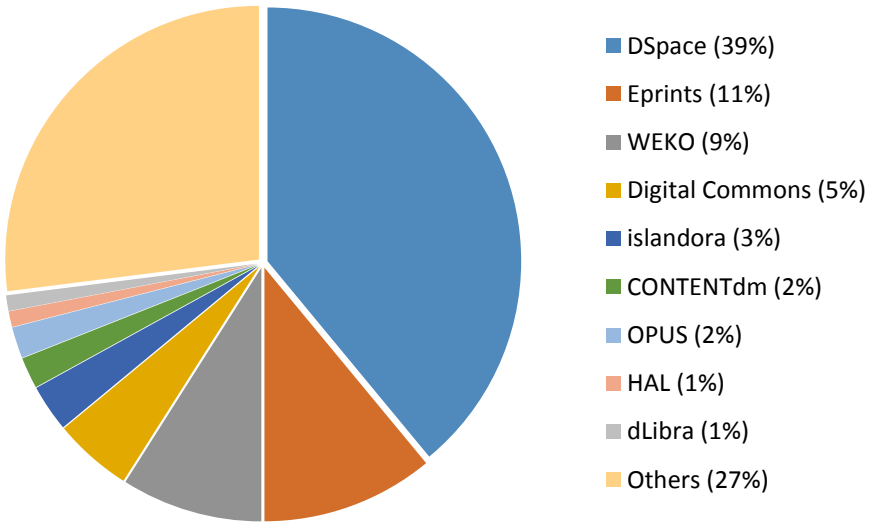

Figure 2. Distribution of software usage in institutional academic repositories.
Source: OpenDOAR.

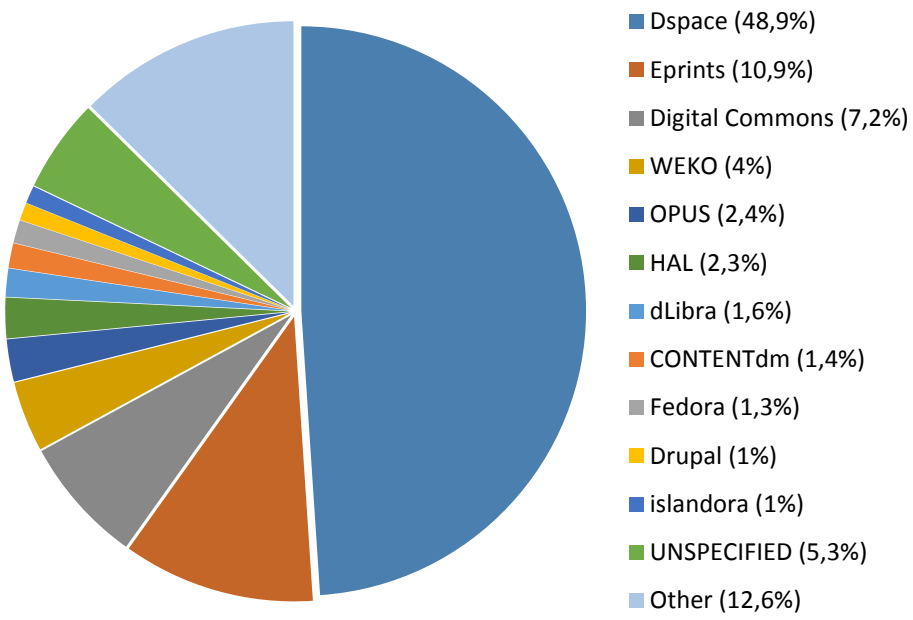

Figure 3. Distribution of software usage in institutional academic repositories with *Learning Objects* classification.

Source: authors' own elaboration on the OpenDOAR website basis.

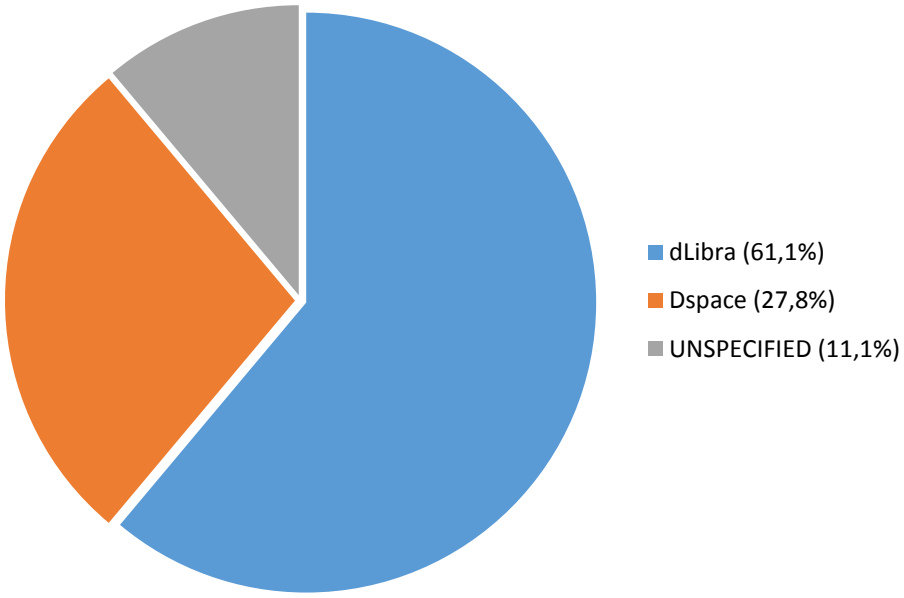

Figure 4. Distribution of software usage in institutional academic repositories with *Learning Objects* classification in Poland.

