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iLed

Innovating Learning Design
in Higher Education

Examination of interoperability requirements

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Aim

In order to support further innovations within BDP tool and enable efficient use of HEI systems we examined the interoperability possibilities between BDP tool and other HEI systems.

Interoperability in the context of learning design and educational technologies refers to the ability of different systems, platforms, tools, and content to work together seamlessly. It ensures that digital learning resources, software applications, and technologies can exchange data, communicate effectively, and function cohesively without compatibility issues.

We analysed the integration and interconnection of BDP tool with other tools/systems used at HEIs within iLed activity “A.2.3.1. Analyzing the necessary interoperability requirements“. As a basis for this activity, we identified HEIs specific information systems (listed below).

System	Aim/Description
Curriculum Management System	designed to streamline and manage all aspects of curriculum development, delivery, assessment, and evaluation within educational institutions. It serves as a centralized hub where educators, administrators, and other stakeholders can collaborate, plan and perform curriculum-related tasks effectively.
Learning Management System	designed to facilitate the administration, delivery, tracking, and management of courses and training programs. It serves as a centralized hub where educators, trainers, and administrators can create, organize, deliver, and track learning materials and activities for learners.
Student Information System	designed to manage and organize student-related data within educational institutions. It serves as a centralized database where administrators, educators, students, and parents can access and update information pertaining to student demographics, enrolment, academic records, and other relevant details.
Human Resources Management	designed to streamline and manage various aspects of human resource management specific to the needs of universities, colleges, and other higher education organizations. It encompasses a wide range of functions related to personnel administration, recruitment, payroll, benefits management, performance evaluation, training and development, and compliance.
Student Services	designed to manage and facilitate various support services and resources offered to students within educational institutions. The primary goal is to enhance the overall student experience by providing efficient access to essential services and promoting student success and well-being.
Library System	designed to manage and facilitate various functions and services offered by the library within the academic environment. It serves as a centralized hub for organizing, cataloguing, accessing, and disseminating library resources, as well as

	providing administrative tools for library staff to efficiently manage library operations.
Knowledge Recognition System	designed to identify and recognize knowledge or expertise possessed by individuals or groups within an organization. The primary goal is to capture, organize, and leverage the collective knowledge and expertise of employees or community members for various purposes such as problem-solving, decision-making, innovation, and learning.
Quality Assurance System	refers to a set of policies, procedures, and processes implemented to ensure and enhance the quality of education and academic programs offered by the institution. The primary goal is to maintain high academic standards, promote continuous improvement, and meet the needs and expectations of stakeholders, including students, faculty, employers, accrediting bodies, and the broader community.

Table 1: HEI specific information systems

Protocol for collecting data from iLed partners

For that purpose, we prepared the protocol for collecting data from iLed partners as follows.

1. Please fill the table “Interoperability Matrix”.

1.1. Identify information systems (*App 1, App 2, App3, ...*) used at your institution and classify it in categories (Curriculum Management System, Learning management System, Student Information System, Human Resources Management, Student Services, Library System, Knowledge Recognition System, Quality Assurance System).

1.2. Identify type of relation between each user information system used at your institution and BDP tool functionalities (specifically course meta data, learning design and analytics):

- User engagement - **U** (*without automatic data exchange*)
- Automatic data exchange – **A**

1.3. Identify relation direction:

- One way relation - **1** (only from one app to another)
- Two-way relation - **2** (from one app to another and reverse)

2. Please fill the table “Interconnection with BDP and additional recommendations for improvement/upgrade”

Analysis

Following the defined Protocol for collecting data all iLed partners (Goethe University, University of Oulu, Open University, School of Medicine, Faculty of Organization and Informatics) provided the data related to the systems they use at their institution in order to examine the possibilities for interoperability with BDP tool.

(Legend: **Goethe University**, **School of Medicine**, **Open University**, **University of Oulu**, **Faculty of Organization and Informatics**)

The Table 2: Interoperability Matrix presents the identified information systems used at each partner institution classified in categories (Curriculum Management System, Learning management System, Student Information System, Human Resources Management, Student Services, Library System, Knowledge Recognition System, Quality Assurance System).

All partner' institutions use different curriculum management systems such as Curriculum/Planet/Power BI/Peppi/O365 for staff/Schedule). Regarding the BDP functionalities, partners identified that the relation among curriculum management systems is possible at all levels (Course meta data/Learning design/Analytics) but the focus is on course meta data exchange.

