# MAPPING INNOVATION IN DIGITAL ASSESSMENT ECOSYSTEMS: A COMPARATIVE ANALYSIS OF EUROPEAN ONLINE UNIVERSITIES

**Maria Clara Dicataldo**
**Università Pegaso**
**mariaclara.dicataldo@unipegaso.it**

**Federica Picasso**
**Università Pegaso**
**federica.picasso@unipegaso.it**

**Irene D. M. Scierri**
**Università Pegaso**
**irene.scierri@unipegaso.it**

**Andrea Tinterri**
**Università Pegaso**
**andrea.tinterri@unipegaso.it**

**Anna Dipace**
**Università Pegaso**
**anna.dipace@unipegaso.it**

**Pierpaolo Limone**
**Università Pegaso**
**pierpaolo.limone@unipegaso.it**

**Double Blind Peer Review**

**Citation**
Dicataldo, M. C., Picasso, F., Scierri, I. D. M., Tinterri, A., Dipace, A., & Limone, P. (2026). Mapping innovation in digital assessment ecosystems: A comparative analysis of European online universities. *Italian Journal of Health Education, Sports and Inclusive Didactics, 10*(3).

**Doi:** https://doi.org/10.32043/gsd.v1i3.1805

**Copyright notice:**
© 2023 this is an open access, peer-reviewed article published by Open Journal System and distributed under the terms of the Creative Commons Attribution 4.0 International, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.

gsdjournal.it
**ISSN: 3103-5744**

**ABSTRACT**
This study examines the institutional formalisation of technological innovation in assessment across 40 accredited European online universities. Through a comparative documentary analysis, it investigates the visibility of Artificial Intelligence, learning analytics, and immersive technologies within assessment-related documentation. Findings show that learning analytics is the most institutionalised area, while AI and immersive technologies remain less formally embedded in assessment ecosystems.

**KEYWORDS**
Digital assessment; assessment innovation; assessment technologies; online higher education.

**Received** 30-06-2026
**Accepted** 17-09-2026
**Published** 30-10-2026

## 1. Introduction

Digital assessment has become a central component of online higher education, supporting not only the certification of learning outcomes but also the monitoring of student progress, the provision of feedback, and the overall quality of the learning experience (Devedzic & Devedzic, 2019; JISC, 2020). This reflects broader developments in assessment for learning, where assessment is understood not only as a mechanism for measuring achievement, but also as a process that can support learning, self-regulation, engagement, and improvement through formative feedback and learner participation (Black & Wiliam, 1998; Nicol & Macfarlane-Dick, 2006; Carless & Boud, 2018). As fully online universities continue to expand across Europe, assessment systems increasingly rely on digital infrastructures capable of supporting both pedagogical and organisational functions, including feedback management, data collection, quality assurance, and the coordination of assessment processes at scale (JISC, 2020; Bandtel et al., 2022; Scierri et al., 2026, in press).

At the same time, rapid technological developments are creating new possibilities for assessment design and implementation. Artificial Intelligence (AI), learning analytics, and immersive technologies have attracted growing attention as potential enablers of more adaptive, personalised, authentic, and data-informed assessment environments. Recent literature highlights the potential of these technologies to support automated feedback, continuous monitoring of learning processes, simulation-based assessment, and the evaluation of complex competences (Holmes, Bialik and Fadel, 2023; Kamalov et al., 2023; REMOTE Project, 2025). These developments are also consistent with wider discussions on technology-enhanced assessment, which emphasise that digital technologies can transform assessment when they are pedagogically aligned and used to promote authenticity, accessibility, feedback quality, flexibility, and higher-order learning outcomes (Redecker & Johannessen, 2013; JISC, 2020; Villarroel et al., 2018).

Despite this growing interest, much of the existing literature focuses on technological capabilities, experimental implementations, or pedagogical applications. Comparatively less attention has been devoted to how higher education institutions formally integrate and communicate innovation within their assessment systems. This distinction is particularly important because the presence

of innovative technologies does not necessarily imply their institutionalisation. Technologies may exist within isolated projects, individual courses, or local initiatives without becoming embedded in institutional policies, assessment strategies, quality assurance processes, or support infrastructures. This reflects a broader issue in educational technology research, where innovation often remains fragmented unless it is supported by coherent institutional strategies, leadership, professional development, and governance arrangements (Benavides et al., 2020).