Source: authors' own elaboration on the OpenDOAR website basis.

DSpace (DSpace, 2022) is the most popular repository system in the considered functionality aspect, both in terms of institutional repositories in general and those relating to *Learning Objects* content. In the latter case, DSpace's worldwide usage reached 50%.

The second is EPrints, but its popularity is several times lower than that of DSpace. In Poland, DSpace takes second place, overtaken by dLibra (dLibra, 2022), which is the domestic, commercial product of PSNC (Poznan Supercomputing and Networking Center). Neither Dataverse (The Dataverse Project, 2022) nor Zenodo (Zenodo, 2022) has been specified in the OpenDOAR resource. Taking into account the above, DSpace 7.2 was chosen as the base software for the RDPD system.

DSpace is open source software. It was developed at MIT in collaboration with Hewlett Packard Laboratories, originally as a repository platform for MIT research results. It enables the indexing, storage, and sharing of digital materials and their long-term preservation. It was built according to the Open Archival Information System (OAIS) reference model (Lee, 2010). The main feature of DSpace is to organise the content presentation in a hierarchical structure (tree) by defining communities, collections, and items, and the relationships (associations) between them (DSpace 7.x Documentation, 2022). The schematic structure of the repository is presented in Figure 5. DSpace collects and stores digital documents in a wide variety of disk file formats: *.pdf, *.docx, *.jpg, *.tif and others. Users have access to pages for individual items (described by metadata) containing files to be downloaded. The software allows developers to customise its interface.

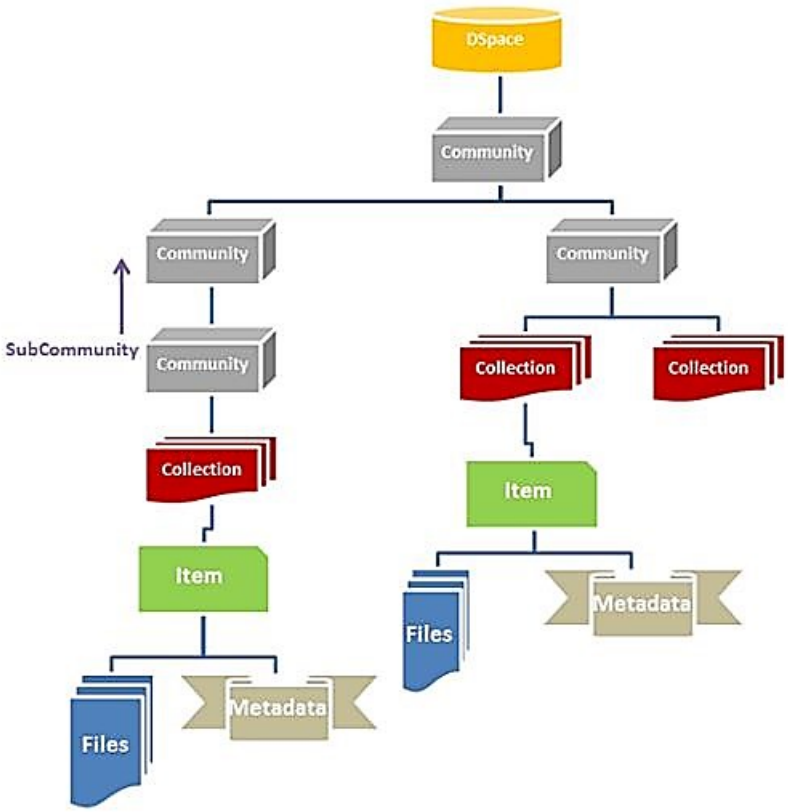

Figure 5. The schematic structure of the DSpace repository system.
Source: https://wiki.lyrasis.org/display/DSDOC7x/Functional+Overview.

3. RDPD metadata schema

Metadata is structured information that describes, explains, locates, and otherwise facilitates finding, using, or managing an information resource. Metadata is often referred to as "data about data" or "information about information." Metadata provides information enabling the data organization of (e.g. documents, graphics files, data sets), concepts (e.g. classification schemes), and reference to real world elements (e.g. people, organizations, places, images, products). A metadata schema is a labelling, tagging, or coding system used to record information about resources or to structure descriptive metadata. A metadata schema establishes the data elements and rules for using data elements to describe a resource. Each repository system is defined by a metadata schema that describes its database. Dublin Core (Dublin Core Metadata Innovation, 2022; Kurtz, 2010), denoted as *dc*, is the standard schema in DSpace. The schema is mainly used to describe scientific publications; to a slightly lesser extent for the description of learning objects (Bueno-de-la-Fuente et al., 2009; Das, 2018). In the RDPD system, *dc* can only be partially used to characterise stored documents.

