EPiC Series in Computing

Volume 95, 2023, Pages 129–139

Proceedings of European University Information Systems Congress 2023

Implementing a data-driven framework for measuring digital readiness across European universities

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Abstract

This paper explores the feasibility of defining a data-driven framework for assessing digital readiness in Higher Education Institutions (HEIs). This is part of a project that aims at measuring digital readiness indicators with the ultimate objective to contribute to the quality assurance processes of the institutions. The project involves the design and demonstration of a prototype toolkit and an Application Programming Interface to enable self-reflection, using data sourced from the institutions' information systems, which are aligned with the indicators of the framework, to provide feedback to relevant stakeholders. The reported research examines information sources of the HEIs involved, auditing of proposed framework indicators, and proposals for further review on digital readiness frameworks and other data-driven approaches as well as the first architectural considerations on implementing the Digital Readiness tool.

Keywords: digital readiness, digital transformation, institutional analytics, learning analytics, higher education

1 Introduction

In an ever-evolving landscape, Higher Education Institutions (HEIs) must be equipped to meet the demands of our digital society. Thus, it is very crucial for HEIs to acquire a better mechanism to evaluate their existing digital readiness levels, identify possible challenges, and establish plans for transitioning to digitally enhanced policies.

The aim of the DigiReady+ project [1] is to define a framework and develop a prototype, in the form of a web tool that would connect to the learning management systems and other institutional informational systems, to measure digital readiness indicators for the higher education institution.

As a starting point, a consolidated working definition has been proposed of the term Digital Readiness that will refer to the institution concerned and the pillars (dimensions) to be measured.

Digital Readiness in higher education institutions is defined as a measure of the inclination and willingness to adopt digital technologies and facilitate digital opportunities to achieve goals faster and with better results [2], [3]. Digital readiness can improve the quality of education and support the needs of students, faculty, and staff. An institution's Digital Readiness can be measured by the following seven dimensions: (1) Firm Leadership and Government related to digital issues. (2) Widely communicated Policies and Strategies within the institution. (3) Wide use of innovative digital technologies in Teaching and Learning. (4) Rich Digital Content and presence of digital skills and competences in curricula. (5) Provision of digital Training and Support to stakeholders. (6) Founded on adequate, up-to-date, and widely available Digital Infrastructure. (7) Participation in Research, Networks and Alliances to improve digital competency and capacity [4]

Based on this understanding of Digital Readiness, the main goal is the design and demonstration of the DigiReady+ tool which will support the self-reflection of an Institution on digital readiness after being fed with data from the Institution's information systems. Specifically, the main objectives are:

- To define an Application Programming Interface (API) that will be responsible for the collection of the data derived from the learning and research platforms to apply data analytics methods to them and extract measures of the digital readiness indicators.
- To create and deliver guidelines that should be followed by an HEI to install and use the API for its own purposes. These guidelines are essential elements for the data collection process and should be used by HEIs to implement their digital readiness analytics tools.
- To design and develop the DigiReady+ tool, a web application that will be used to measure digital readiness and provide feedback to the stakeholders regarding the digital readiness of the HEI. It is a dynamic dashboard that will visualize the measures of the digital readiness indicators according to the framework and suggest measures for improvement.

A reference conceptual architecture is shown in Figure 1.

In order to identify the data sources that can be mapped to the DigiReady+ framework indicators, a multi-step methodological approach was implemented, the phases of which are outlined in the sections that follow. In Section 2, the initial step of this work is presented, which involves the survey conducted among the project participants to evaluate the framework indicators in terms of understandability, measurability, and perceived importance. In Section 3 the second phase is described in which, an expert panel was convened to review the survey results and make recommendations on the data sources that can be mapped to the proposed indicators in different HEIs. In Section 4, the suggested data sources are being further investigated in order to identify the most suitable data sources for each indicator. Finally, the next steps for the development of a reliable and comprehensive assessment framework for digital readiness in HEIs has been discussed.