This issue is especially relevant in fully online universities, where digital infrastructures constitute a core component of educational provision and where technological innovation is frequently presented as a strategic institutional objective. In such contexts, assessment design is closely connected to institutional capacity, platform architecture, academic integrity policies, accessibility requirements, staff competences, and student support systems (Bandtel et al., 2022; Rossade et al., 2022). Understanding how innovation is formalised at institutional level may therefore provide important insights into the maturity of digital assessment ecosystems and the relationship between technological change and assessment governance.

Rather than evaluating the effectiveness of these technologies or their actual implementation in teaching practice, the study focuses on their institutional formalisation. In doing so, it contributes to the emerging debate on assessment innovation by providing a comparative European perspective on how technological developments are translated into visible institutional strategies, policies, and assessment infrastructures. This focus is consistent with documentary and institutional approaches to educational research, which consider policies, strategy documents, quality assurance frameworks, and support materials as important sources for understanding how institutions define priorities, legitimise innovation, and communicate organisational change (REMOTE, 2025; Gaebel & Morrisroe, 2023; EADTU, 2012; JISC, 2020; Rossade et al., 2022; Bandtel et al., 2022).
Accordingly, the study addresses the following research question:
**RQ1:** How are emerging technologies for assessment formally represented within the institutional documentation of European online universities, and what patterns of institutional formalisation can be identified across Artificial Intelligence, learning analytics, and immersive technologies?

### 1.2 Assessment Innovation in Digital Assessment Ecosystems

The digital transformation of higher education has progressively expanded the range of technologies available to support assessment. Moving beyond the digitisation of traditional examinations, contemporary assessment systems increasingly incorporate tools capable of generating feedback, monitoring learning processes, supporting decision-making, and creating authentic assessment environments (JISC, 2020). This shift is aligned with the literature on technology-enhanced assessment and feedback, which argues that digital assessment should not merely reproduce conventional assessment formats online, but should support more flexible, inclusive, efficient, transparent, and learning-oriented forms of assessment (JISC, 2010; Redecker & Johannessen, 2013; Boud & Molloy, 2013; Carless & Boud, 2018).

Within this broader landscape, innovation in assessment can be understood as the integration of emerging technologies that extend the possibilities of assessment beyond conventional practices (Devedzic & Devedzic, 2019). Among the technologies receiving greatest attention in recent years are Artificial Intelligence, learning analytics, and immersive environments. Although differing substantially in their functions and applications, these technologies share a common characteristic: they aim to enhance assessment through greater personalisation, automation, data-informed decision-making, or authenticity of learning experiences (KAmalov et al., 2023) These aims correspond to key directions identified in current assessment research, including the development of adaptive feedback, continuous assessment, authentic tasks, analytics-informed interventions, and assessment designs capable of capturing complex competences and higher-order learning outcomes (Villarroel et al., 2018; JISC, 2020).

Artificial Intelligence has been associated with automated feedback generation, adaptive assessment systems, intelligent tutoring, automated scoring, task generation, peer allocation, and support for assessment management (Zawacki-Richter et al., 2019; Kamalov et al., 2023; Swiecki et al., 2023). Learning analytics enables the collection and interpretation of learner data to support monitoring, prediction, feedback, and educational interventions, making it possible to identify learning patterns and inform pedagogical decision-making (Ferguson, 2012; Siemens, 2013; Gašević, Dawson & Siemens, 2015). Immersive technologies such

as virtual and augmented reality have been linked to simulation-based assessment and the evaluation of complex competences in authentic contexts, particularly where practical, professional, collaborative, or problem-solving skills are difficult to assess through traditional formats (REMOTE Project, 2025).

The growing prominence of these technologies has generated considerable discussion regarding their educational potential. However, innovation in assessment cannot be reduced to the existence of technological tools alone. Educational technologies become institutionally meaningful when they are embedded within policies, infrastructures, support systems, professional development opportunities, and governance arrangements that enable their sustainable, ethical, and responsible use. As Bandtel et al. (2022) argue, assessment in digital higher education should be understood as a systemic phenomenon shaped by interactions between technological, organisational, pedagogical, and regulatory dimensions. This systemic perspective is also supported by research on educational technology and digital transformation, which emphasises that sustainable innovation requires alignment between institutional strategy, pedagogical design, staff capacity, quality assurance, and organisational culture.

From this perspective, the key issue is not simply whether innovative technologies are available, but whether they are formally integrated into institutional assessment ecosystems. Formalisation represents an important indicator because it reflects the extent to which innovation becomes visible, recognised, and embedded within institutional structures (Benavides et al., 2020). Examining documentary evidence of innovation therefore provides insight into how universities position themselves in relation to emerging technological developments and how far these developments have moved beyond isolated experimentation towards institutional adoption. Institutional documents, policies, strategic plans, quality assurance procedures, and support resources can therefore be read as traces of how assessment innovation is framed, legitimised, and governed within higher education institutions (Bandtel et al., 2022).