It has been assumed that the documents generated by the university didactic processes are defined by means of study plans, study programs (especially syllabi), student achievements, orders of university authorities and departments related to the realisation of the educational mission. Their current versions are usually made available through various systems operating at a given university. The task of the developed RDPD system is to archive these resources. Contrary to the original DSpace concept, in which the structure of the system follows the organisational structure of an institution, RDPD is intended to reflect the classification structure of university documents.

In the initial stage of the RDPD development, consultations were carried out in Kielce University of Technology academic community, with its main target users, i.e. academic teachers and vice-deans for student affairs and teaching in all the faculties. The consultations aimed at presenting the concept of the Repository, gaining acceptance, and receiving feedback on expectations regarding the functionality of the system, especially regarding the scope of resources stored in the Repository.

The schematic RDPD structure is presented in Table 1. There are six communities at the highest level of the hierarchy. They reflect the most general university didactic document classification. Communities contain collections that are groups of thematically related content. For example, the *Thesis* collection relates to engineering, bachelor and master theses of all university students. Each collection is composed of items that are the basic archival elements of the Repository. Each item is owned by one collection, and it is described by metadata fields. The metadata schema elaborated by the authors is denoted by *rdpd*, while the DSpace default metadata schema remained unchanged as *dc*. Each field is assigned to the metadata schema to

which it belongs. In the table, the metadata for an item in the collection are marked with a tick. For example, there are the following metadata fields for items in the *Thesis* collection: *dc.date.issued* (date of diploma submission), *rdpd.osoba.student* (diploma author – student), *rdpd.osoba.opiekun* (diploma supervisor – academic teacher), *rdpd.osoba.recenzent* (diploma reviewer – academic teacher), *rdpd.poziomKsz* (education cycle), *rdpd.slowaKlu* (diploma keywords), *rdpd.studia.kierunek* (student's field of study), *dc.title* (diploma title), *rdpd.wydzial* (faculty name), *rdpd.studia.tryb* (study mode). As soon as the item is given its metadata (in the above example, the information about the diploma of a certain student), the data connected with the item are loaded to the repository. The data are a set of bitstreams. Bitstreams are streams of bits, usually ordinary disk files. For example, in the case of the student thesis these can be: the diploma information page (a *pdf* format file), the content of the diploma (a *pdf* format file), the diploma appendix (e.g. a program source code in a *txt* format file), the content of the diploma reviews (*pdf* format files; in KUT, the reviews are prepared by a reviewer and a supervisor).

Table 1.
The schematic RDPD structure

		Communities	Students' academic performance		Fields of study			Orders of the university authorities				Teaching activity organization			Students' accomplishment		Various others		
		Collections	Thesis	Course credit protocols	Applications for the creation of field of study	Programs of study	Assessment reports of field of study	Rector's orders	Deans' orders	Resolutions of university senate	Resolutions of faculty councils	Full-time study timetables	Part-time study timetables	Reports on the realisation of teaching loads	Individual student's accomplishment	Student teams' accomplishment	Student research clubs	Erasmus+ program	Promotional activities
RDPD field name*	**Field description**																		
dc. date.issued	Date of the respective document/event		✓		✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓			✓
rdpd. dyscyplinyNau	Scientific discipline					✓													

Cont. table 1.

rdpd. formaZaj	Form of teaching		✓														
rdpd. jednostka	University department											✓					
rdpd. klasyfikacja	Accomplishment classification												✓	✓			
rdpd. osoba.student	Student name	✓											✓				
rdpd. osoba.nauczyciel	Teacher name											✓					
rdpd. osoba.opiekun	Supervisor name	✓													✓		
rdpd. osoba.recenzent	Reviewer name	✓															
rdpd. nazwaKol	Research club name														✓		
rdpd. nrUch	Resolution number								✓	✓							
rdpd. nrZar	Order number						✓	✓									
rdpd. opis	Accomplishment description												✓	✓			✓
rdpd. organizator	Activity organiser																✓
rdpd. poziomKsz	Education cycle	✓	✓	✓	✓	✓											
rdpd. przedmiot.kod	Subject code		✓														
rdpd. przedmiot.nazwa	Subject name		✓														
rdpd. rodzaj	Type of action																✓
rdpd. rokAka	Academic year		✓		✓						✓	✓	✓			✓	
rdpd. rokNasWiz	Year of the next assesment					✓											
rdpd. semestr.nazwa	Semester name										✓	✓					
rdpd. semestr.numer	Semester number		✓														
rdpd. slowaKlu	Keywords	✓															
rdpd. studia.kierunek	Field of study	✓	✓	✓	✓	✓						✓					
rdpd. studia.profil	Profile of study			✓	✓	✓											
dc. title	Title of the respective document/event	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
rdpd. wydzial	Faculty name and its acronym	✓	✓	✓	✓	✓		✓		✓	✓	✓	✓			✓	✓	

Cont. table 1.

rdpd. zespol	Team													✓				
rdpd. studia.tryb	Study mode	✓	✓															

* selected fields are taken from the DSpace *dc* metadata schema (*dc* prefix), the other fields are defined by the authors (*rdpd* prefix)

Source: authors' own elaboration.

