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Designing faculty standards for technology integration in higher education institutions: a design-based research study

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Abstract
This design-based research study responds to the call from scholars, organizations, and institutions to address the gap in scholarly knowledge regarding the lack of technology standards for faculty in higher education. These standards cover the three areas of faculty workload: teaching, research, and service. Conducted over two iterative macro cycles, this unique study engaged 114 participants, including faculty from a range of disciplines and institutional types, accreditation organizations and coordinators, and education and technology organizations. The outcome is a framework comprising six faculty standards; Instructor, Coordinator, Leader, Researcher, Learner, and Contributor. Each outcome is accompanied by practical indicators that support effective, ethical, and contextually relevant technology use across teaching, research, and service. Faculty, administrators, and academic support staff, including Deans, Provosts, accreditation leads, instructional designers, researchers, and curriculum developers, can use these standards to provide a flexible structure to guide faculty development, inform institutional planning, and align with accreditation processes.

Globally, faculty in higher education (HE) institutions undertake three core responsibilities: teaching, research, and service. In broad terms, teaching involves the design and teaching of courses to facilitate student learning. Research advances disciplinary knowledge through scholarly inquiry. Service includes contributions to the university, profession, and community. The relative emphasis placed on each of these areas varies according to institutional type (e.g. Carnegie Classification of Institutions of Higher Education (2025) and global context. Within HE, digital technologies have been used to improve and enhance teaching and learning across disciplines (Gurevych et al., 2021), support student engagement (Bedenlier et al., 2020), improve practices and enrollment systems (Tømte et al., 2019), and introduce novel approaches that enhance the speed and efficiency of digital data analysis (Massaro, 2023).

However, HE faculty do not always have sufficient knowledge and understanding to effectively take advantage of the affordances of digital technologies (Drew et al., 2021).

Faculty often use technology to replicate current teaching practices and do not employ technology in a manner that alters existing educator-centered approaches (Amhag et al., 2019; Ferede et al., 2022). Furthermore, faculty report that they have low or medium-low digital competence (Basilotta-Gomez-Pablo et al., 2022). This acknowledgment of the low level of competence reinforces the need for standards for HE faculty. The lack of sufficient expertise among higher education faculty has prompted increasing interest from scholars (e.g., Basilotta-Gomez-Pablo et al., 2022, Sobeida et al., 2024, Tondeur et al., 2023), organizations (e.g., Higher Learning Commission (HLC), 2023; The American Association of State Colleges and Universities (AASCU), 2024) and institutions (e.g., Indiana University Faculty Academy on Excellence in Teaching (IUFACET), 2025; University of Central Florida's Division of Digital Learning (UCFDDL), 2025) in establishing a set of digital standards and competencies to ensure faculty are adequately prepared to use these tools effectively. A common set of standards can provide benchmarks against which faculty can measure their use of digital technologies and guide their professional development.

The purpose of this study is to answer this call from scholars, organizations, and institutions by developing a set of technology standards specifically for HE faculty. These standards will also provide indicator descriptors that illustrate examples of effective implementation for each standard. This study focuses on the use of digital technologies, which are defined as tools and systems that transform analog data, such as text, sound, and images, into digital formats for fast and accurate processing, storage, and sharing. They include hardware (e.g., devices and sensors), software (e.g., applications), and communication networks (Cetindamar & Phaal, 2023; Li et al., 2024). Faculty are defined as higher education professionals responsible for teaching, research, and service.

Literature review

The COVID-19 pandemic further exposed critical gaps in faculty preparedness for using technology, as the abrupt shift to remote modalities necessitated the use of digital tools to sustain teaching, research, and service responsibilities. Empirical studies indicate that faculty encountered substantial difficulties in delivering instruction and maintaining student engagement, often struggling with even basic pedagogical and communication practices in digital environments (Sum & Oancea, 2022). Additionally, faculty experienced significant challenges conducting research through online platforms, particularly in addressing technical issues and navigating unfamiliar methodological constraints (Xue & Crompton, 2022).

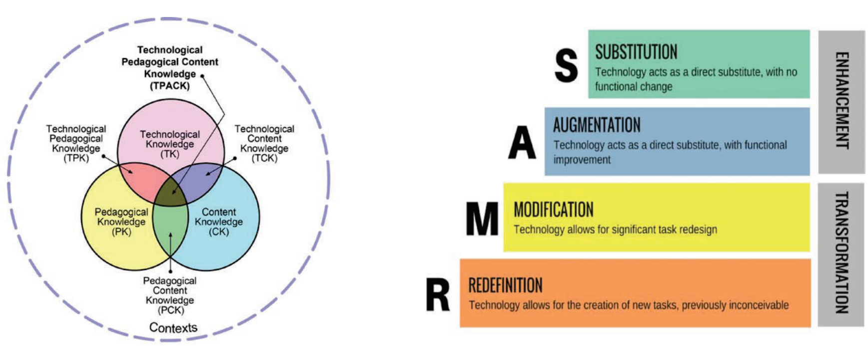
In the post-pandemic context, evidence suggests that many students have come to value the flexibility and convenience of online, hybrid, and blended learning formats (Dabbagh et al., 2019, McKinsey, 2022). Concomitantly, as institutions face the emerging "enrollment cliff" marked by declining student numbers (Best Colleges, 2024), universities are increasingly turning to expanded digital offerings as a strategic means to attract and retain students by providing greater flexibility and choice. These efforts aim not only to appeal to traditional college-aged students but also to meet the needs of non-traditional learners, including working adults, caregivers, and individuals seeking to reskill or upskill through more flexible educational pathways (Mowreader, 2025). A critical factor in the successful integration of technology in HE is a faculty's ability to know why, when, and how best to implement technology (Feng et al., 2025). It is important to recognize, accredit, and certify these competencies. Doing so would provide valid and transparent instruments to guide faculty as they work to increase their effectiveness in teaching in a digital world (Basilotta-Gomez-Pablo et al., 2022).

Extant frameworks

Theoretical frameworks play a crucial role in the implementation of digital technologies as they assist in implementation efforts and provide a structured approach to understanding how technology can enhance teaching and learning. (Chugh et al., 2023). Faculty can use a theoretical framework to ensure that their technology integration efforts are aligned with established principles and best practices, leading to more effective and sustainable outcomes (Çer, 2025). A number of frameworks currently exist to provide guidance for educators.