Further, all partner institutions use Learning Management Systems, mostly LMS Moodle, while University of Oulu also use Exam (electronic exam system), Google Workspace for Education and Laturi (electronic theses). Regarding the BDP functionalities, partners identified that the relation among learning management systems is possible at all levels (Course meta data/Learning design/Analytics). The focus is on course meta data exchange and learning design data exchange.

Regarding the Student Information Systems, partner institutions use the following systems: QIS/LSF, Studomat, ISVU – Information System for Higher Education, Circe, Power Bi, Peppi, Tuudo (private), STIS – Student Information System. Regarding the BDP functionalities, partners identified that the relation among student information systems is possible at all levels (Course meta data/Learning design/Analytics) but the focus is on course meta data exchange.

Partner institutions also use different Human Resource Management Systems such as: Goethe Lerncampus LMS, Personnel, Success factors, Certia (contains human resource Mepco, Travel management), E-form, UniOulu Sign (singing eforms), Staff training portal, Osku, Varbi (recruiting system), CATS (time allocation). Regarding the BDP functionalities, partners identified that the relation among human resource management systems is possible at all levels (Course meta data/Learning design/Analytics) but the focus is on course meta data exchange.

Partner institutions also use different Student Services systems such as Student Mobility, Student Internship, Peppi. Regarding the BDP functionalities, partners identified that the relation among human resource management systems is possible at all levels (Course meta

data/Learning design/Analytics). The focus is on course meta data exchange and learning design data exchange.

All partner institutions use different Library Systems such as Library, Knowledge and Information Management (KIM), Dynasty (records management), Oula Fina (library catalogue). Regarding the BDP functionalities, partners identified that the relation among library systems is possible at all levels (Course meta data/Learning design/Analytics) but the focus is on learning design data exchange.

Regarding Knowledge Recognition system only one partner institution use it: Lehrevirtuell (Website). Regarding the BDP functionalities, the partner identified that data exchange is possible only at learning design level.

Regarding the Quality Assurance Systems, partner' institutions use different systems: Survey, Survey ISVU, Survey through Moodle, Peppi feedback system, Lato (strategy implementation), IMS (process descriptions), Reporting portal (Power BI). Regarding the BDP functionalities, partners identified that the relation among quality assurance systems is possible at all levels (Course meta data/Learning design/Analytics) but the focus is on learning design data exchange.

Systems	BDP functionalities			Direction
	Course meta data	Learning Design	Analytics	
Curriculum Management System				
Curriculum	A		A	2
Curriculum	A		A	2
Planet	U	U	U	2
Power Bi	U	U	U	2
Peppi	A			2
O365 for staff				
Curriculum	A		A	2
Schedule	A			1
Learning Management System				
Moodle	A	A	A	2
Moodle	A	A		2
Moodle	U	U	U	2
Moodle	A	A	A	2
Exam (electronic exam system)	A			1
Google Workspace for Education				
Laturi (electronic theses)				
Moodle	A	A		2

Student Information System				
QIS/LSF	A	A	A	2
Studomat				
ISVU	A			1
Circe	U	U	U	2
Power Bi	U	U	U	2
Peppi	A	A		1
Tuudo (private)	A	A		1
Studomat				
STIS	A			
Human Resources Management				
Goethe Lerncampus LMS	A	A	A	2
Personnel	U		U	
Success factors				
Certia (contains human resource Mepco, Travel management)				
E-form				
UniOulu Sign (singing eforms)				
Staff training portal Osku	A			2
Varbi (recruiting system)				
CATS (time allocation)				
Personnel	U	U	U	
Student Services				
Student Mobility	U		U	
Student Internship	U		U	
Peppi				
Student Mobility	U	U	U	
Student Internship	U	U	U	
Library System				
Library		A		1
Library	A		A	1
Knowledge and Information Management (KIM)				
Dynasty (records management)				
Oula Fina (library catalogue)				
Library		A		1
Knowledge Recognition				
Lehrevirtuell (Website)		A		1
Quality Assurance				

Survey		A		2
Survey ISVU		A	A	2
Survey through Moodle	A	A	A	1
Peppi feedback system			U	1
Lato (strategy implementation)				
IMS (process descriptions)				
Reporting portal (Power BI)				
Survey		A		2

Table 2: Interoperability Matrix (all partners)

Users also provided comments regarding the interconnection with BDP and additional recommendations for improvement/upgrade (presented in Table 3: Interconnection with BDP and additional recommendations for improvement/upgrade).