4. The key elements of RDPD installation and configuration

Many institutional academic repositories are built on the basis of the DSpace system. There are non-standard implementations among them. In a few publications, the authors share their experiences in this regard (Prasad, 2006; Winter, Bowen-Chang, 2010; Ahammad, 2019; Temirbekov et al., 2019). The non-standard (custom) implementation of DSpace was carried out for the RDPD system, as required by the authors' metadata schema. The DSpace test installation for RDPD was prepared on the virtual server of Kielce University of Technology, Poland, running under the GNU/Linux operating system, equipped with a quad-core processor, 8 GB of operating memory, and 200 GB of disk space, according to the instructions provided in the DSpace documentation (DSpace 7.x Documentation, 2022). The following issues were to be addressed in the customisation process: adding new elements to the database, input forms for submission processes, indexing, displaying search results, and data uploading and downloading.

DSpace is software with a layered architecture in which logical layers are separated: data layers (database and search system), business logic (DSpace backend) and presentation (DSpace frontend). The RDPD deployment required the installation and configuration of the operating system and additional applications, as listed below:

- in the data layer: PostgreSQL database management system version 11.x with pgcrypto extension, Apache search platform Solr 8.x,
- in the business logic layer: Java JDK runtime environment (OpenJDK version 11), DSpace application building tools (Apache Maven, Apache Ant), and Apache Tomcat 9 application container,
- in the presentation layer: Node.js 14.x runtime environment, DSpace-UI user interface application building and management tools (NPM, Yarn), and PM2 process manager.

In addition, a PROXY server has been installed and configured: the Apache HTTP Server, which allows the implementation of an encrypted connection.

Adapting DSpace to the needs of the RDPD system required modifying configuration files responsible for the following activities: organization of cooperation with the database, file store customisation, backend location settings, user interface modification, and configuration.

The concept of the RDPD system is reflected in the user interface, available in Polish and English. However, the metadata values (such as the names of communities, collections, items, and item descriptions) presented on the RDPD websites are in Polish, as shown in Figure 6; the English equivalents of the communities are given in commentary frames.