The Technological, Pedagogical, and Content Knowledge framework (TPACK: Koehler & Mishra, 2014) is a framework developed for K-12 teachers that represents three types of knowledge that educators should have: technological, pedagogical, and content knowledge (see Fig. 1). This framework is represented by a three-circle Venn diagram which indicates how the three types of knowledge work together for effective technology integration. This framework allows teachers to think about how the three types of knowledge intersect. This framework is similar for technology integration processes in HE, with andragogy replacing pedagogy to focus on HE learners. However, scholars note that the TPACK framework has unclear boundaries (Angeli & Valanides, 2009) and uneven intersections which connote that parts of the framework are more important than others (Chai et al., 2011).

The Replacement, Amplification, and Transformation (RAT) framework (Hughes et al., 2006) outlines three stages of technology integration (see Fig. 1), progressing from using technology as a direct substitute for traditional methods (replacement), to enhancing instructional efficiency (amplification), and finally to creating entirely new instructional practices (transformation). Educators found the shift from amplification to transformation challenging, prompting the development of the SAMR model by Puentedura (2009), which expands RAT into a four-level continuum: substitution, augmentation, modification, and redefinition. While SAMR offers a more detailed progression, scholars (Crompton & Burke, 2020; Cherner & Mitchell, 2021; Hamilton et al., 2016) have critiqued its lack of theoretical grounding and its emphasis on technological outcomes over pedagogical processes.



TPACK Framework (Mishra & Koehler, 2006) SAMR Model (Puentadera, 2009)

Fig. 1 TPACK and SAMR framework

The Socio-Ecological Technology Integration (SETI: Crompton et al., 2024) framework provided more details than TPACK, RAT, and SAMR to include other aspects, such as training, tech support, policies as well as taking into account individual beliefs and national socio-cultural tech norms, See Fig. 2.

These frameworks are helpful in providing overarching guidance, but a set of digital standards and competencies would extend these frameworks further to provide a more granular review of standard benchmarks for faculty to use digital tools effectively (Basilotta-Gomez-Pablo et al., 2022, Sobeida et al., 2024).

Extant standards

A review of the existing academic literature reveals the lack of any such comprehensive standards for HE. Standards that do exist focus primarily on pre-collegiate educators. The International Society for Technology in Education, UNESCO, and the European Union developed a set of standards for K-12 teachers. ISTE developed standards for K-12 educators. These standards provide competencies for learning, teaching, and leading with technology (ISTE, 2024). They focus on seven areas for educators: learner, leader, citizen, collaborator, designer, facilitator, and analyst. UNESCO's (2018), the United Nations intelligence division developed the ICT Competency Framework for Teachers has designed educator technology competencies to support countries in developing comprehensive K-12 educator technology standards. The six areas of these

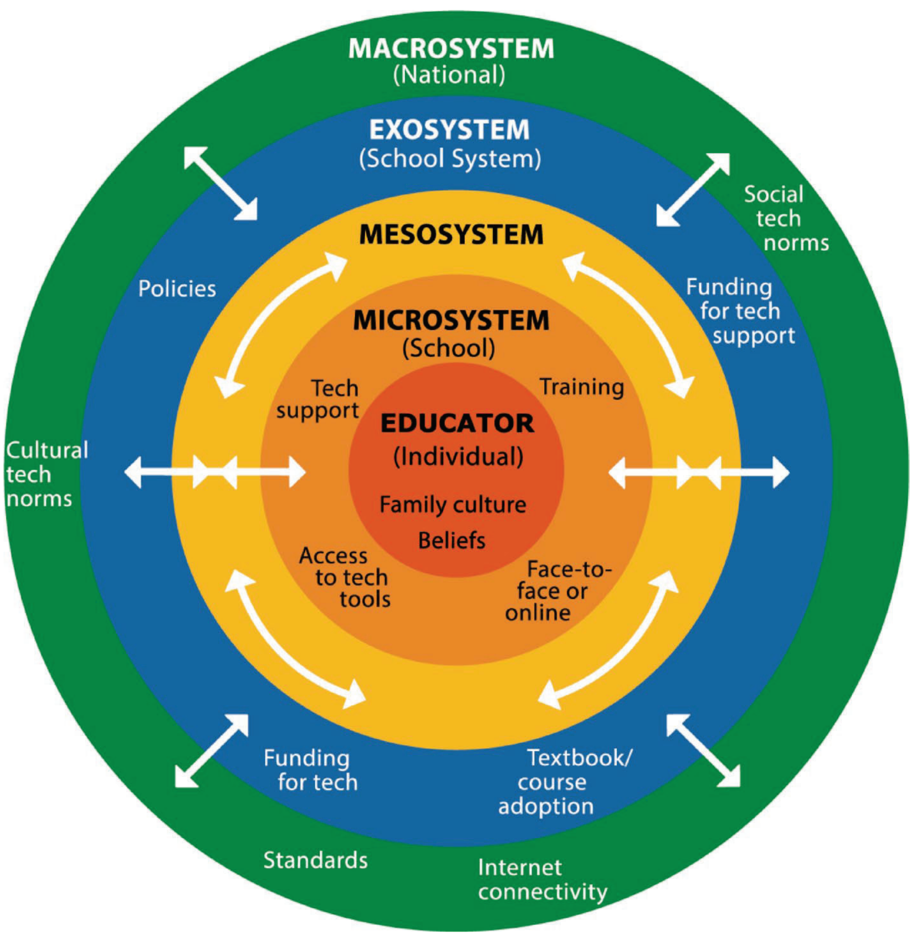


Fig. 2 Socio-ecological technology integration (Crompton et al., 2024)

competencies are (1) understanding ICT in education, (2) curriculum and assessment, (3) pedagogy, (4) application of digital skills, (5) organization and administration, and (6) teacher professional learning. The European Framework for the Digital Competence of Educators (DigCompEdu: Redecker, & Punie, 2017), delineates 22 educator-specific digital competencies organized into six areas: (1) Professional Engagement, (2) Digital Resources, (3) Teaching and Learning, (4) Assessment, (5) Empowering Learners, and (6) Facilitating Learners' Digital Competence. While these K-12 standards provide some guidance for HE faculty, they do not specifically focus on faculty working in HE and only address the teaching portion of a faculty's role.