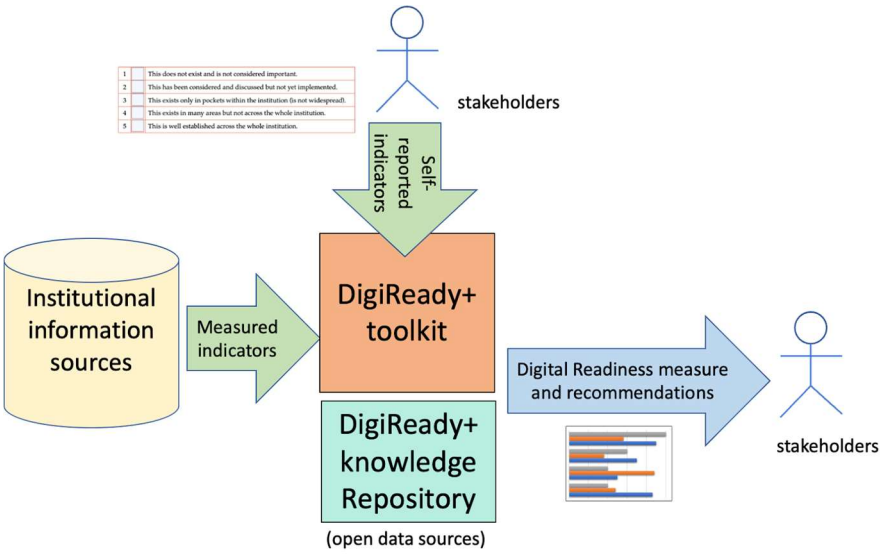

Figure 1. Conceptual architecture of the DigiReady tools

2 Auditing of the DigiReady+ Framework

This section presents the results of the first phase of the reported research, which involved auditing the DigiReady+ framework. Through this study that involved all partners of the project, a critical stance was taken over the dimensions and related indicators of the framework, to improve the understanding of the developed framework, so that subsequently be able to implement the framework in different HEIs.

In total, the framework suggests 72 indicators with brief descriptions that have been produced from the stakeholders' workshops where these indicators originate. The idea was to evaluate the current state of each indicator, to identify areas of improvement and develop strategies to address any issues relating to their implementation. The task was to review individually the indicators, one at a time, and based on their brief description, evaluate their measurability (i.e. decide if it can be quantified), understandability (i.e. how clear the description is, or if there is ambiguity), and their level of importance, based on the two earlier criteria. The evaluation scale had three values 0 (not at all), 1 (moderately), and 2 (easily measurable/understandable). For the level of importance, the values were 0 (low), 1(moderate), and 2 (high). In addition, there was an open question for comments. Considering perceived importance as the most salient construct, the average value of perceived importance was studied for the 72 indicators. Next, a unique score per indicator was defined, considering all three constructs: "importance", "measurability" and "understandability". This score ranged from 0 to 1. This score was used for selecting the most promising indicators to discuss with the HEI stakeholders.

As an example, from the seven dimensions of the proposed framework, we will select one: *D3 Teaching and Learning*. This dimension has a high overall score (75%). We present the indicators of this dimension that scored high in terms of importance, understandability and measurability, i.e. *D3.13 Degree of satisfaction of students and professors regarding the use of digital tools*, (score 70%). Let us next examine how this indicator was perceived during the auditing and framework implementation.

D3.13 involves questionnaires and surveys regarding systems' usage (e.g. monitoring users' perception of system usage) and teaching and learning practices. From the auditing some interesting

observations were made: Since satisfaction is subjective, questionnaires, surveys regarding systems' usage (e.g. monitoring users' perception of system usage) and teaching and learning practices could be used to measure the indicator. Furthermore, it could be beneficial to provide a list of digital tools to consider the multidimensionally of this indicator, perhaps using results of the QA (Quality Assurance) unit. Therefore, one may suggest this dimension to become more specific per tool/platform. In addition, it is not clear if we need to examine existence only of assessment tools/processes or to examine the results too (levels of satisfaction). A doubt was expressed whether teachers' satisfaction is related to HEI digital readiness. In the next section, we discuss how this particular indicator was seen from the perspective of specific HEIs.

3 Implementation of the framework in Higher Education Institutions

Four of the project partners (the University of Patras and GUNET for the Kapodistrian University of Athens, Greece, University of Valladolid, Spain, University of Duisburg-Essen, Germany) undertook the responsibility to contact key stakeholders from their institutions who are responsible for digital infrastructure, information systems, and other data sources necessary for calculating the indicators in the DigiReady+ framework. The panel consisted of experts from the project team, HEIs' experts from the digital sector, and academics from the field of digital readiness. The experts were asked to review the survey results and suggest relevant data sources that can be mapped to the proposed indicators.

The objective of these multiple studies was to identify typical examples of implementation of the DigiReady+ framework, for specific indicators that are mapped to available information resources in the specific institution. Then, in the final phase of the study, the collected examples of framework implementation will be used for feeding into the design requirements of the DigiReady toolkit and API.

The studies conducted by the four teams have provided valuable insights into the complexities of assessing digital readiness of higher education institutions. In addition, the need for a universal solution for measuring digital readiness was highlighted, which necessitates the development of more sophisticated and reliable data sources, better data quality assurance systems, and improved frameworks and models.