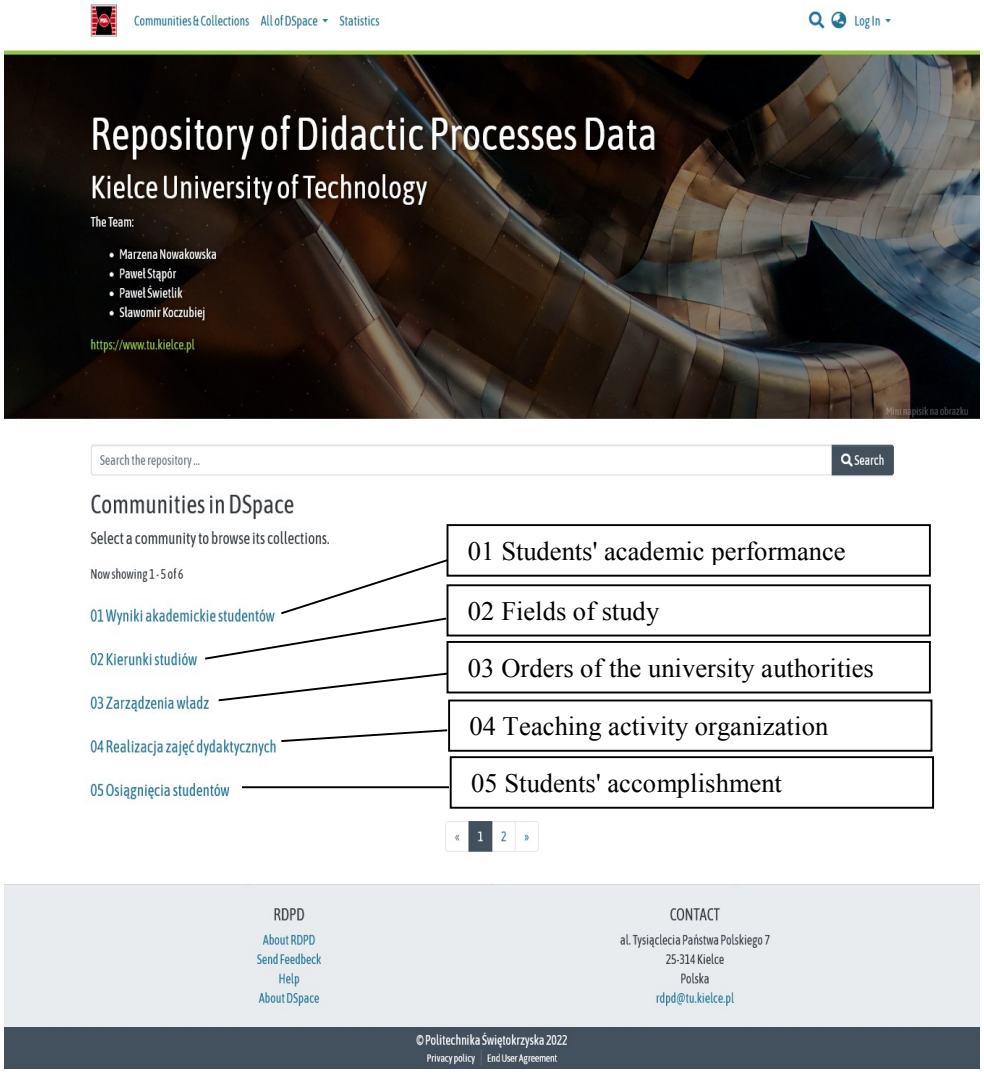

Figure 6. The home page of the RDPD system.
Source: authors' own elaboration.

5. Implementation of the metadata structure

The implementation of the RDPD metadata structure involved the development of authors' own solution concepts and their realisation by working out some components of the system. Three key steps are described below.

A. Creating and importing the dedicated Repository structure: communities and collections within them. The custom repository structures, defined in the *file.xml*, were introduced into the system in a batch mode using the command:

[dspace-dir]/dspace structure-builder –e <user> -f [path]/file.xml –o [path]/output_file.xml

where *dspace-dir* stands for the home directory of DSpace installation.

DSpace assigns handles not only to each digital object in the repository, but also to each community, sub-community, and collection. The imported custom structures: communities and collections along with the handles created for them are saved in the output file *output_file.xml*.

B. Creating the custom metadata schema. Dublin Core (*dc*) is the default DSpace metadata schema. The *dc* structure is not useful for the concept of the RDPD schema. The developed metadata schema, saved in the *rdpd-types.xml* file, is implemented in RDPD by the following import to the system:

[dspace-dir]/dspace registry-loader –metadata [path]/rdpd-types.xml

For each metadata in the schema, the following elements had to be specified: the name of the schema to which it belongs [*name*], the identifier [*element*], and, optionally, the qualifier [*qualifier*], which specifies the use of the metadata. An annotation of the field can also be included, which is a kind of comment for the designer [*scope_note*].

C. Developing submission forms for collections. Because each collection requires a different set of metadata elements, a submission form was defined for each collection. The base forms for the collections are specified in the *submission-forms.xml* file. All base form items on the DSpace system websites are presented in English, which is the default language. Implementing custom RDPD forms in English requires adding their definitions in the *submission-forms.xml* file. However, a separate forms file has to be created when a language version is created. For the Polish language, the *submission-forms_pl.xml* file was prepared, in which all the labels of the base forms have their Polish equivalents. For any other language version, the code of the appropriate language should be entered instead of *pl* in the file name, according to the ISO 639-1 list (ISO 639 - Language codes, 2022). Each form defined in the file has a unique name.

D. Developing an action path when adding new records – workflow. In this action, one defines how the process of adding a new record to a specific collection will be carried out. The definitions are stored in the *item-submission.xml* file. Each process is assigned a unique identifier and associated with a collection. The following steps constitute the process:
   - the specification of the form (a unique name taken from the *submission-forms.xml* file – see point C) to be displayed on the screen (and handled by this process),
   - enabling the user to enter a license (optional),
   - providing the user with the ability to upload files.

   Both the number and the order of steps can be freely modified. The same form can be used by different processes.

Any changes to the configuration files require restarting the Tomcat server (refreshing the information about the new elements in the DSpace structure).

6. RDPD data management

The system is prepared for the user to perform the following tasks: entering data according to the metadata schema (Table 1), data editing, browsing repository contents and searching for information, managing users.

Entering a new item involves filling in the corresponding metadata form and loading files (bitstreams) constituting the data for the item. Figure 7 presents the form for the *Full-time study timetables* item. A necessary action of registering any item in the system is to upload bitstreams to the repository (*Drop files to attach them to the item*). Following the DSpace assumptions (DSpace 7.x Documentation, 2022), the RDPD system accepts a variety of disk file formats like, for example: *.docx, *.xlsx, *.pdf, *.avi, *.zip, *.gif, *.html.

Data editing is implemented in a different form than for adding data – compare Figures 7 and 8. In the submission form, a specific data format can be enforced, e.g. in the case of the *dc.date.issued* field, only numeric data corresponding to the successive components of the date (year, month, day) can be entered. On the other hand, in the edit form, the field presenting this data has a text format; changing the value to any text overwrites the existing valid date. The same remark applies to fields with similar restrictions, such as a drop-down list. Therefore, it is the system administrator's responsibility not to allow data to be changed in the edit mode to inappropriate values.