HEI apps	Interconnection with BDP	Additional recommendations for improvement/upgrade
<p>Curriculum Management System</p>	<ul style="list-style-type: none"> ● Enable in BDP tool connection with developed study programmes, course catalogues and teachers ● Automate course catalogue synchronization: BDP could regularly import and synchronize with the curriculum management system, ensuring the latest course details and updates are reflected in the design tool. ● By using an AI tool that automatically recognizes similarities between learning outcomes and curriculum content, BDP can recommend relevant learning outcomes for each subject, speeding up the process of defining outcomes ● AI tools can regularly review curriculum updates and suggest adjustments in the BDP to ensure all courses remain aligned with the latest changes. ● Planet contains high-level info on each module, including presentation dates, personnel, LOs, assessments. ● Course metadata is used in both Peppi and BDP. The connection could be automated both ways so that information could be exchanged. 	<ul style="list-style-type: none"> ● Support defining level of learning outcomes through recommender tool; ● Develop educational resources repository and enable in BDP tool connection of teaching and learning activities with educational resources and further export in LMS ● Build an educational resources repository that connects directly to the curriculum management system, linking teaching materials and resources to learning activities within the BDP. ● Use AI to automatically map course content to relevant learning outcomes, accelerating the process of defining outcomes for each course within the BDP. ● An AI tool could analyse previous curricula and predict the necessary teaching materials or resources, automatically linking them to the appropriate learning outcomes in the BDP. ● Enable continuous feedback loops where AI detects shifts in curriculum requirements and provides real-time updates in the BDP tool. ● An automated creation of learning objects in BDP based on Planet records ● Most of the teachers/educators/learning designers still struggling with defining appropriate learning outcomes and constructive alignment. It would be very useful to enable design of course "big picture"/course

	<ul style="list-style-type: none"> ● Enable in BDP tool connection with developed study programmes, course catalogues and teachers; 	<p>macroplanning which would encompass defining learning outcomes and connection with topics in a more user-friendly way.</p>
Learning Management System	<ul style="list-style-type: none"> ● Export of learning design in form of aligned e-course with corresponding descriptions to LMS ● Based on feedback from courses through surveys, AI can adjust learning outcomes within BDP and suggest different, better teaching designs. ● Course metadata and learning design are essential parts of Moodle and BDP. The connection could be automated both ways so that information could be exchanged. BDP analytics and Moodle analytics could be integrated to support LD development. 	<ul style="list-style-type: none"> ● Develop dashboards at course level in LMS ● By using AI tools, based on data from BDP, a smart dashboard can be created that displays key information about student progress and course performance in real time. ● The AI tool can analyse student engagement in the LMS and suggest improvements in teaching design within BDP to achieve better educational outcomes. ● Primary delivery mechanism for OU modules. Once ideas and intentions captured in BDP, they would need to then be taken into Moodle module website. ● Content creation based on learning design data supported by AI assistance
Student Information System	<ul style="list-style-type: none"> ● Export of learning design from BDP tool to inform students. Learning Outcomes to analysis and improve the Learning Design ● Course metadata is already presented to students in Peppi and Tuudo. Learning design could also be presented to inform students. ● Export of learning design from BDP tool to inform students 	<ul style="list-style-type: none"> ● The AI tool can analyse learning outcomes and automatically propose the appropriate number of ECTS credits for student internships, facilitating their proper distribution. ● An AI tool can analyse grades, exam schedules, and attendance data to ensure alignment with the planned learning outcomes in the BDP.
Human Resources Management	<ul style="list-style-type: none"> ● Use BDP tool for Human Resource Management through development of personalized learning designs supporting academic progress 	<ul style="list-style-type: none"> ● AI can analyse faculty activities and suggest personalized professional development programs based on their involvement in course design.

	<ul style="list-style-type: none"> ● Osku is a staff training portal. The course metadata could be shared between BDP and Osku. 	
Student Services	<ul style="list-style-type: none"> ● Use BDP tool for comparison of learning designs of similar courses at different institutions in order to define appropriate ECTS; ● Use BDP tool for learning design of students' internship; 	<ul style="list-style-type: none"> ● Using AI, the BDP can compare learning outcomes between institutions and recommend equivalent courses for student mobility programs, ensuring ECTS alignment. ● Based on internship feedback, AI can tailor learning outcomes in the BDP and suggest better integration of internships into the overall curriculum.
Library System	<ul style="list-style-type: none"> ● Enable connection between BDP tool and systems that provide literature data; connection of teaching and learning activities with literature data ● By using AI search, BDP can automatically link literature and resources from library databases to learning activities created in the BDP, ensuring that relevant sources are available for each course. 	<ul style="list-style-type: none"> ● Upgrade of details of teaching and learning activities in BDP tool with literature data ● AI could analyse learning outcomes and automatically suggest relevant additional literature from the library, open repository and other sources speeding up the process of preparing teaching materials. ● AI-powered analytics can track how frequently students use certain resources and suggest improvements in the choice of additional literature for future course designs.
Knowledge Recognition System	<ul style="list-style-type: none"> ● Best practices of Learning Designs 	<ul style="list-style-type: none"> ● With the help of AI tools, BDP can compare curriculum design and the use of learning materials and identify areas where students are not meeting learning outcomes, suggesting targeted interventions in the BDP to close knowledge gaps. ● Enable connection between BDP tool and systems that support recognition of skills/competencies/knowledge