The present study adopts this perspective by investigating the institutional formalisation of assessment innovation within European online universities. Particular attention is given to three areas that currently occupy a prominent position in policy and research debates: Artificial Intelligence, learning analytics,

and immersive technologies. By focusing on these areas, the study does not seek to determine whether such technologies are effective in practice, but rather to analyse how they are made visible within institutional strategies, policies, assessment infrastructures, and support systems. In doing so, it contributes to the literature on digital assessment by shifting attention from technological affordances and local experimentation to the institutional conditions through which assessment innovation becomes part of broader digital assessment ecosystems.

## 2. Methods and materials

### 2.1 Research Design

This study adopts a comparative documentary analysis to investigate the institutional formalisation of technological innovation within digital assessment ecosystems in fully online higher education. Documentary analysis is particularly suitable for examining how institutions publicly communicate, regulate, and formalise assessment-related practices through official documents, regulations, policies, quality assurance reports, and institutional websites.

### 2.2 Sample

The study is based on a sample of 40 accredited fully online universities (Appendix 1). The sample derives from a broader research project aimed at developing and applying the Digital Assessment Ecosystem Framework (DAEF) to investigate how digital assessment is formally embedded within European online higher education institutions. The overarching project examined nine dimensions: Governance and Institutional Policy, Institutional Support for Assessment Capacity, Curricular Alignment, Assessment Architecture, Feedback and Formative Dimension, Integrity and Security, Accessibility and Equity, Technologies and Innovation, and Operational Support and Accompaniment. The present paper focuses specifically on the Technologies and Innovation dimension, exploring the institutional formalisation of Artificial Intelligence, learning analytics, and immersive technologies within assessment systems.

To be included in the sample, institutions had to satisfy three requirements: (a) recognised higher education institution status within the EHEA; (b) accreditation through quality assurance systems aligned with the European Standards and Guidelines for Quality Assurance in the European Higher Education Area (ESG,

2015); and (c) provision of educational programmes delivered entirely or predominantly online, without systematic on-campus attendance requirements.

The final sample included institutions distributed across multiple European countries and representing a variety of organisational models, including public open universities, distance teaching universities, and private online higher education institutions.

**2.3 Analytical Framework and Coding Procedure**

The analysis was guided by the Technologies and Innovation dimension of the Digital Assessment Ecosystem Framework (DAEF), mentioned above, through the synthesis of European quality assurance references, digital assessment frameworks, and policy reports on technology-enhanced assessment[1].

For the purposes of this study, three categories of technological innovation were examined:

- Artificial Intelligence for feedback or scoring;
- Learning analytics;
- Immersive technologies.

Artificial Intelligence for feedback or scoring refers to the documented use of AI-based systems supporting automated feedback generation, automated scoring, adaptive assessment, or intelligent tutoring functions related to assessment.

Learning analytics refers to the documented use of data-driven systems designed to monitor, analyse, or support assessment processes and student performance.

Immersive technologies refer to the documented use of Virtual Reality (VR), Augmented Reality (AR), simulation environments, or similar immersive systems employed for formative or summative assessment purposes.

Each category was operationalised through observable indicators derived from publicly available institutional evidence. Sources included institutional regulations,

[1] The analysis was based exclusively on publicly available documentary evidence retrieved from institutional websites, including regulations, quality assurance documents, assessment policies, strategic plans, digital learning environment descriptions, and dedicated webpages. Data collection was conducted between March 2026 and April 2026, and only information publicly accessible at the time of the analysis was considered.

assessment policies, quality assurance documents, strategic plans, programme descriptions, digital platform descriptions, dedicated web pages, and technical documentation.

The coding process employed a three-point ordinal scale:

- 0 = Absent: no publicly available evidence corresponding to the indicator;
- 1 = Implicit: the institution refers to the practice or technology without specifying concrete tools, procedures, or implementation mechanisms;
- 2 = Explicit: the institution documents the practice or technology through identifiable tools, systems, procedures, or implementation mechanisms.

### 2.4 Data Collection and Analysis

The coding protocol focused exclusively on documentary evidence. Consequently, coding decisions reflected levels of institutional formalisation and visibility rather than direct measures of technological adoption or effectiveness.