The browsing in DSpace can take place at the main level concerning all repository resources, as well as at the community and collection levels. Indexes defined for selected fields of the metadata schema are used to support browse operations. There are two types of indexes in the DSpace system:

- *item*; it supports all items at a specific level (whole repository, community, collection), sorted by the field indicated in the index. The displayed data refer to those items for which the indexed field is not empty,
- *metadata*; if the index is of metadata type, the unique values of the indexed field are displayed, along with information on how many items there are that have the given value at a certain level of the repository structure (whole repository, community, collection).

Only two RDPD elements map with existing Dublin Core elements in the browse option: *dc.date.issued* and *dc.title*. Thus, custom metadata elements for browsing operation have to be added by the DSpace administrator. Here, the *rdpd.wydzial* field (referring to a university faculty) was introduced. Such an operation requires handling with one of the following configuration files:

- *[dspace-backend]/config*/*dspace.cfg* (global settings),
- *[dspace-backend]/config/local.cfg* (local settings, overrides global settings, recommended for customisation); definition of indexes,

where: *[dspace-backend]* stands for the home directory of the DSpace application's business logic layer software installation.

After the modification, the indexes should be refreshed with the command:

[dspace-backend]/bin/dspace index discovery –b.

The browse buttons corresponding to the newly defined indexes appear automatically on the DSpace website. When an index is deleted, the corresponding button is also automatically deleted.

The search option is available from any level of the repository; if the user does not enter restrictions on a selected community or collection, it applies to the resources of the entire repository. Search indexes are configurable, which additionally enables the definition of a contextual filtering capability by selected metadata fields. Such an operation requires a modification of the configuration file:

- *[dspace-backend]/config/spring/api/directory/discovery.xml*

and refreshing the indexes with the command:

[dspace-backend]/bin/dspace index discovery -b.

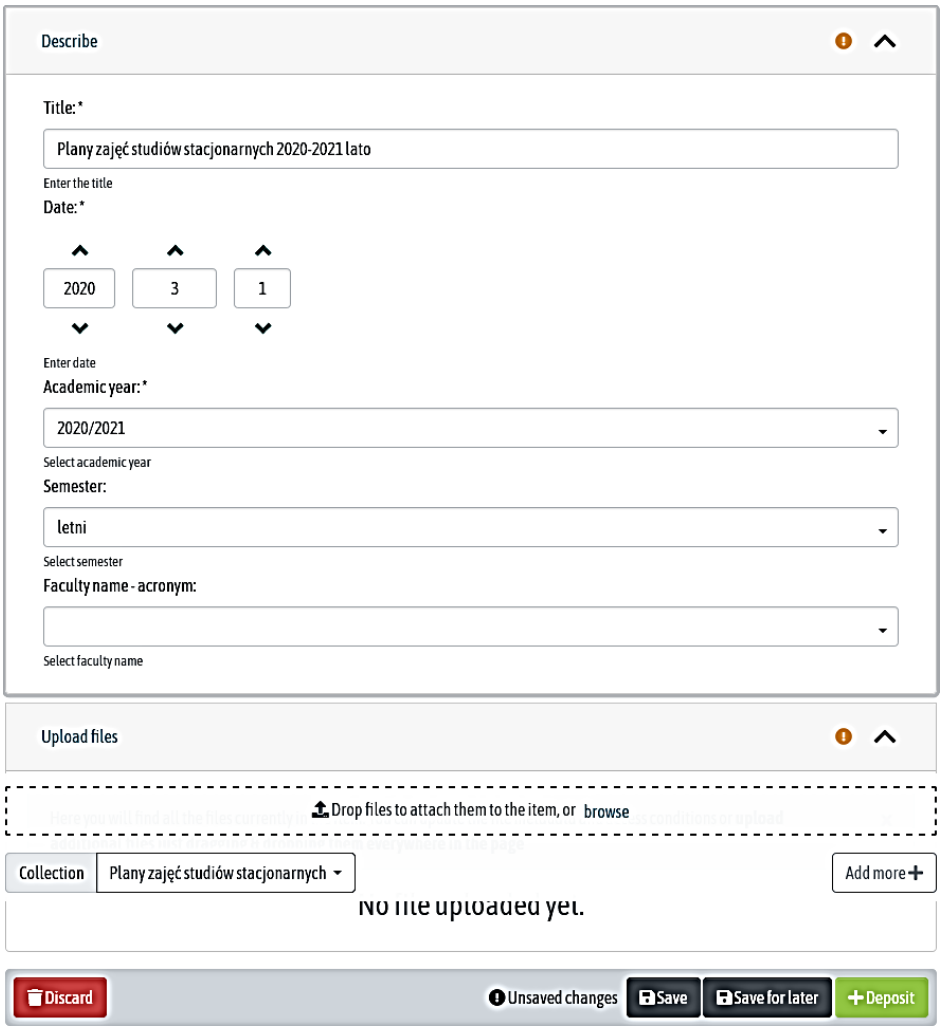

Figure 7. The RDPD submission form for the metadata of the *Full-time study timetables* item; in the example, the timetable is obligatory for the whole university, therefore the box *Faculty name-acronym* is empty.