A review of HE organizations indicates a recognition of the need for HE faculty digital competencies; however, most do not publish specific, detailed technology standards. The Association of American Colleges & Universities (AAC&U) (2024) integrates technology, digital learning, and equity-focused innovation into its broader standards and initiatives for faculty development and institutional effectiveness. The Higher Learning Commission (HLC) does not prescribe specific technology standards for faculty; however, it acknowledges the evolving nature of educational environments and the role of technology in teaching and learning, and the encourages institutions to support faculty in staying current with technological advancements relevant to their disciplines and teaching methodologies (2023).

Discipline specific professional organizations often provide general guidance regarding the use of digital technologies in their professions. The National League for Nursing (NLN) has established Core Competencies for Academic Nurse Educators to guide nurse educators in effectively preparing nursing students for contemporary practice (Wells-Beede et al., 2023). While these competencies do not explicitly list technology standards, they do encompass the integration and proficient use of technology in nursing education. Similarly, the Accreditation Board for Engineering and Technology (ABET) sets accreditation standards for engineering and technology programs, emphasizing the integration of technology to ensure graduates are well-prepared for professional practice (ABET, 2025). The Association of College and Research Libraries (ACRL) provides guidelines and standards to enhance the effectiveness of academic libraries. While ACRL does not set explicit technology requirements for faculty, it emphasizes the integration of technology in several key areas to support teaching, learning, and research (Free, 2021). In the discipline of teacher education, The Teacher Educator Technology Competencies (TETCs) define competencies all teacher-educators need to support teacher-education candidates (Foulger et al., 2017). While discipline specific HE organizations acknowledge the importance of technology integration into HE teaching practices, these do not provide a set of standards for those in higher education to encompass teaching, research, and service across disciplines.

One context within higher education in which technology standards have been developed is the online and hybrid learning environment. The Quality Matters (QM: n.d.) Framework provides a set of standards specifically focused on the design of online and hybrid courses. These standards serve as a guide for faculty in the development and evaluation of course structure. However, the QM Framework is limited to design elements and does not address standards related to course content, instructional facilitation, or implementation processes (Sheets et al., 2023). The Higher Education Digital Competence (HeDiCom) framework includes four dimensions of faculty digital competencies:

(1) Teaching practice, (2) Empowering students for a digital society, (3) Educators' digital literacy, and (4) Educators' professional development (Tondeur et al., 2023). These standards do provide faculty in higher education with some guidance on how to integrate technology into some teaching aspects of their role, but they do not cover all other areas related to teaching nor the research that many faculty are responsible for, and the service in serving on committees or reviewing academic peer review papers.

Purpose of the study

The purpose of this study is to respond to the call of scholars (Basilotta-Gomez-Pablo et al., 2022, Sobeida et al., 2024, Tondeur et al., 2023), organizations (HLC, 2023; AASCU, 2023), and institutions (IUFACET, 2025; UCFDDL, 2025) to address the gap in scholarly knowledge regarding the lack of technology standards for HE faculty. The two questions guiding this research are:

Research Questions:

1. What key standards should faculty demonstrate when integrating technology in higher education?
2. What indicators can be provided to faculty as examples of meeting these standards?

Methods

A design-based research method (Gravemeijer & van Eerde, 2009) was used to answer the two questions guiding this study. This study included two macro cycles, involving a cyclical method of design, experiment, and retrospective analysis. A theory of ontological innovation was then developed to provide a set of technology integration standards for faculty in higher education.

Participants.

A total of 114 individuals participated in the study. Of the 49 higher education institutions invited, 28 institutions agreed to participate. To ensure the standards represent the different types of higher education institution, five categories of institutions were identified (see Table 1), and two institutions were selected from each category for each macro cycle.

From each institution, faculty were selected to represent nine discipline areas (see Table 2). Some of the institutions will not have faculty to represent all discipline areas. These institutions would include those that they have. Nonetheless, from the faculty that agreed to participate, not all completed the survey, and the total numbers of those that

Table 1 Institutional types

Type of Institution	Description
Research Universities	Doctorate-granting Universities are institutions that awarded at least 20 research/scholarly doctorates in the update year (the most recent being a minor update in 2021)
Masters' Universities	Master's Colleges and Universities are institutions that "awarded at least 50 master's degrees in 2013–14, but fewer than 20 doctorates."
Baccalaureate Colleges	Baccalaureate Colleges are institutions where "bachelor's degrees accounted for at least 10% of all undergraduate degrees and they awarded fewer than 50 master's degrees (2013–14-degree conferrals)."
Associate Colleges	Associates Colleges are institutions whose highest degree is the associate degree, or bachelor's degrees account for fewer than 10% of all undergraduate degrees (2013–14-degree conferrals)

(Carnegie, 2025)

Table 2 Faculty disciplines

Discipline	Examples
Humanities	Literature, History, Philosophy, Arts
Social Sciences	Sociology, Psychology, Political Science, Economics, Education
Natural Sciences	Physics, Chemistry, Biology, Earth Sciences
Formal Sciences	Mathematics, Computer Science, Statistics
Applied Sciences	Engineering, Medicine, Environmental Science, Agricultural Sciences
Business	Business Administration, Finance, Marketing, Accounting
Law	Criminal Law, Civil Law, International Law
Fine and Performing Arts	Music, Theatre, Dance, Film Studies
Interdisciplinary Studies	Gender Studies, Environmental Studies, Cognitive Science

Table 3 Participants

Participant title	*N*	Role/participant description
Faculty	73	Faculty from different types of institutions were selected to represent different disciplines and academic levels. These participants completed a survey. These were faculty from the USA representing nine states geographically spread across the country
International Faculty	12	Faculty working at institutions outside of North America represented 11 different countries across six continents
Directors of Centers for Teaching	7	Those leading university centers to support faculty in their teaching duties completed a survey
Institutional Accreditation Coordinators	9	People responsible for institution-wide accreditation completed a survey
Educational Technology Organizations	6	People representing educational technology organizations were interviewed
Accrediting Associations	3	People representing discipline specific accrediting associations were interviewed
Global Education Organizations	4	People representing global education organizations completed a survey
Total	114	

Further details on the types of faculty disciplines and academic levels are described below the table

participated are included in Table 3. Faculty respondents taught both undergraduate and graduate students, with approximately one quarter working with graduate students due to some of the institutional types only working with undergraduate students. These numbers align with the typical distribution of higher education students with the large majority undergraduates.

In addition to the faculty participating from the selected institutions, Directors of Centers for Teaching, and Institutional Accreditation Coordinators also participated from that institution. International faculty at other institutions participated providing an international perspective across the disciplines. To gain the voice of the wider community, key personnel at education technology associations, accrediting associations, and global organizations were also included. Table 3 presents the participant role, number of participants, and a description of how they were selected and their role in the study.