All identified evidence was independently reviewed and classified according to the coding scheme. To enhance consistency, coding procedures followed shared operational definitions and indicator descriptions. Ambiguous cases were discussed among the researchers until consensus was reached.

Following coding, descriptive statistics were calculated to identify patterns of documentary formalisation across the three categories. Frequencies and percentages of absent, implicit, and explicit evidence were used to compare levels of institutional visibility for Artificial Intelligence, learning analytics, and immersive technologies. The analysis aimed to provide a comparative overview of how technological innovation is formally represented within the assessment ecosystems of European online universities.

## 3. Results

Table 1 presents the distribution of coding scores (0 = absent, 1 = implicit, 2 = explicit) assigned to each institution across the three technological innovation categories considered in the analysis.

For reasons of readability, the table includes only those institutions for which at least one category received a score of 1 or 2, while institutions with scores of 0 across all three dimensions were excluded.

**Table 1:** Distribution of Coding Scores Across the Three Technological Innovation Categories

| | ***AI for feedback or scoring*** | ***Learning analytics*** | ***Immersive technologies*** |
|---|---|---|---|
| *Cosmos* | *0* | *2* | *0* |
| *German Open BS* | *1* | *2* | *2* |
| *Fernhochschule Hamburg* | *2* | *2* | *1* |
| *IUL* | *0* | *2* | *0* |
| *Marconi* | *0* | *1* | *2* |
| *Unitelma* | *0* | *1* | *2* |
| *da Vinci* | *0* | *2* | *0* |

| | | | |
|---|---|---|---|
| *Open Portugal* | *0* | *2* | *1* |
| *Swiss distance Education University* | *2* | *1* | *0* |
| *Arden University* | *2* | *1* | *0* |
| *Conservatoire Nationale* | *0* | *0* | *2* |
| *Tomorrow University of Applied Sciences* | *1* | *0* | *0* |
| *Universitat Oberta de Catalunya* | *0* | *2* | *0* |
| *HFH* | *2* | *1* | *0* |
| *AKAD* | *0* | *2* | *0* |

| | | | |
|---|---|---|---|
| *Unipegaso* | *0* | *2* | *0* |
| *Unimercatorum* | *0* | *1* | *0* |
| *San Raffaele* | *1* | *1* | *1* |
| *Open Universiteit Netherlands* | *0* | *1* | *1* |
| *Swiss Distance University of Applied Sciences* | *0* | *1* | *0* |
| *Open University* | *1* | *2* | *0* |
| *Open College of the Arts* | *0* | *1* | *0* |

The analysis reveals a heterogeneous and only partially consolidated landscape with regard to the institutional formalisation of technological innovation in assessment.

Learning analytics appears in a substantial proportion of universities through the use of dashboards, performance indicators, learning pathway monitoring systems,

and data-driven reporting mechanisms. The most advanced examples include the German Open Business School and Europäische Fernhochschule Hamburg (HFH), where analytics is integrated into institutional strategies supporting student monitoring, early intervention mechanisms, and evidence-based decision-making. Other institutions, such as Cosmos Open University, IUL, Telematic University Leonardo da Vinci, Open University of Portugal, and Universitat Oberta de Catalunya (UOC), also document significant uses of analytics, particularly for tracking participation, academic progression, and programme quality. However, in several cases, including Marconi University, Unitelma Sapienza, and Arden University, the use of analytics appears less explicitly connected to assessment processes, suggesting that data is often employed primarily for quality assurance and institutional monitoring rather than as a fully integrated component of assessment design.

The use of Artificial Intelligence for assessment-related purposes appears considerably less widespread. Explicit evidence of AI-supported assessment is concentrated in a small number of institutions. Europäische Fernhochschule Hamburg (HFH) represents the most advanced example, with its AI-based feedback system providing immediate formative feedback and supporting opportunities for revision and self-regulated learning. Swiss Distance Education University and Arden University also document AI-driven mechanisms aimed at personalised learning support and adaptive feedback. Other institutions, such as German Open Business School and Tomorrow University of Applied Sciences, demonstrate interest in AI through experimentation, research activities, or AI-powered learning assistants; however, the available evidence does not indicate a fully institutionalised use of AI for assessment, feedback, or automated scoring. Overall, AI appears to remain at an exploratory stage in most online universities, with only a limited number of cases demonstrating formal integration into assessment ecosystems.