Source: authors' own elaboration.

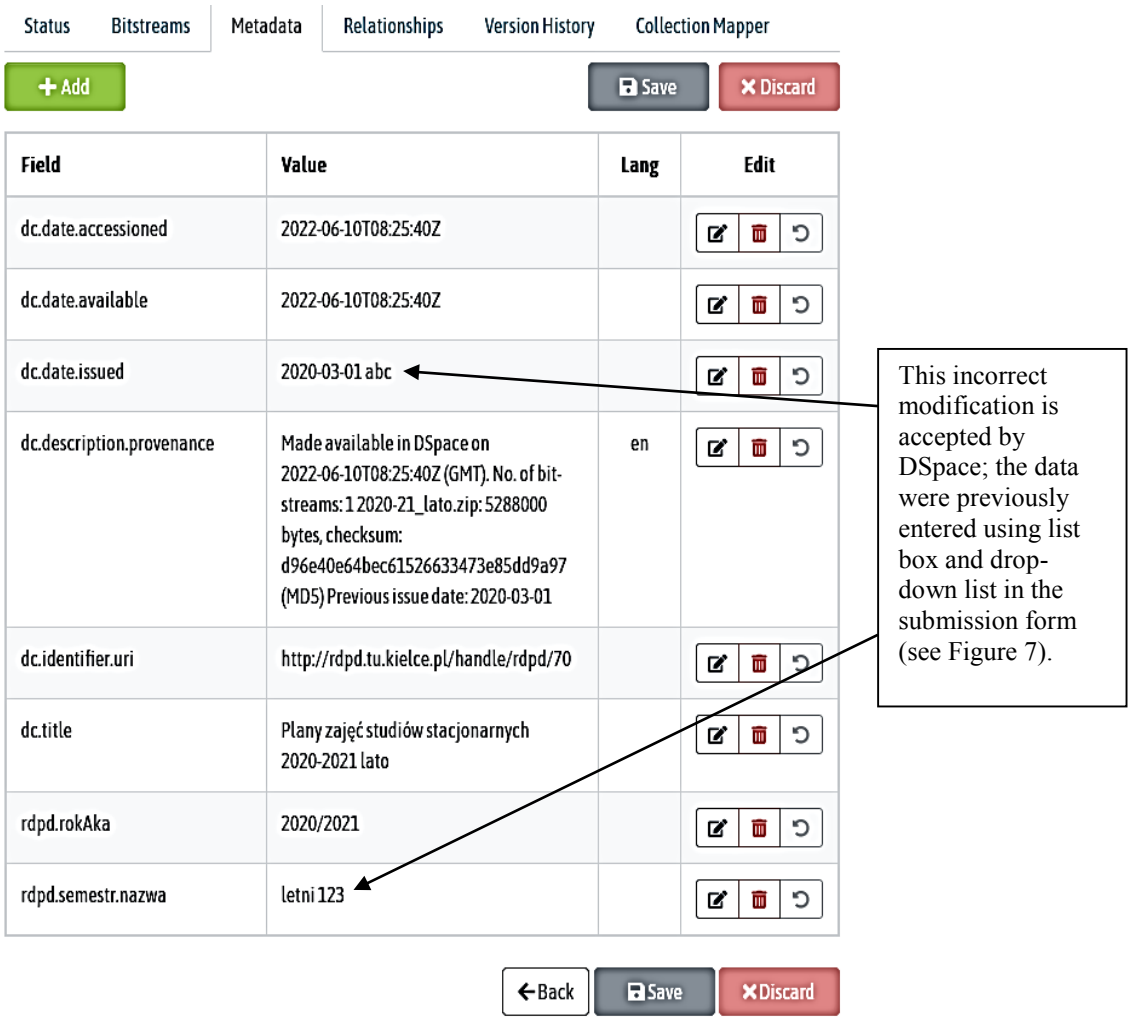

Figure 8. The RDPD edit form for the metadata of the *Full-time study timetables* item; the two fields are incorrectly modified, which is indicated by arrows.

Source: authors' own elaboration.

7. RDPD users management

RDPD user groups have been defined according to their roles in didactic processes:

- *Anonymous* relates to any web surfer, a student in particular.
- *Academic* relates to university teachers.
- *Dean* relates to deans and vice-deans of all university faculties (departments).
- *Rector* relates to a rector and vice-rectors.
- *Administrator* relates to persons responsible for managing the system (administrators).

The administrator has full rights (full access) to all elements of the Repository structure.

All other user groups have only the right to read communities, collections, items, and selected bitstreams. With regard to bitstreams, the read permission depends on the group to which the user is assigned. Table 2 compiles the list of permissions proposed for RDPD.