Design-based research protocol for this study

Design-based research has been selected as the empirical method used to develop the set of educational technology standards. This method is especially relevant for educational purposes as design-based research is (1) situated in a real educational context, (2) focused on the design and testing of a significant intervention, (3) uses mixed methods where appropriate, (4) involves multiple iterations, (5) involves a collaborative partnership between researchers and practitioners, (6) involves the evolution of design principles, and (7) provides practical impact on practice (Anderson & Shattuck, 2012). The specific design-based research protocol selected for this study was developed by Gravemeijer and colleagues (Gravemeijer, 1994; Gravemeijer & Cobb, 2006; Gravemeijer & van Eerde, 2009).

The main element of design-based research is the development of an ontological innovation, which is generating, selecting, and validating design alternatives for learning (diSessa & Cobb, 2009). The ontological innovation is a set of educational technology standards that are developed through macro cycles involving a process of design, implementation, analysis, and revision.

This design-based research study involved two macro cycles with the three phases within each macro cycle: (a) instructional design, (b) experiment and mini cycle analysis, and (c) retrospective analysis (See Fig. 3). In the design phase, standards are developed as a conjectured theory of ontological innovation. The experiment is when the standards are tested to see if they function as needed. The mini cycle of analysis refers to the ability to revise the standards as needed rather than waiting until the end of a macro cycle. The retrospective analysis is when all data are analyzed together at the end of the. This is then repeated in the next macro cycle.

Instructional design

In Macro Cycle One, a review of extant literature was conducted and from that a set of standards were developed. This served as the initial conjectured theory of ontological innovation. In the instructional design of the second macro cycle, a revised set of

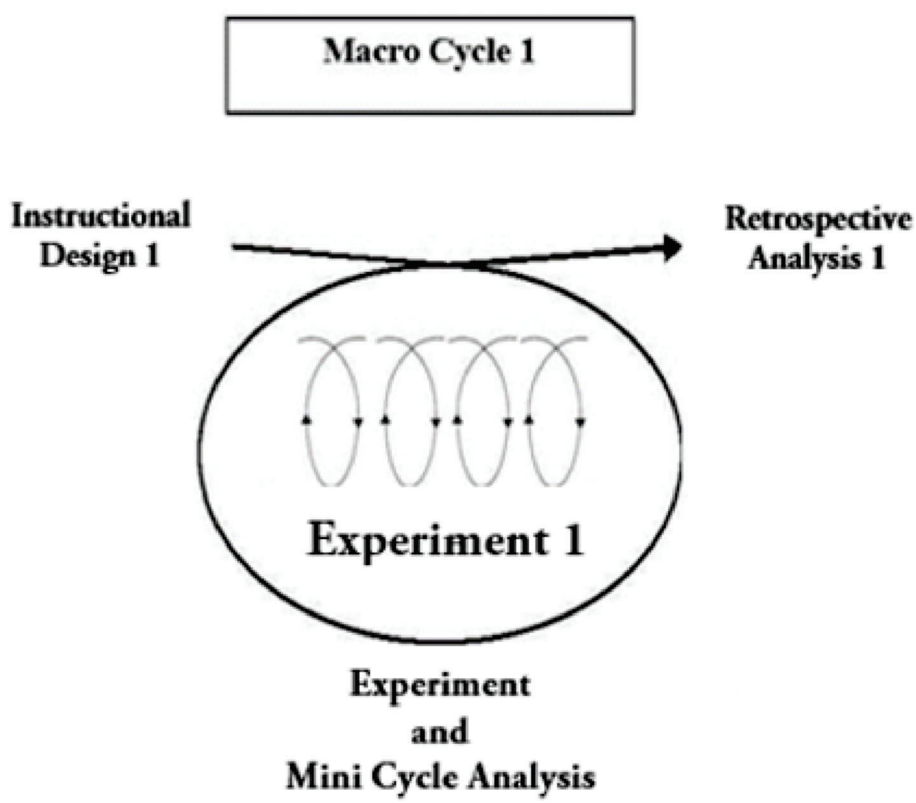


Fig. 3 One macro cycle of design-based research (Gravemeijer & van Eerde, 2009)

standards were developed from a further review of the literature and from the findings of Macro Cycle One.

Experiment

In Macro Cycle One, Faculty ($n=20$) had 2–4 weeks to review and explore how they could implement the standards in their practice. Centers for Teaching and Learning ($n=4$), and Accreditation Coordinators ($n=4$) at those institutions were given the same time to report on the alignment to pedagogies and accreditation requirements. Feedback from these participants was collected through an online Qualtrics survey. International Faculty ($n=5$) from across disciplines, and Global Education Organizations ($n=1$), also provided feedback through survey. Key personnel at Accrediting Associations ($n=1$), and Educational Technology Organizations ($n=3$) provided feedback through interviews. During the experiment, any changes needed to be rectified immediately were done through the mini cycle of analysis.

Macro Cycle Two followed the same format as Macro Cycle One with these numbers of participants: Faculty ($n=58$), Centers for Teaching and Learning ($n=3$), Accreditation Coordinators ($n=4$), International Faculty ($n=7$), Global Education Organizations ($n=0$), Accrediting Associations ($n=2$), and Educational Technology Organizations ($n=3$).

Retrospective analysis

During the retrospective analysis, all the data gathered from the design and experiment were analyzed. The standards were then revised and made ready for feedback in Maco Cycle Two. The revisions made during the retrospective analysis in Macro Cycle Two were the set of standards at the conclusion of the study.

Data collection and analysis

Design-based research involves various sources of data which provide a comprehensive understanding to direct the design of the standard (Cobb et al., 2003). Data in this study includes feedback from multiple groups via surveys and interviews. A diagrammatical representation of the study and data collection points is presented in Fig. 4.

Surveys

Seven different participant groups completed surveys during the experimental phase. Faculty surveys had faculty responding to five questions that were developed for each of the standards, questioning clarity, usefulness, connectivity, and revisions. The Center for Learning and Teaching participants answered six questions similar to the faculty that focused on the standards as a whole. Institutional Accreditation Coordinators completed the same type of questions with the addition of a question that asked about aligning with accreditation requirements. Key people at higher education associations and global organizations responded to three questions requesting feedback on quality and alignment of the standards. Data from the surveys were quantitatively gathered from the Likert ratings and the text responses were qualitatively coded.