3.1 Example of review of a specific indicator across different HEIs

Next, let us see the reception of D3.13 in the HEIs in which this was considered.

University of Patras: The comment of the stakeholder on D3.13 was that this indicator is considered important, but it is hard to measure, as there is no data available relating to user satisfaction with tools like the learning management system. The only relevant information is the answers provided by the students through the Quality Assurance (QA) questionnaire, on use of ICT tools by the tutor in a particular course, but this often is misinterpreted by the students, and it is not considered reliable.

University of Valladolid: The four stakeholders who participated in the study considered this indicator as of medium measurability (0.62), as it is potentially measurable with surveys, but the response rates are very low. There is also a risk of overloading students and teachers with extra surveys. The UVA QA unit controls the surveys performed e.g. the program accreditation processes, are typically managed through Lime-Survey. On the other hand, the understandability of this term is also dubious (0.75), as the term "Use of ICT" needs to be better defined, while it is not clear whether the indicator refers to the resources themselves, or to the use of the resources by teachers. Finally in this University too they thought that this indicator is of high importance (0.87), as they commented that the level of satisfaction of students and teachers about the use of digital resources is very relevant to assessing how these resources are implemented and what are their potential improvements. Given the above, the overall score is 0.78. An interesting additional comment was the concern that "*The main*

problem is data collection. The regular students' survey demonstrates how difficult it is to obtain meaningful and reliable data. It is also intrusive and overburdens the users". In addition, there is a need to separate between satisfaction with teacher use of ICTs and satisfaction with ICT availability.

University of Duisburg-Essen: The three stakeholders who audited the framework considered indicator D3.13 of high measurability (1.00), different from the other two universities of medium understandability (0.50), and high importance (0.85), therefore the overall score calculated as, 0.79. The relevant comment was that "*the users' assessment depends strongly on their knowledge of the use of digital tools in teaching/learning. The knowledge is quite heterogeneous and would have to be considered*". This signifies the need to control for indicators that relate to users' perception or satisfaction like D3.13.

As a summary, from the presentation of D3.13 auditing and implementation, it was found that the auditors thought that the indicator is important, but it needs to be clarified. The HEIs stakeholders confirmed this, as they considered this indicator of high importance, however when it comes to its measurement, different HEIs hold different views. Some serious concerns were expressed that relate to unavailability of this measure directly in QA surveys as well as concerns on the definition of the indicator, the issue of different platforms and concerns on overuse of surveys, with negative effect on the reliability of their findings. Similar concerns were expressed for many indicators of the proposed framework.

3.2 Inspiration from other digital readiness measurement frameworks

This work was instrumental in furthering the understanding of the metrics used to evaluate higher education institutions and the complexities associated with them. However, due to current limitations in the sector (e.g. low interoperability of systems) and the complexity of the nature of the indicators, some of the indicators of the proposed framework are currently difficult to measure. To improve the process of defining a data-driven approach, it is important to develop an updated comprehensive strategy to ensure the accuracy of the data and the ability to measure the indicators without risking the universality of the framework. By understanding the issues at hand and making the best of the available data, an upgraded strategy needs to be formed to effectively measure the progress and ensure successful implementation and use of the framework.

A comprehensive scan of data sources that are relevant to the indicators was performed. This scan included both internal data sources of HEIs and research on external sources (e.g. from public authorities, and international organizations). It was important to search sources beyond the academic sector that inspired the DigiReady+ framework. Moreover, the quality metrics associated with these terms are greatly linked to the financial results seen in the corporate sector. This research was conducted to understand the application of these quality metrics beyond the academic sphere and to appreciate the importance of the connection between industry and research. The results showed that the relationship between industry and research is fundamental in terms of understanding and implementing these quality metrics [5], [6].

It is essential that data quality is assessed, and a quality assurance system is employed to meet the standards. To assist with this process, various frameworks and models have been developed to guide organizations through the digital transformation process. These frameworks and models provide a structured approach to planning and executing digital transformation initiatives and include topics such as creating a digital transformation vision, establishing a digital transformation team, developing a digital transformation roadmap, and more. By utilizing these frameworks and models, institutions can gain a better understanding of the digital transformation process and ensure a successful outcome. To ensure successful digital readiness, institutions must develop an effective strategy and plan that considers the organization's goals, resources, culture, and current technology landscape. Examples of frameworks and policy documents include the Digital Transformation Bible, the Digital Economy and Society Index (DESI), Cisco Digital Readiness Index (DRI), Sustainable Governance Indicators (SGI),

European Network for Quality Assurance (ENQA), and Environmental, Social, and Governance (ESG). These are all frameworks or models developed to help organizations plan and execute successful digital transformation initiatives. They all provide guidance on developing strategies and measuring and improving performance. They can be used in combination with one another to create a holistic digital transformation strategy[7],[8],[9], [10],[11],[12],[13],[14],[15].

