Responsible Enterprise Pedagogy

Conceptualisations and practices of future-proofing in online course design

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Received 12 January 2026
Revised 13 February 2026
Accepted 16 February 2026

Abstract

Purpose – This study explores how learning designers in higher education, as key architects of online course design, conceptualise and implement future-proof dimensions in online course design from a pedagogical perspective. Future-proofing is understood as the deliberate creation of learning environments that are sustainable, adaptable and capable of evolving with technological and social change. While existing literature identifies key structural attributes of future-proof online education, less is known about how these principles are enacted through pedagogical design.

Design/methodology/approach – Using a phenomenographic approach, the study investigated the qualitatively different ways learning designers experience and apply seven dimensions of future-proofing: relevance, adaptability, quality, scalability, efficiency, inclusion and access and employability. Data were collected from 21 learning designers through an open-ended survey and analysed using a seven-stage phenomenographic process.

Findings – The findings revealed a developmental progression from efficiency-oriented to learner-centred conceptions that integrate adaptability, inclusivity and employability as foundations of educational resilience.

Research limitations/implications – The study was conducted within a single institutional context, which limits the transferability of findings to other settings. Future research could extend this work by including multiple institutions, longitudinal designs, or complementary perspectives from academics and students.

Practical implications – The findings provide actionable insights for learning designers, academic developers and institutions seeking to enhance the sustainability of online courses.

Social implications – By emphasising inclusion, accessibility and employability, the study supports the development of online education that is more equitable and responsive to diverse learner needs.

Originality/value – This study offers an original pedagogical perspective on future-proofing online education by focussing on learning designers' conceptions and practices.

Keywords Future-proofing, Online course design, Pedagogical resilience, Sustainable learning environments

Paper type Research article

Introduction and background

Future-proofing in online education is defined as the deliberate design of educational systems and practices that are sustainable, adaptable and responsive to ongoing technological, social and economic change (Rehman and Ryan, 2018; Johnson and Simon, 2018). It is a strategic response to the accelerating pace of digital transformation in higher education, requiring institutions to prepare for uncertainty while maintaining academic quality and equity (Kalendra, 2024; Salama and Hinton, 2023). Future-proof design extends beyond durability, encompassing adaptive sustainability, learning environments that evolve with emerging technologies, shifting labour markets, widening digital divides and changing learner expectations (Celbis *et al*., 2025; Price, 2023). Thus, future-proofing is not merely reactive to technological change but also a proactive framework for long-term educational resilience and vitality.

The problem of future-proof online course design

The COVID-19 pandemic transformed online delivery from a supplementary option into the primary mode of instruction, producing many hastily assembled courses lacking coherent design and quality assurance (Dorresteijn *et al*., 2025). As emergency remote teaching evolved into permanent programmes, institutions faced enduring challenges of engagement, equity and sustainability (Najjar *et al*., 2025).

Post-pandemic, institutions must move beyond reactive solutions to create online learning ecosystems that are strategic, quality-assured and adaptable over time. Sustainable platforms

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2755-6743
DOI 10.1108/RESEP-01-2026-0001

require continuous technological renewal and faculty development to maintain educational quality, equity and economic viability (Xie, 2025). Future-proofing demands flexible pedagogical and institutional frameworks that accommodate evolving technologies and learner needs (Naidu and Roberts, 2018).

Ensuring engagement, equitable access and curricula aligned with industry trends is critical for viability (Meng *et al*., 2024; Salama and Hinton, 2023). Without foresight, university courses may quickly become technologically obsolete or disconnected from labour-market realities (Price, 2023).

Research emphasises that sustainable online education must integrate pedagogical quality, inclusivity and environmental efficiency (Xie, 2025; Vakaliuk *et al*., 2020). Naidu and Roberts (2018) describe this as flexible learning, an institutional capability to pivot while preserving academic integrity. Within this model, adaptability stems from systemic design principles, not isolated technological upgrades.