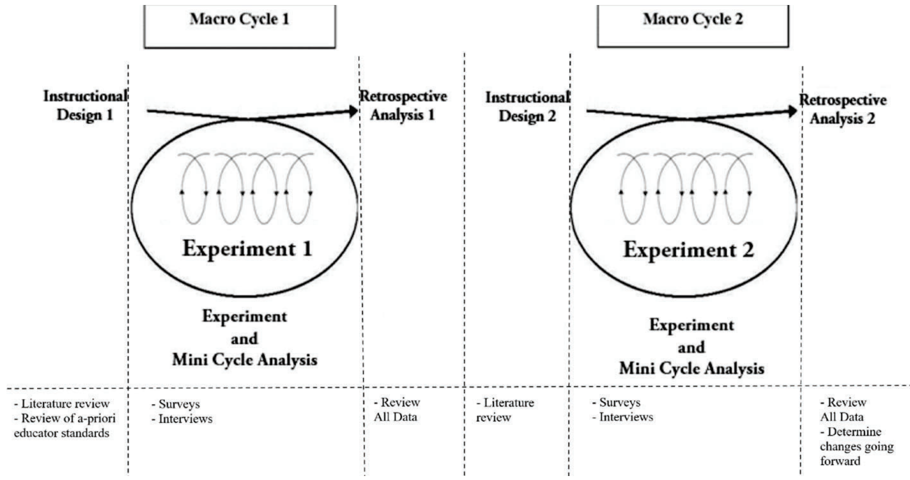


Fig. 4 A diagrammatical representation of the study and data collection points

Interviews

In the experiment, key personnel at technology education associations and discipline specific accrediting organizations were interviewed using a semi-structured approach. Aligned to the study purpose, three overarching questions were asked about how the standards supported in the various responsibilities that faculty have, how they met the standards required in the discipline, and how they could prepare students for their future jobs. Interview transcripts were coded.

Coding

Data from the surveys and interviews were qualitatively coded using a grounded theory design with a constant comparative method (Strauss & Corbin, 1998). In the first step, the participant responses were open coded by four researchers to identify important themes in the data and then were labelled. The study of the data was an iterative and inductive process. The initial codes led to intermediate coding and the constant comparison of feedback data to feedback data, feedback data to codes, codes to codes, codes to categories, and categories to categories. The codes were deemed to be theoretically saturated once data continued to fit into existing categories and no additional categories were needed. In this study, the codes highlight the findings of what revisions need to be made to the standards. In collective discussion, the four researchers reviewed the codes to determine the revisions and 100% agreement was achieved. These standards are the conjectured theory of ontological innovation.

Findings and discussion

The objective of this study was to develop an ontological innovation that identifies the standards to guide faculty in the effective integration of technology within higher education and determine the indicators that reflect the activities aligned with these standards. Aligned with Gravemeijer and van Eerde's (2009) Design-Based Research used in this study, the findings present the results of the retrospective analysis of Macro Cycles One and Two with examples of the changes made.

Macro cycle one retrospective analysis

Following the instructional design phase of Macro Cycle One, the resulting conjectured standards were developed (see Appendix A). The participants were positive overall about the conjectured standards. An accreditation association noted that faculty would be able to use these standards and see that they are well fitted to faculty roles and, "they are a call for comprehensive integration of technology". Another accreditation association wrote, "These Standards exceed most accreditation requirements, so in this thinking if they follow these standards, they should be meeting their other standards". In response to the question "What is missing?" an institutional accreditation coordinator stated, "I think the question ought to be flipped to: What is missing in institutional accreditation requirements in relation to these standards?"

While there were positives, the data also revealed changes needed to both the standards and the indicators that provide the faculty with examples of what the standards would look like in practice. (see Fig. 5). With these codes, there were axial codes of other changes needed within the primary codes.

Standards

From the coding of the data, there were two codes and six axial codes of changes requested to the standards. For Standard Five, the name Administrator was initially chosen to describe how faculty manage the courses and the programs that they are a part of. However, as both faculty and organizations provided feedback, they expressed confusion that this standard referred to those acting as Deans and other similar leadership roles. "Is administrator the best heading? Or do most faculty associate the term administrator with someone in a role of authority?" "This is more applicable for department chairs and up. Not for faculty." In reflecting on the feedback, the term Administrator is often connected with those in non-faculty leadership roles, such as the Dean. With this, the standard name Administrator was changed to Coordinator and the word administration was removed from the standard description. The data suggested coordinator was a good fit for those responsible for managing programs and courses as this responsibility requires

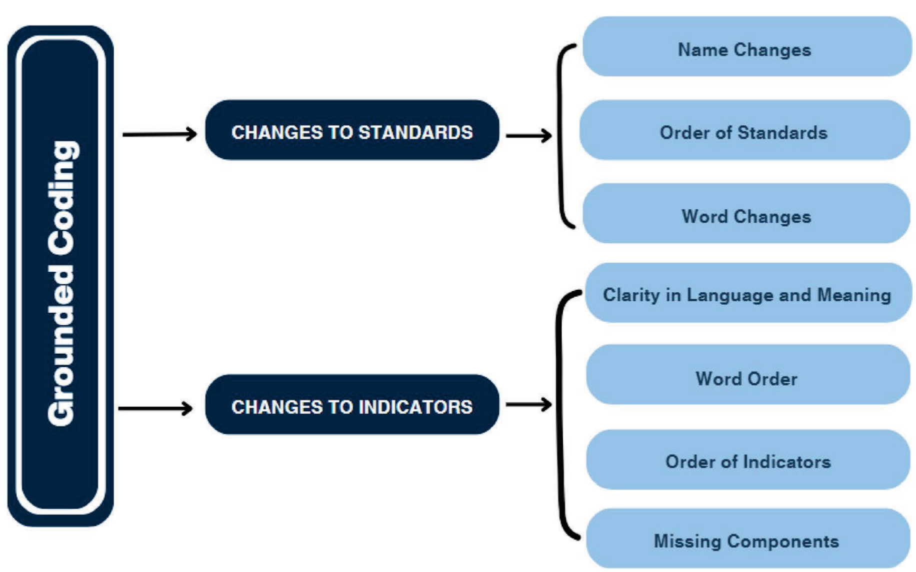


Fig. 5 Grounded coding of macro cycle one

coordination and the name is Program Directors are often used interchangeably with Program Coordinators (Shelton et al., 2024).