		<ul style="list-style-type: none"> ● Use course meta data in BDP tool necessary for development of microcredentials
Quality Assurance System	<ul style="list-style-type: none"> ● Enable connection between BDP tool and survey that provide feedback from students/educators/learning designers necessary for improvement of learning design ● By using AI tools, BDP can analyse feedback from students and teachers, automatically suggesting changes in the course design to improve learning outcomes. ● Based on the data collected from the quality assurance system, AI can recommend optimizations in BDP's course design to improve learning outcomes. ● Integrating student feedback 	<ul style="list-style-type: none"> ● Embed survey results in BDP ● learning analytics to support improvement of learning design; ● The AI tool can automatically incorporate survey results (from ISVU) into curriculum performance analysis within BDP, allowing for quick curriculum adjustments. ● Transferring student feedback to BDP might be challenging as this might require students data transfer from Peppi to BDP. ● Embed survey results in BDP ● learning analytics to support improvement of learning design;

Table 3: Interconnection with BDP and additional recommendations for improvement/upgrade

Conclusion

Interoperability analysis and recommendations for the Balanced Design Planning (BDP) tool

The analysis of interoperability requirements for the Balanced Design Planning (BDP) tool highlights significant opportunities to enhance educational processes across partner institutions. All partners currently use various systems across categories such as Curriculum Management Systems, Learning Management Systems, Student Information Systems, Human Resources Management, Student Services, Library Systems, Knowledge Recognition Systems, and Quality Assurance Systems. Despite the diversity of these tools, the potential for integration with the BDP tool has been widely recognized.

Data standardization as a foundation for interoperability

Ensuring seamless interoperability between the BDP tool and institutional systems requires data standardization. This involves developing a meta-model for learning design, which would serve as a guiding framework for creating consistent, scalable, and adaptable learning design models or instances.

Interoperability purposes and prioritization based on collected data

In the table below are presented purposes of interoperability of BDP tool with each HEI system and based on the collected data from partners are identified priorities for interoperability.

HEI system	Purpose of interoperability of BDP tool with system	Priority for interoperability
Curriculum Management System	<ul style="list-style-type: none">- Align course design with curriculum structures.- Automate data exchange for course planning and design.- Enable holistic design of study programs.	High
Learning Management System	<ul style="list-style-type: none">- Export learning designs and metadata to LMS (e.g., Moodle).- Enable AI supported content creation based on learning design data and export to LMS (e.g. Moodle).	High
Student Information System	<ul style="list-style-type: none">- Informing students on course design- Integrate student data for personalized learning paths.- Track student progress and workload alignment with course designs.	Medium
Human Resources Management	<ul style="list-style-type: none">- Align teaching assignments with faculty expertise.- Support workload management and resource optimization.- Identify training needs.	Low
Student Services	<ul style="list-style-type: none">- Informing students on course design- Facilitate alignment of course design with student support offerings.	Medium
Library System	<ul style="list-style-type: none">- Connect course content with relevant library resources.	High

	- Automate the recommendation of readings and materials based on learning outcomes.	
Knowledge Recognition System	- Support issuing of microcredentials	High
Quality Assurance System	- Ensure alignment of course design with accreditation standards. - Automate reporting and monitoring for continuous improvement.	Medium

Proposed upgrades for the BDP tool to enhance interoperability

1. Curriculum Management Systems Integration

- All partner institutions use curriculum systems to manage curriculum development, delivery, assessment, and evaluation. Establishing integration for user engagement and automatic data exchange between the BDP tool and these systems would be highly beneficial.
- A potential upgrade to the BDP tool could include functionality for designing study programs holistically. This would allow institutions to use the tool for end-to-end study program design and development.