Immersive technologies constitute the least formalised area of innovation. Nevertheless, a small group of institutions provides evidence of simulation-based environments, virtual laboratories, or virtual and augmented reality applications. Notable examples include Marconi University, Unitelma Sapienza, German Open Business School, and the Conservatoire National des Arts et Métiers, where immersive technologies are used to support the assessment of practical, professional, or applied competences through authentic learning environments. In contrast, institutions such as Open University of Portugal and Europäische Fernhochschule Hamburg show more limited or emerging forms of adoption, while

the majority of universities provide no substantial evidence of immersive assessment practices. Moreover, even where immersive technologies are present, their explicit integration into formal assessment procedures often remains unclear.

Furthermore, an examination of the mean scores assigned to the three innovation categories provides a synthetic overview of the level of institutional formalisation observed across the sample (Table 2).

**Table 2:** Mean scores of categories and dimension

| Category | Category | Category | **Dimension** |
|---|---|---|---|
| *AI for feedback or scoring* | *Learning analytics* | *Immersive technologies* | **Technologies and Innovation** |
| **M=0,3** | **M=0,8** | **M=0,3** | **M=0,4** |

Using the coding scale ranging from 0 (absent) to 2 (explicit), Learning Analytics achieved the highest average score (M = 0.8), indicating that data-driven monitoring and reporting systems represent the most visible and established form of technological innovation within the assessment ecosystems of the universities analysed. By contrast, both Artificial Intelligence for feedback or scoring (M = 0.3) and Immersive Technologies (M = 0.3) recorded considerably lower mean values, suggesting that these areas remain only marginally formalised and are documented in a limited number of institutions. When the three categories are considered together, the overall mean score is 0.4, confirming a generally low level of institutional formalisation of emerging technologies in assessment.
The distribution of frequencies further supports this interpretation (Table 3).

**Table 3:** Distribution of frequencies

| | Category | Category | Category |
|---|---|---|---|
| | *AI for feedback or scoring* | *Learning analytics* | *Immersive technologies* |
| **% of 0 Absent** | 80 | 50 | 82,5 |

| | | | |
|---|---|---|---|
| **% of 1 Implicit** | 10 | 25 | 7,5 |
| **% of 2 Explicit** | 10 | 25 | 10 |
| **Total** | **100 (n. 40)** | **100 (n. 40)** | **100 (n. 40)** |

For Artificial Intelligence, 80% of institutions showed no evidence of AI-based feedback or scoring systems, while only 10% provided implicit evidence and 10% explicit evidence. A similar pattern emerged for Immersive Technologies, with 82.5% of universities showing no evidence of virtual reality, simulation-based assessment, or related immersive environments, 7.5% providing implicit references, and only 10% documenting explicit implementation. Learning Analytics presented a substantially different profile: although 50% of institutions showed no evidence, 25% displayed implicit forms of adoption and a further 25% documented explicit institutional use. These results indicate that learning analytics has achieved a significantly higher degree of institutional visibility than the other two categories, while AI-supported assessment and immersive technologies remain largely absent from publicly available assessment-related documentation. Overall, the findings suggest that technological innovation within European online universities is characterised by selective adoption, with data-driven monitoring systems showing greater levels of institutional consolidation than technologies directly associated with personalised feedback or immersive assessment experiences.

## 4. Discussion

The findings show that technological innovation in assessment is unevenly formalised across the online universities analysed. Rather than revealing a homogeneous model of advanced digital assessment, the results point to a differentiated pattern in which learning analytics is the most visible and institutionally consolidated area, while Artificial Intelligence and immersive technologies remain more fragmented and less systematically embedded in assessment-related documentation.

A first relevant finding concerns the relatively stronger position of learning analytics. This result is consistent with the broader development of learning analytics as a field concerned with the collection, analysis and reporting of learner

data in order to understand and optimise learning environments (Siemens, 2013; Yan et al., 2024). In the institutions analysed, learning analytics is often documented through dashboards, performance indicators, tracking systems, exam statistics and reporting tools. These uses appear particularly compatible with the organisational needs of online universities, where digital platforms continuously generate data on student participation, progression and performance. In this sense, the greater visibility of learning analytics may be explained by its institutional utility: it supports monitoring, quality assurance, retention strategies and evidence-based decision-making. However, the findings also suggest that learning analytics is not always clearly connected to assessment design or formative feedback. In several cases, analytics appears to function mainly as a monitoring and reporting infrastructure rather than as a fully pedagogical assessment tool. This distinction is important. Previous research has shown that learning analytics can support student success and progression in higher education, but its educational value depends on the extent to which data are translated into meaningful interventions and learning support (Ifenthaler & Yau, 2020). From this perspective, the results of the present study indicate that many institutions have begun to institutionalise data-informed monitoring, but have not yet fully integrated analytics into assessment processes capable of generating personalised feedback, adaptive pathways or systematic formative intervention.