One of the technology associations suggested that the teaching be grouped together, then the research, and the service to match a faculty member's responsibilities. The standards were reordered to Instructor, Coordinator, Leader, Researcher, Learner, and Contributor. Faculty also recommended revising the language of the Instructor standard, noting that "designing" and "planning" are synonymous, and that "implementing" was absent from the sequence despite being a critical phase. As a result, the phrasing was revised to "designing, implementing, and evaluating."

Indicators

The codes from the data indicated the need for revisions to the indicators, including clarifying their language and meaning, reordering words and indicators, and incorporating additional indicators. For ease of interpretation and reference, the codes are provided in tabular form in Table 4 with examples of some of the requested changes that appeared within those codes.

Clarity in language and meaning was reflected in the axial codes. These are important changes to ensure the indicators are read with the meaning intended. As the participants were examining the indicators, words, such as leverage appeared to be unnecessarily complicated and instead, the simple word "use" was preferred. While these may be simple changes, they could make a big difference to faculty finding these accessible and useful. Empirical evidence shows that educators can lack self-efficacy in integrating technology (Williams et al., 2023). Reading comprehension is highly tied to background knowledge of a topic (Smith et al., 2021). Therefore, reducing complexity is important as new concepts are presented.

As Smith et al. (2021) noted background knowledge is important and connecting to what faculty do know about the topic can be used to make it easier to follow. The code "Order of Indicators" connected with what faculty understand about education as they requested the indicators to be in the order in which they happen during instruction going from design to facilitate and then to evaluate. The revisions to the conjectured standards were made and these went forward as the conjectured standards for Macro Cycle Two (See Appendix B).

Macro cycle two retrospective analysis

The grounded coding of Macro Cycle Two revealed positives in various parts of the standards and suggestions for improvements. Figure 6 shows the grounded primary and axial codes for Macro Cycle 2. In this cycle, the data show that Faculty reported no changes were needed to five of the six overarching standards. The requests for changes to the indicators were few. The majority of participants noted that no changes were needed revealing acceptance of the conjectured theory of ontological innovation. The suggestions for improvement for MC2 are provided as examples below. The coding show changes to the opening description for MC2, the Standards, and the Indicators.

Opening description

Participants from across all categories highlighted the need to define the term digital technologies. For these standards, digital technologies are defined as tools and systems

Table 4 Changes to indicators macro cycle one

Changes requested	Changes made
Clarity in Language and meaning	
Faculty commented on the overuse of the term leverage and wanting it to be simplified. They noted, "*I would recommend perhaps simplifying word usage (e.g., "use" for "leverage"?)"*	The word leverage was swapped to the word use
Technology associations and faculty questioned the phrasing of the indicator as it was unclear if we were "mentoring students to use technology or using technology to mentor students"	Punctuation was added to provide clarification of the use of technology to mentor
Faculty commented that if you ensure accessibility the word inclusive is redundant	The word inclusive was removed
Faculty noted that incorporating technology was not specific enough	The word appropriate was added to be "incorporating appropriate technology"
Faculty stated that the word "equip" is more robust than "prepare" when describing the process of supporting students in the use of technology	Prepare was changed to equip
Faculty stated that plan and design were similar and only design was needed	The word plan was removed
Faculty noted that teach and facilitate were similar and only facilitate was needed	The word teach was removed
Word order	
Technology associations suggested that learning should come first before engagement	The words in the indicators were switched to highlight learning first
Technology associations highlighted that the order of "online, hybrid, and face-to-face" may look tech-centric and suggested face-to-face, hybrid, and online." They stated, *"In that very 1st line faculty leverage technology to mentor and facilitate learning in online hybrid and face to face, flipping the order there. So you start with face to face and then do hybrid. And then online."*	The order was changed
Order of indicators	
Faculty highlighted that the indicators for Instructor would be clearer if they are described in the order that they happen in practice. They suggested, *"I would order this in an operational way."*	The indicators at various places throughout the indicators were aligned with the task order for the standard
Missing components	
Technology associations and faculty suggested the need for advocacy for resources	Advocacy for resources was added as a new indicator under Coordinator

that transform analog data, such as text, sound, and images, into digital formats for fast and accurate processing, storage, and sharing. They include hardware (e.g., devices and sensors), software (e.g., applications), and communication networks (Cetindamar & Phaal, 2023; Li et al., 2024). Some of the faculty respondents indicated that they were not always required to perform all the roles outlined in the standards, such as those who do not perform formal research. The language was changed to note that these standards are to support faculty in their diverse roles as defined by the context in which they work. Therefore, if research was not listed as a required aspect of a faculty member's role, this standard may not be prioritized, nonetheless, research would still be relevant to keep updated and informed in their teaching role.

A faculty participant noted that "research, teaching and service" in the opening description did not match the order of the standards. Therefore, this was changed to "teaching, research, and service". Also, as the majority of institutions do have teaching

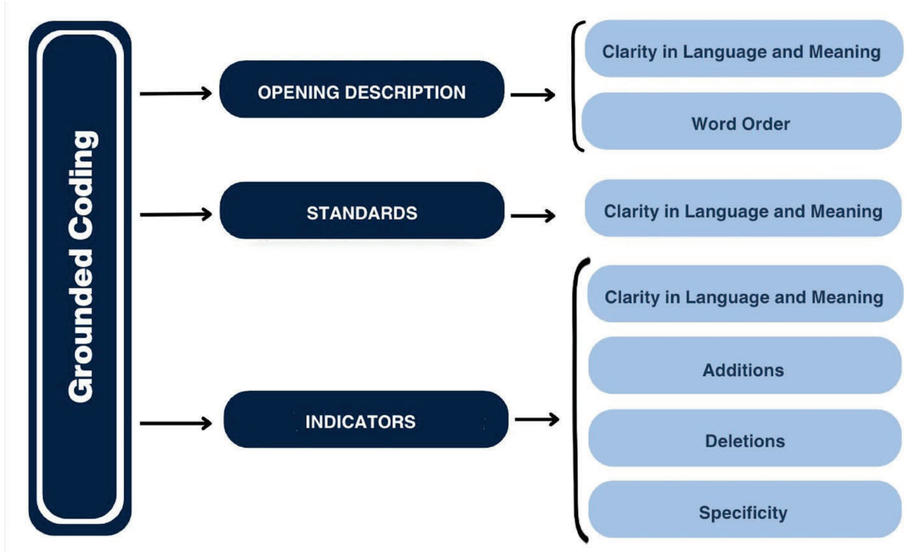


Fig. 6 Grounded coding from MC2 retrospective analysis

as the primary faculty role, teaching was listed first. However, this does not connote a prioritization of any particular faculty responsibility.