Table 2.
The list of permissions available in the RDPD system

Collection	Bitstream	Anonymous	Academic	Dean	Rector	Administrator
Thesis	Thesis abstract	✓	✓	✓	✓	✓
	Thesis content		✓	✓	✓	✓
	Thesis review			✓	✓	✓
Course credit protocols	All bitstreams			✓	✓	✓
Applications for the creation of field of study	All bitstreams		✓	✓	✓	✓
Programs of study	All bitstreams	✓	✓	✓	✓	✓
Assessment reports of field of study	All bitstreams			✓	✓	✓
Rector's orders	All bitstreams	✓	✓	✓	✓	✓
Deans' orders	All bitstreams	✓	✓	✓	✓	✓
Resolutions of university senate	All bitstreams	✓	✓	✓	✓	✓
Resolutions of faculty councils	All bitstreams	✓	✓	✓	✓	✓
Full-time study timetables	All bitstreams	✓	✓	✓	✓	✓
Part-time study timetables	All bitstreams	✓	✓	✓	✓	✓
Reports on the realisation of teaching loads	All bitstreams			✓	✓	✓
Individual student's accomplishment	All bitstreams	✓	✓	✓	✓	✓
Student teams' accomplishment	All bitstreams	✓	✓	✓	✓	✓
Student research clubs	All bitstreams	✓	✓	✓	✓	✓
Erasmus+ program	All bitstreams	✓	✓	✓	✓	✓
Promotional activities	All bitstreams	✓	✓	✓	✓	✓

Source: authors' own elaboration.

8. Discussions

University institutional repositories are mainly systems created for the management of digital scientific documents (articles, PhD, MA thesis, reports) whose authors are researchers employed at universities providing the repositories. Repositories are maintained by higher education units independently or by consortia formed by such units. The access to didactic materials manifests itself in rendering university press books, textbooks and other learning materials along with making them adopted to use in e-learning.

Brief information on example repositories around the world and in Poland, the content of which is classified, among others, as *Learning Objects* is given below. The information is limited to the didactic contents of the systems.

- MIT Libraries (MIT, US); http://dspace.mit.edu/, based on the DSpace system. The repository provides access to: diploma theses, archived courses (included are: leading teachers, syllabuses, assignments and solutions to assignments). Materials for students are available as resources embedded in the repository or at other addresses through links.
- Apollo (University of Cambridge, UK); https://www.repository.cam.ac.uk/, based on DSpace system. Instructional materials and course notes are available.
- E-Prints Complutense (Complutense University of Madrid, Spain); https://eprints.ucm.es, based on the EPrints system. Teaching resources, mainly in *pdf* formats, can be downloaded by a user.
- Digital Library of Wroclaw University (Wroclaw University, Poland); https://www.bibliotekacyfrowa.pl/dlibra, based on dLibra. Educational materials contain digital copies of course lectures, textbooks, bachelor's dissertations and master's and PhD theses to be used during educational processes at the University. The materials are part of the university main library resources.
- University of Lodz Repository (University of Lodz, Poland); https://dspace.uni.lodz.pl, based on DSpace. Didactic materials are offered as *pdf* documents. The repository contains also publication of the university academic clubs.

University institutional repositories are, as a rule, dedicated to managing the scientific output of employed scholars. In terms of didactic processes, repositories provide only learning (teaching) materials and, often, to a limited extent. In most cases, the repositories are developed on the basis of ready-made systems, both in the sphere of front-end organization and metadata schema (international standard: Dublin Core). The authors have not found a concept or solution similar to the one presented in the study. Although the discussed RDPD system is also an adoption of the well-known DSpace solution, its development required a completely different concept, an approach to the metadata schema, and the maintenance.

9. Conclusions

It is likely that in the next few years the concept of institutional repositories will develop both in a convergent and a divergent way. The idea of open-source software, in particular, has gained increasing attention in the higher education sector over the last several years. One of the most commonly used software is DSpace, on the basis of which universities have established standard institutional repositories. However, there are few implementations in which the system is used for custom (non-standard) solutions.

In the study, the original (custom) concept of Repository of Didactic Processes Data (RDPD) for universities was presented. The Repository was developed and implemented in Kielce University of Technology (Poland) on the basis of the DSpace system. The purpose of the Repository is to handle formally organised content in a digital form, covering resources created in connection with the didactic processes, and the origin of which is a university community. The following tasks were undertaken in the environment of DSpace, the system chosen for RDPD development: adapting the data schema developed for RDPD and the implementation of the operations of loading, browsing, and searching of data as well as user management. The logical metadata layers as well as the technical implementation of the proposed Repository in the DSpace system were elaborated. In order to introduce the authors' idea, the entire work required in-depth study of the DSpace documentation, the installation of supporting software, modification of configuration files. In the study, the key elements of the development of the RDPD system were discussed.

The RDPD system was prepared for Kielce University of Technology, Poland, but, after verification of the test version, it can be made available to other universities in Poland. Users can work with the Repository developed according to the proposed schema by entering their own metadata and data into it.

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