The second finding concerns the limited formalisation of Artificial Intelligence for feedback or scoring. Although AI is widely discussed in the literature as a technology capable of supporting automated grading, personalised feedback, adaptive assessment and intelligent tutoring (Swiecki et al., 2022; Lodge et al., 2023), the present analysis shows that explicit institutional evidence remains concentrated in a small number of cases. This suggests that, in online higher education, AI-supported assessment is still moving from experimentation towards institutional consolidation. This result is consistent with recent literature, which highlights both the potential and the risks of AI in education (Holmes et al., 2023; Kasneci et al., 2023). AI can increase efficiency, scalability and immediacy in assessment processes, particularly through automated feedback and grading support (Kamalov et al., 2023; Deepshikha et al., 2026). At the same time, its use raises important concerns related to bias, transparency, explainability, data protection and the preservation of human judgement. The limited level of formalisation found in this study may therefore reflect not only a lack of technological maturity, but also the complexity of embedding AI responsibly within assessment systems. In other

words, institutions may be experimenting with AI tools faster than they are able to regulate, document and integrate them into formal assessment policies.

The third finding relates to immersive technologies, which represent the least formalised area in the sample. Although virtual reality, augmented reality and simulation-based environments are increasingly discussed as tools for authentic and experiential learning (Radianti et al., 2020), their use for assessment purposes remains marginal in the institutional documentation analysed. This is particularly significant because immersive environments have strong potential for assessing practical, professional and complex competences in realistic contexts. Recent reviews show that VR can support interactive learning environments and hands-on training in higher education, but they also highlight persistent challenges related to infrastructure, cost, pedagogical design, accessibility and staff expertise (Stracke et al., 2025; Llanos-Ruiz et al., 2025). The weak formalisation of immersive assessment may therefore be interpreted as the result of higher implementation requirements. Unlike learning analytics, which can often be integrated into existing learning management systems and quality assurance processes, immersive technologies generally require more substantial redesign of assessment tasks, specialised platforms, technical support and teacher training. Their limited presence in formal documentation suggests that they remain associated with localised initiatives or disciplinary experimentation rather than with institution-wide assessment strategies.

Taken together, these findings reveal a hierarchy of institutional innovation. Learning analytics appears to be the most institutionalised technology because it aligns closely with existing organisational priorities such as monitoring, reporting and quality assurance. AI occupies an intermediate position: it is increasingly visible in educational discourse and appears in some advanced cases, but its integration into formal assessment systems remains cautious and uneven. Immersive technologies occupy the weakest position, as their assessment-related use requires deeper pedagogical and infrastructural transformation.

This hierarchy suggests that innovation in digital assessment does not progress only according to technological potential. Rather, it depends on the degree to which technologies can be absorbed into institutional routines, governance structures and quality assurance systems. Technologies that support existing institutional functions are more likely to be formalised, whereas technologies requiring substantial pedagogical redesign or new regulatory frameworks remain less visible.

## Conclusions, Limitations and Future Research

This study examined the institutional formalisation of technological innovation in assessment across 40 accredited European online universities. The findings reveal a differentiated pattern of adoption, with learning analytics emerging as the most visible and institutionalised area, while Artificial Intelligence for feedback or scoring and immersive technologies remain less systematically documented. Overall, the results suggest that the integration of emerging technologies into assessment ecosystems is still evolving and that substantial differences exist in the extent to which institutions formalise and communicate innovation through publicly available policies, strategies, and assessment-related documentation.

Some limitations should be acknowledged. The analysis relied exclusively on publicly available institutional documentation and therefore reflects the visibility and formalisation of technological innovation rather than its actual implementation in educational practice. Furthermore, differences in institutional transparency and website organisation may have affected the availability of evidence across universities. The study also does not evaluate the effectiveness, pedagogical quality, or impact of the technologies identified.

Future research could complement documentary analysis with interviews, surveys, and in-depth case studies involving institutional leaders, academic staff, and assessment designers. Such approaches would help to explore how emerging technologies are implemented in practice and to what extent formal institutional commitments correspond to actual assessment practices and learning experiences.