Standards

The grounded coding highlighted input for only one of the standards, Standard 6, Contributor. Participants noted the importance of this standard, *"I love this standard and would shout it from the rooftops! So often, I am collaborating with others who claim "I'm not a tech-y person, so I don't use my calendar, Teams, etc." This attitude and related behaviors stall out productivity and opportunities to collaborate efficiently."* However, the international faculty were less clear on this aspect of faculty work. The word "service" is well recognized in countries, such as the USA and Canada, but is not recognized as clearly in the UK, France, and Japan. This is important as these international standards should be comprehensible to faculty across the world. Thus, examples were provided in the standard description regarding what service would involve, such as committees and peer review. Furthermore, the standard is named "Contributor" to further capture the work as a more recognizable term.

Indicators

The grounded coding showed the majority of the changes to the indicators were small. The requests for changes were in terms of "Clarity in Language and Meaning", "Additions", "Deletions", and "Specificity." (See Table 5 with examples).

The data revealed some similar codes to Macro Cycle One. However, data seemed to focus at a more granular level and further international nuances were also uncovered. Requests were made for text to be removed to avoid narrowing thought. In the example (Table 5) "conference" was changed to "event" to be more inclusive of other "events". This change can be helpful as specificity can focus faculty to a narrow line of thought that is indicator can only happen in one context, rather than multiple contexts.

Nonetheless, one of the codes "Specificity" had the opposite line of thought in that requests were made to focus on a specific area of technology integration. For example,

Table 5 Changes to indicators macro cycle two

Changes requested	Changes made
Clarity in Language and meaning	
International faculty noted the term "instruction" can have didactic connotations or just be confusing They stated, "*I think 'design instruction' could be confusing. In the UK we tend to talk about teaching, education, but not instruction so much.*"	The word "instruction" was changed to "learning opportunities"
Faculty noted that the Learner standard should remind faculty that they can learn about digital methods and tools in their discipline, but that they would also learn methods and tools from other disciplines as they work in multi-disciplinary teams	The words "in and across disciplines" were added
Technology Associations and Faculty pointed out that conferences were just one type of event and there are other forms, such as a symposium	The language was changed to remove naming a specific type of event
Accrediting Associations and Faculty asked for a change from tools to strategies in the Instructor Indicator to keep the focus on strategies rather than the too	The language was changed from tools to strategies
Additions	
Faculty requested that student experience be included as well as student achievement. They noted, *"Add student experience. A well-organized course is not just important for academic outcomes but has wider benefits to student experience and perceptions of their course and teachers."*	Student experience was added
Technology Associations and Faculty suggested adding the word "legal" to model ethical and responsible behaviors	Legal was added to the language
Technology associations highlighted the need for ensuring the effective need for technology to meet workforce needs	A new indicator was added to Coordinator. "Ensure the effective integration of technology within the academic discipline to equip students with the experiences and skills required to meet workforce demands."
Deletions	
Technology Associations and Faculty noted that advocate for accessibility was already covered in Standard 3 explicitly	This indicator was deleted from Standard 2
Specificity	
Faculty requested that the standards and indicators focus on using AI	No changes were made as these standards are for the use of any digital technology. It is important for faculty to understand that these are overarching standards that do not focus on specific technologies
Accrediting Associations and Faculty requested that specific technologies be listed	No changes were made as this could appear that specific technologies were being recommended and that is not the case. Furthermore, the standards can quickly appear dated as technologies change very quickly
Faculty requested that the research indicators focus on a specific research agenda, such as the efficacy or use of technology	No changes were made as the Research standard focuses on research in and across disciplines and does not focus on faculty only researching technology

there were requests for a named list of technologies and to have the standards focus only on artificial intelligence. These requests were few but notable. As part of design-based research, extant literature is used alongside data to inform changes. Extant empirical evidence across time (viz., Baron, 2010) show that the technological context is highly changing and naming technologies can quickly leave documents dated and irrelevant as technologies are replaced, renamed, or obsolete.

Aligned with the codes of changes to the standards, the international faculty also highlighted changes necessary to be indicators that faculty across the world can relate to. The example in Table 5, highlighted a problem with the word "instruction" as being confusing. Therefore, the sentence was changed to avoid the use of that word. The changes made at the end of retrospective analysis 2 resulted in the final version of standards in this study See Table 6).

These Faculty Standards for Technology Integration are the final theory of ontological innovation from this study. Nonetheless, it is important for these standards to be carefully adopted into practice. The following section provides examples of how these standards can be used.

Practical implications

These standards are designed to elevate current practice by providing a clear vision for the integration of technology in teaching, research, and service in higher education. As participants in this study note "To be effective, however, the standards must be paired with actionable tools such as self-assessments, rubrics, and measurable outcomes. Without these supports, the standards risk being aspirational rather than practical [for the individual and the institution]." To translate this vision into effective practice, the standards can be further paired with actionable tools such as self-assessments, rubrics, and measurable outcomes.

Practical applications of the standards may be shaped at the institutional, disciplinary, or individual level. They offer a strong foundation for institutional and personal evaluation and accreditation processes by establishing a shared framework for excellence in technology integration. To operationalize these standards within faculty development programs, institutions can embed them into structured professional learning pathways that include orientation sessions, mentoring, and ongoing microcredential opportunities. For instance, a university might introduce a certificate where participants complete modules aligned with each of the six standards. Participants, for example, may design a digital learning activity addressing the *Instructor* standard, conduct a small-scale data analysis project for the *Researcher* standard, and develop a departmental outreach plan integrating digital collaboration tools for the *Contributor* standard. Culminating reflection and peer review activities would allow faculty to demonstrate mastery and plan next steps for continued growth. Through such structured implementation, the standards become a living framework that supports measurable, sustained professional development rather than a static set of expectations.

The standards are intentionally adaptable, enabling operationalization across a range of academic disciplines and professional roles. This flexibility allows for the alignment of the standards to specific instructional methods, research goals, and service roles, thereby maintaining their relevance and maximizing impact across varied higher education settings.