It is paramount that we take all the findings of the analysis and other related digital readiness frameworks into account in the design of our prototype. In the next section, we proceed with some architectural considerations and first requirements of the DigiReady+ tool.

4 On designing the DR+ framework tool and API.

As discussed in the previous sections, we discovered that measuring digital readiness across all institutions using a single formula was not practical, owing to the various structures, information sources, and values of the discussed indicators at different universities. As a result, the indicators must be prioritized on a case-by-case basis and measured using the available data sources and institutional practices. To ensure the successful implementation and use of the framework, different aspects should be considered so the framework encompasses and implements an appropriate strategy. A systematic approach can be employed to identify the data sources and give a universal answer to this problem based on 5 basic elements: the DR+ HEI Identity, the DR+SMART Indicators, the DR+ Questionnaire, the DR+ Score Pyramid and the DR+ Recommendations.

4.1 DR+ HEI Identity

The DR+ HEI identity provides a structured outline that reflects its unique strengths, values, and mission, and captures in figures the size, the digital capacity, the range of educational and research activities, the human capital, and the overall potential of the Institution. A clear and distinctive HEI identity is an important element of the DR+ approach, and includes 2 sections, the qualitative and the quantitative one. On one hand, the HEI identity outlines the profile of the institution and reflects its values and personality. This information is the qualitative part and should be considered as essential for the assessment and measurement of the digital readiness of the HEI. On the other hand, the quantitative part of the HEI identity provides a metric of the size of the HEI in all aspects of its operations, including teaching and learning, research, administration, and communication. These figures will be used for the normalization of the DR+ Indicators measurements so that the DR+ score is comparable between different HEIs.

It is important to note that the accessibility policies and services of a HEI are included in its identity and play a distinctive role in DR+ approach considered as indicators of digital readiness maturity. Accessibility policies play a critical role in ensuring that a Higher Education Institution (HEI) provides equal access and opportunities to all students, including those with disabilities. These policies typically cover a wide range of areas, including course content, physical spaces, technology, and communication.

4.2 DR+ SMART Indicators

DR+ Indicators are the most important part of the data-driven DR+ Framework because they provide the means for assessing an institution's digital capabilities and identifying areas for improvement. These indicators can help HEIs to benchmark their digital readiness against peer institutions and set goals for improvement. They can also provide a roadmap for developing a comprehensive digital strategy that aligns with the institution's overall mission and vision. Indicators for measuring digital readiness as mentioned in section 1 may include factors such as infrastructure, technology integration, teaching and

learning, digital skills and training, support services, and digital culture. However, DR+ Indicators should be SMART - Specific, Measurable, Achievable, Relevant and Time-bound.

- Specific, means that the indicator needs to be narrow and accurately describe what needs to be measured.
- Measurable, means that regardless of who uses the indicator it would be measured in the same way.
- Achievable, means that collecting the data should be straightforward and cost-effective.
- Relevant, requires that the indicator be closely linked to the relevant outcome.
- Time-bound, means that there should be a timeframe linked to the indicator.

4.3 DR+ Questionnaire

As already mentioned above, measuring HEI's digital readiness involves assessing institution's capacity to use digital technologies effectively to achieve its goals in several key areas (7 dimensions). To measure digital readiness, a combination of quantitative and qualitative methods can be used. Quantitative measures may include automated data retrieval, surveys, data analysis, and scoring systems to assess digital infrastructure, services, and skills. Qualitative measures are more demanding and include targeted closed type questions referred to specific DR+ Indicators to gain deep insights into the quality of digital content, student support, policies, strategies, and partnerships.

The DR+ Questionnaire is a core element of the proposed DR+ approach. DR+ Indicators are analyzed and several well-defined targeted DR+ Questions are prepared that are clear, concise, easy to understand and answer and effective in measuring digital readiness. Where it is possible, answers to specific questions are directly linked to data sources by using DR+ Application Programming Interface (API). DR+ API is responsible for the collection of the data derived from the learning and research platforms to apply analytics methods to them and extract measures of digital readiness in specific indicators. The DR+ Questionnaires are inspired by methodologies and techniques from other tools like Analytics, Business Intelligence and HEI's Ranking, as also discussed in the previous section, and include well-defined questions of the following types:

- Numerical (automatically retrieved / estimated / calculated or manually inserted with reference to the data source).
- Closed questions (Y/N, List of choices / One answer or Multiple answers, Likert scales).
- Text / Info (automatically retrieved or manually inserted with reference to the data source).