## Author contributions

The article was jointly developed by all the authors. Specifically, paragraph 1 was written by Anna Dipace, paragraph 1.1 by Federica Picasso, paragraph 2 by Irene D. M. Scierri, paragraph 3 by Maria Clara Dicataldo, paragraph 4 by Andrea Tinterri, and paragraph “Conclusions, Limitations and Future Research” by Pierpaolo Limone.

## References

Bandtel, M., Baume, M., Benke-Aberg, R., Brinkmann, E., Bedenlier, S., Budde, J., Eugster, B., Ghoneim, A., Halbherr, T., Persike, M., Rampelt, F., Reinmann, G., Sari,

Z., & Schulz, A. (2022). *Digital Assessment in Higher Education. Perspectives of a European Community of Practice.* Whitepaper No 65 / November 2022.

Benavides, L. M. C., Tamayo Arias, J. A., Arango Serna, M. D., Branch Bedoya, J. W., & Burgos, D. (2020). Digital transformation in higher education institutions: A systematic literature review. *Sensors*, 20(11), 3291.

Black, P., & Wiliam, D. (1998). Assessment and classroom learning. Assessment in Education: principles, policy & practice, 5(1), 7-74.

Carless, D., & Boud, D. (2018). The development of student feedback literacy: Enabling uptake of feedback. *Assessment & evaluation in higher education*, 43(8), 1315-1325.

Cappuccio M.L. (2019), (edited by). *Handbook of Embodied Cognition and Sport Psychology*. Cambridge: MIT Press.

Deepshikha D (2026). A systematic review on the future of educational assessment: AI-driven grading and personalised feedback in higher education. *Artificial Intelligence in Education, 2* (2), 75–115. https://doi.org/10.1108/AIIE-03-2025-0036

Devedžić, V. B., & Devedžić, M. (2019). Technology-Enhanced Assessment at universities and in schools: An initiative. *International Journal of Learning and Teaching*, 11(3), 89–98.

European Association of Distance Teaching Universities (EADTU). (2012). *Quality assessment for E-learning: a benchmarking approach* (second edition).

Ferguson, R. (2014). Learning Analytics: fattori trainanti, sviluppi e storie. *Italian Journal of Educational Technology*, 22(3), 138-147.

Gašević, D., Dawson, S., & Siemens, G. (2015). Let's not forget: Learning analytics are about learning. *TechTrends*, 59(1), 64-71.

Holmes, W., Bialik, M., & Fadel, C. (2023). Artificial intelligence in education. İçinde C. Stückelberger & p. Duggal (Editörler). Data ethics: building trust : how digital technologies can serve humanity. (ss. 621-653). *Globethics Publications.*

Ifenthaler, D., & Yau, J.YK. (2020). Utilising learning analytics to support study success in higher education: a systematic review. *Educational Technology Research and Development 68*, 1961–1990. https://doi.org/10.1007/s11423-020-09788-z

JISC (2020). The future of assessment: five principles, five targets for 2025. https://www.jisc.ac.uk/reports/the-future-of-assessment-five-principles-five-targets-for-2025

Kamalov, F., Santandreu Calonge, D., Gurrib, I. (2023). New era of artificial intelligence in education: Towards a sustainable multifaceted revolution. *Sustainability*, 15, 12451. https://doi.org/10.3390/su151612451

Kasneci, E., Seßler, K., Küchemann, S., Bannert, M., Dementieva, D., Fischer, F., ... & Kasneci, G. (2023). ChatGPT for good? On opportunities and challenges of large language models for education. *Learning and individual differences, 103*, 102274. https://doi.org/10.1016/j.lindif.2023.102274

Llanos-Ruiz, D., Abella-García, V., & Ausín-Villaverde, V. (2025). Virtual Reality in Higher Education: A Systematic Review Aligned with the Sustainable Development Goals. *Societies, 15*(9), 251. https://doi.org/10.3390/soc15090251

Lodge, J., Howard, S., Bearman, M. L., Dawson, P., & Associates (2023). Assessment Reform for The Age of Artificial Intelligence. *Tertiary Education Quality and Standards Agency*. https://www.teqsa.gov.au/sites/default/files/2023-09/assessment-reform-age-artificial-intelligence-discussion-paper.pdf

Nicol, D. J., & Macfarlane-Dick, D. (2006). Formative assessment and self-regulated learning: A model and seven principles of good feedback practice. *Studies in higher education*, 31(2), 199-218.