Limitations, gaps, and future research

The findings of this research illustrate several cultural and institutional nuances in how faculty roles and expectations are understood across global higher education systems. While these differences were identified and partially addressed during the study through feedback from international participants, they highlight the importance of contextual

Table 6 Final technology standards for faculty in HE

These standards are specifically designed for higher education faculty to support their diverse roles in teaching, research, and service by intentionally integrating technology across all areas, aligning with the evolving demands of academia and promoting excellence in every aspect of their professional responsibilities

Standard	Indicators
1. Instructor Faculty use technology in face-to-face, hybrid and online modalities, when creating and implementing instruction	Faculty: 1.a. Design learning opportunities that integrate digital tools and resources, foster innovative, inclusive learning experiences, and equip students to use technology in the workforce 1.b. Ensure accessibility by using technology to design learning environments that accommodate diverse learner needs and abilities, making content and resources accessible to all students 1.c. Facilitate learning by incorporating appropriate technology that maximizes student learning and engagement across various modalities 1.d. Mentor students using technology-enhanced guidance and support that fosters academic growth 1.e. Evaluate student learning using technology-enabled assessment strategies to inform instruction and measure learning outcomes
2. Coordinator Faculty use technology to manage and coordinate academic programs, courses, and communications	Faculty: 2.a. Manage courses and curricula through digital systems and tools that support academic success and student experience 2.b. Communicate effectively using digital platforms to engage with students, colleagues, and stakeholders in academic and administrative functions 2. c. Ensure the effective integration of technology within the academic discipline to equip students with the experiences and skills required to meet workforce demands
3. Leader Faculty provide leadership by using technology to mentor others, advocate for the institution's vision, drive innovation to create new opportunities, and model ethical digital practices	Faculty: 3.a. Mentor colleagues and students by modeling and sharing effective use of technology in teaching, research, and service 3.b. Innovate by using technologies to create and implement new ideas and opportunities in teaching, research, and service for growth in the institution and the wider community 3.c. Model ethical and responsible behaviors by promoting the safe, legal, and responsible use of technology in academic and professional practices 3.d. Advocate for accessibility by promoting the use of digital tools and resources that ensure equitable access to learning opportunities for all students
4. Researcher Faculty engage in technology-enhanced research by identifying critical questions, conducting research, sharing findings, and mentoring others in the use of digital tools for research	Faculty: 4.a. Seek out important questions in their field using digital tools for data collection, analysis, and collaboration 4.b. Explore ways to use technology to conduct ethical and legal research that contributes to advancing knowledge and scholarship 4.c. Share research findings using digital platforms and publishing tools to reach a wide academic audience 4.d. Mentor students and colleagues in the use of technology for research, fostering a culture of digital inquiry and collaboration

Table 6 (continued)

These standards are specifically designed for higher education faculty to support their diverse roles in teaching, research, and service by intentionally integrating technology across all areas, aligning with the evolving demands of academia and promoting excellence in every aspect of their professional responsibilities	
Standard	**Indicators**
5. Learner Faculty actively use technology to connect with others, engage in professional development, and participate in ongoing learning communities	Faculty: 5.a. Connect with colleagues and students using collaborative digital platforms to foster local and global learning networks 5.b. Participate in professional development activities to stay current with emerging technologies and innovative practices in their field 5.c. Explore new digital methodologies and tools, in and across disciplines, that enhance teaching, research, and service
6. Contributor Faculty use technology to engage in service to their institution, community, and profession, including activities such as committee work, peer review, and public engagement	Faculty: 6.a. Engage in service activities by using technology to enhance communication, coordination, and effectiveness across institutional, community, and professional contexts 6.b. Support digital initiatives that advance institutional policies and practices, and foster partnerships to help achieve community goals 6.c. Serve in leadership or support roles, using digital tools to engage with institution, community, and professional organizations effectively

sensitivity in applying the standards. Cultural variations in governance, academic hierarchies, and pedagogical traditions can shape how faculty interpret and enact the standards in practice. Therefore, adopters of these standards should carefully consider local contexts to ensure their successful and meaningful implementation. Further testing in a variety of countries would strengthen the understanding of these standards in action globally.

Future research can also explore how the standards are interpreted and applied across different institutional and disciplinary contexts. Design-based studies could examine the development and testing of certificate programs based on these standards and accompanying tools, such as self-assessments, rubrics, and evaluation protocols to ensure practical implementation. This could be extended to include a developmental continuum based on these standards.

Conclusion

This study is unique in developing an empirically constructed theory of ontological innovation of how faculty in higher education to support their diverse roles in teaching, research, and service by intentionally integrating technology across all areas, aligning with the evolving demands of academia and promoting excellence in every aspect of their professional responsibilities. This study followed the call from scholars (Basilotta-Gomez-Pablo et al., 2022, Sobeida et al., 2024, Tondeur et al., 2023), organizations (HLC, 2023; AASCU, 2023), and institutions (IUFACET, 2025; UCFDDL, 2025) to address the gap in scholarly knowledge regarding the lack of technology standards for HE faculty that cover teaching, research, and service.

These Faculty Standards provide a framework for higher education faculty to integrate technology meaningfully across their professional responsibilities. The Faculty Standards consists of six standards that reflect the multifaceted roles of higher education faculty:

Instructor, Coordinator, Leader, Researcher, Learner, and Contributor. Each role emphasizes the intentional use of digital tools to support excellence in teaching, research, and community engagement.

Each of the six Faculty Standards is accompanied by a set of indicators that illustrate what effective technology integration looks like in practice. These indicators serve as concrete examples to guide faculty in applying the standards across their professional roles. For instance, within the Instructor standard, indicators include designing inclusive digital learning experiences and using technology to assess student learning. In the Researcher standard, indicators involve using digital tools for data analysis and sharing findings through digital platforms. These indicators are not exhaustive checklists but representative practices that help faculty understand how to implement the standards meaningfully in varied academic contexts.

These standards are designed primarily for higher education faculty, including full-time, part-time, adjunct, and clinical instructors. However, their application extends to institutional Deans, Provosts, accreditation coordinators, instructional designers, research coordinators, postdoctoral researchers, and academic staff involved in curriculum development or faculty support may also use these standards to guide their integration of technology into professional practice. Additionally, institutions can adopt the standards as a framework for faculty development, performance review, and strategic planning, ensuring consistent and intentional use of digital tools across teaching, research, leadership, and service contexts.

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Declarations

Competing interests
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