4.4 DR+ Score Pyramid

DR+ Scoring analyzes data and assigns scores to each of the assessed DR+ Indicators. Then it calculates a score per dimension and an overall score to determine the level of HEI's Digital Readiness. Digital readiness scoring can help to identify areas that need improvement and guide investment decisions, but also can be used as a benchmark for comparing digital readiness across higher education.

The DR+ Score Pyramid visualizes (see figure 2) the different scores/areas of Digital Readiness (DR) in a pyramid. A number of 4 predefined digital readiness areas are included. The 4 DR+ Score areas are the following:

- DR-A (score 90-100) is the top of the pyramid and includes HEIs that have fully implemented digital strategy which is constantly updated based on metrics, analytics, and business intelligence.

- DR-B (B1 score 75-90, B2 score 60-75) includes HEIs that have implemented digital strategy and they have adequate capacity of digital readiness, but there is room for improvements in specific areas.
- DR-C (C1 scores 10-30, C2 scores 30-45, C3 scores 45-60) includes HEIs that have digital services in all dimensions, but no clear digital strategy and they need to improve in terms of policies, interoperability, and process re-engineering.
- DR-D (score 0-10) includes HEIs that have no or limited digital services and no digital strategy.

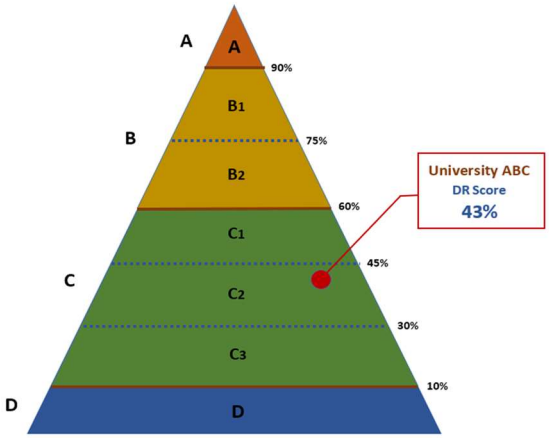

Figure 2 The DR+ Score Pyramid visualizing the different scores/areas of Digital Readiness (DR)

4.5 DR+ Recommendations

The DR+ Recommendations is the last element of the proposed DR+ systematic approach aiming at analyzing data and scoring systems and identifying patterns and trends in the digital readiness of HEIs. The main goal of the recommendation engine is to suggest areas where HEIs can improve their digital readiness based on their current level of readiness. For example, if an HEI has a low score in teaching using digital tools, the engine could recommend training programs or resources to help faculty members to improve digital skills.

The DR+ Recommendations also provide actionable insights to HEIs both horizontally (general recommendations) and vertically (recommendations per dimension). This could include detailed reports on each area of digital readiness and specific action plans to help HEIs improve their digital readiness. More specifically, the DR+ Recommendations tool provides:

- General recommendations based on the HEI's profile and the overall digital readiness score to up-scale. For example, if an HEI has an overall score placed in area C3 of the DR+ pyramid the general recommendations provide insights for moving up to the next DR+ levels C2, C1, and B1.
- Vertical recommendations per DR+ dimension based on dimension's score and weak points.
- Targeted recommendations based on answers in specific DR+ Indicators (identify weak points and give suggestions for improvements)

5 Conclusions

Higher Education Institutions (HEIs) need to remain competitive in the rapidly evolving digital landscape. This requires having a strong online presence and ensuring that digital technologies are integrated seamlessly into all aspects of the institution's operations, including teaching and learning, research, administration, and communication. HEIs need to develop a comprehensive digital strategy that aligns with their overall mission and vision, and invest in the necessary infrastructure, tools, and skills aiming at improving digital readiness. Furthermore, digital readiness requires a culture of innovation and collaboration, where faculty, staff, and students are encouraged to experiment with new technologies and work together to create new knowledge and solutions.

This paper outlines a systematic approach as a reliable and comprehensive assessment framework for measuring digital readiness in higher educational institutions. By measuring digital readiness, HEIs can identify gaps and prioritize investments in areas where they are most needed. This can help ensure that the institution is well-positioned to leverage digital technologies into all aspects of the institution's operations. In the paper, we have presented the auditing and implementation study of the proposed digital readiness framework, involving four European HEIs. We discussed observed limitations of proposed dimensions and finally proposed the first components of the DR+ toolkit and API. Given the difficulty of the task, further analysis and design phases need to follow before the proposed framework can be tested in specific HEIs.

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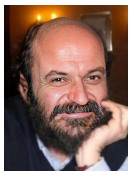

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