Radianti, J., Majchrzak, T. A., Fromm, J., & Wohlgenannt, I. (2020). A systematic review of immersive virtual reality applications for higher education: Design elements, lessons learned, and research agenda. *Computers & education, 147*, 103778. https://doi.org/10.1016/j.compedu.2019.103778

Redecker, C., & Johannessen, Ø. (2013). Changing assessment—Towards a new assessment paradigm using ICT. *European Journal of Education*, 48(1), 79-96.

REMOTE Project. (2025, April 4). *Guidelines for remote assessment in STEM* (WP4-A8).

Rossade, K. D., Janssen, J., Wood, C., & Ubachs, G. (2022). *Designing Online Assessment – Solutions that are Rigorous, Trusted, Flexible and Scalable.* Maastricht, The Netherlands: EADTU.

Scierri, I. D. M., Picasso, F., Di Cataldo, M. C., & Dipace, A. (2026, in press). Institutional policy responses to generative AI in European higher education: a scoping review of published research. *Research on Education and Media*.

Siemens, G. (2013). Learning analytics: The emergence of a discipline. *American behavioral scientist*, 57(10), 1380-1400.

Stracke, C.M., Bothe, P., Adler, S. et al. (2025). Immersive virtual reality in higher education: a systematic review of the scientific literature. *Virtual Reality 29*, 64. https://doi.org/10.1007/s10055-025-01136-x

Swiecki, Z., Khosravi, H., Chen, G., Martinez-Maldonado, R., Lodge, J. M., Milligan, S., Selwyn, N., & Gasevi ˇ c, D. (2022). Assessment in the age of artificial intelligence. *Computers and Education: Artificial Intelligence, 3*, 100075.

Villarroel, V., Bloxham, S., Bruna, D., Bruna, C., & Herrera-Seda, C. (2018). Authentic assessment: Creating a blueprint for course design. *Assessment & Evaluation in Higher Education*, 43(5), 840-854.

Yan, L., Martinez-Maldonado, R., & Gasevic, D. (2024). Generative artificial intelligence in learning analytics: Contextualising opportunities and challenges through the learning analytics cycle. In *Proceedings of the 14th learning analytics and knowledge conference* (pp. 101-111). https://doi.org/10.1145/3636555.3636856

Zawacki-Richter, O., Mar ́ın, V. I., Bond, M., & Gouverneur, F. (2019). Systematic review of research on artificial intelligence applications in higher education – Where are the educators? *International Journal of Educational Technology in Higher Education*, 16(1), 1–27.

**Appendix 1:**

| **University** | **Country** |
|---|---|
| AKAD University of Applied Sciences Leipzig | Germany |
| Arden University | United Kingdom |
| Atatürk University | Türkiye |
| Conservatoire national des arts et métiers | France |
| Cosmos Open University | Cyprus |
| Digital Business University of Applied Sciences | Germany |
| Europäische FernHochschule Hamburg GmbH Hamburg (Priv. FH) | Germany |
| Ferdinand Porsche FERNFH - Distance-Learning University of Applied Sciences | Austria |
| German open Business School - HS für Wirtschaft und Verwaltung Berlin (Priv- FH) | Germany |

| | |
|---|---|
| Hellenic Open University | Greece |
| HFH Hamburger Fern-Hochschule (Priv. FH) | Germany |
| International Online University UNINETTUNO | Italy |
| International University of La Rioja | Spain |
| Italian University Line - IUL | Italy |
| Marconi University | Italy |
| Online University "e-Campus" | Italy |
| Online University "Giustino Fortunato" | Italy |
| Online University "Pegaso" | Italy |
| Online University San Raffaele Rome | Italy |
| Open College of the Arts | United Kingdom |
| Open University of Catalonia | Spain |
| Open University of Cyprus | Cyprus |
| Open University of Madrid (UDIMA) | Spain |
| Open University of Portugal | Portugal |
| Open University of the Netherlands | Netherlands |
| SRH Fernhochschule Riedlingen | Germany |
| Stichting LOI Hoger Onderwijs | Netherlands |
| Swiss Distance Education University | Switzerland |
| Swiss Distance University of Applied Sciences | Switzerland |
| Telematic University Leonardo da Vinci | Italy |
| The Open University | United Kingdom |
| Tomorrow University of Applied Sciences | Germany |
| UNIPRO University Digital Europe | Andorra |
| Unitelma Sapienza | Italy |
| Universidad Nacional de Educación a Distancia (Madrid) | Spain |
| Universitas Mercatorum | Italy |
| University Niccolò Cusano | Italy |
| University of Hagen | Germany |
| Valencian International University | Spain |
| Wilhelm Büchner Hochschule Darmstadt (Priv. Fern-FH) | Germany |