2. Learning Management Systems (LMS) export functionality

- The iLed project has enabled the export of learning designs from the BDP tool to Moodle, which has been well-received by users. Expanding this functionality to allow content creation based on course learning design metadata, which could also be directly exported to Moodle, was identified as a valuable enhancement.

3. Support to issuing European Digital Credentials

- In order to support issuing of microcredentials it is planned to extend the data in the BDP tool to be aligned with data of European Digital Credentials issued through Europass platform. Besides that, in order to shorten the process of credential creation, within the BDP tool will be able to create credentials in json format that can be uploaded to Europass platform enabling moving on to the next step of reviewing and digitally sealing credentials.

Additional proposed upgrades for the BDP tool

1. Macro-Level Course Planning

- Many educators and learning designers face challenges in defining appropriate learning outcomes and achieving constructive alignment. A proposed functionality would enable users to design the "big picture" of a course, incorporating learning outcomes and their connection to topics in a user-friendly manner. This could be supported by AI tools or methods like the Analytic Hierarchy Process (AHP) or Social Network Analysis (SNA).

2. AI-Powered Real-Time Assistance

- Feedback from partners strongly supports the inclusion of AI-driven assistance throughout the learning design process. Suggested functionalities include:

- Recommending relevant learning outcomes for courses.
- Proposing teaching materials and resources for activities.
- Analyzing learning outcomes to suggest appropriate ECTS credits.
- AI assistance could be implemented across multiple levels of the BDP tool, including course-level, learning outcomes, topics, units, teaching and learning activities (TLAs), and analytics.

Enhancing the interoperability and functionality of the BDP tool through these proposed upgrades will enable better integration with institutional systems, support educators in designing high-quality courses, and improve user experience through AI-powered assistance. These improvements will ensure the BDP tool continues to be a valuable resource for modernizing learning design.

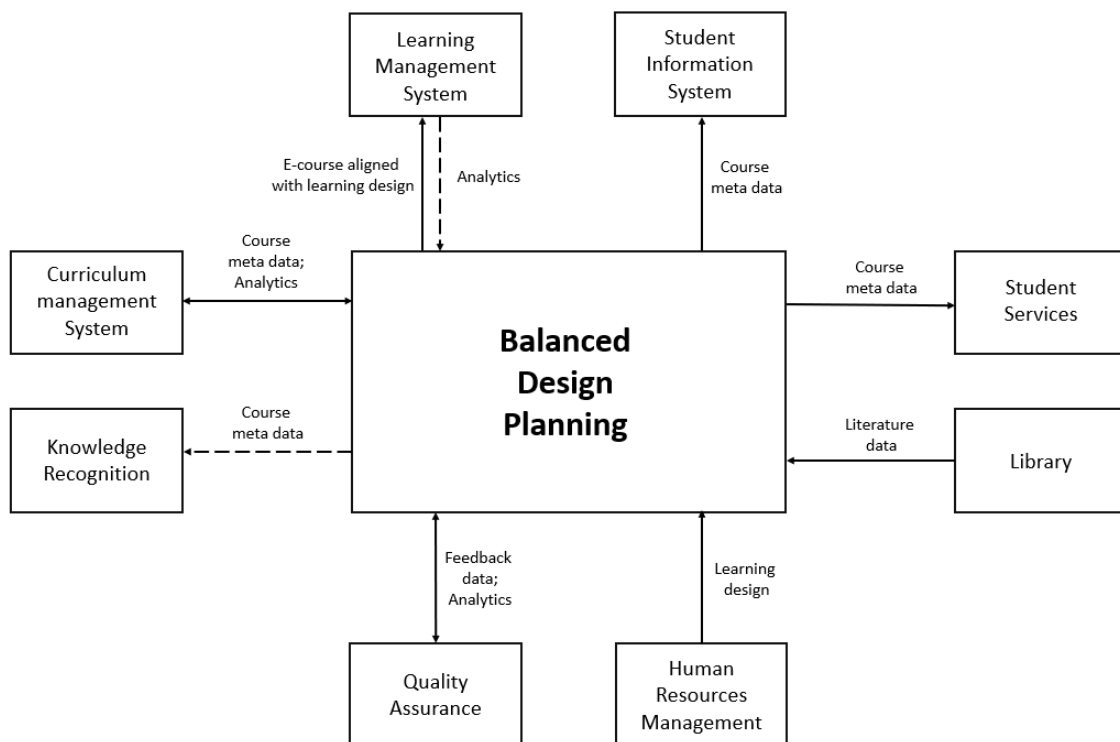


Figure 1. BDP-centered technology ecosystem in HE