Student engagement remains central to this, consistently predicting learning outcomes in digital contexts (Yılmaz and Banyard, 2020). Effective strategies include prompt feedback, active learning and collaborative tasks to sustain motivation and deepen understanding (Yılmaz and Banyard, 2020). Designing with engagement at the core ensures that technological innovation translates into meaningful learning.

Ultimately, future-proof design reflects anticipatory adaptation. Marotta and van de Laar (2024) define "e-resilience" as balancing technological innovation with social equity. This involves modular content, data-driven personalisation and iterative feedback for responsive design (Ayeni *et al*., 2024). Martin and Bolliger (2022) emphasise rubric-guided design to maintain pedagogical coherence and learner satisfaction, ensuring that innovation remains educationally purposeful.

Attributes of future-proof learning design

The literature identifies seven interrelated attributes of future-proof online course design: relevance, adaptability, quality, scalability, efficiency, inclusion and access and employability. These attributes synthesise insights from sustainability frameworks (Vakaliuk *et al*., 2020; Alharthi and Spichkova, 2016), resilience research in higher education (Kalendra, 2024; Price, 2023; Marotta and van de Laar, 2024) and meta-analyses of online learning effectiveness (Dorresteijn *et al*., 2025; Wright *et al*., 2023). Collectively, they describe a complex, multi-dimensional design that is durable yet evolves with technological innovation, shifting learner needs and global trends.

Relevance concerns aligning course content with societal priorities and workforce needs. Chamba and Chikusvura (2024) link relevance to the Sustainable Development Goal 4, showing that integrated assessment systems build 21st-century competencies such as teamwork and problem-solving. Brockhaus *et al*. (2023) argue that anticipating industry transformation is essential for curricular relevance. Kalendra (2024) highlights continual recalibration of outcomes to ensure both conceptual understanding and transferable skills. Courses should also embed socio-technical awareness and literacies such as AI fluency, data ethics and sustainability (Ayeni *et al*., 2024; Moreira *et al*., 2024).

Adaptability refers to the ability of online environments to respond to new contexts, technologies and learner needs. Flexible design and technology-supported personalisation enhance engagement, retention and satisfaction (Najjar *et al*., 2025; Meng *et al*., 2024; Turan *et al*., 2022; Ayeni *et al*., 2024).

Quality depends on coherent structure, interaction and valid assessment (Wright *et al*., 2023). It operates across institutional and pedagogical levels and is shaped by faculty expertise, support and infrastructure (Dorresteijn *et al*., 2025; Martin and Bolliger, 2022). Productive collaboration between faculty and designers strengthens coherence (Yuan and Carliner, 2020). Continuous evaluation, professional learning and equitable access link quality to sustainable development (Xie, 2025).

Scalability involves expanding access while maintaining pedagogical integrity. It is supported by cloud-based infrastructure, open educational resources and flexible learning policies (Vakaliuk *et al*., 2020; Naidu and Roberts, 2018). Modular and stackable micro-credentials enable scalable personalisation (Kalendra, 2024).

Efficiency centres on optimising human, technological and environmental resources. Effective role delineation reduces redundancy (Yuan and Carliner, 2020), while automation and AI streamline feedback and administration (Ayeni *et al*., 2024). Eco-efficient infrastructures and agile governance further enhance sustainability (Vakaliuk *et al*., 2020; Floria *et al*., 2025).

Equity and accessibility are essential for sustainable online education. Socio-economic disparities and connectivity barriers limit participation (Mbonigaba *et al*., 2025; Najjar *et al*., 2025). Inclusion functions as a resilience strategy, helping institutions maintain continuity during disruption (Marotta and van de Laar, 2024). Universal design principles and assistive technologies underpin accessible systems (Martin and Bolliger, 2022), while policies promoting digital literacy and cultural responsiveness support equity (Xie, 2025).

Employability anchors learning in evolving labour-market needs. Curricula that develop transferable competencies and authentic problem-solving build future readiness (Chamba and Chikusvura, 2024; Khadri, 2022). Keeping content aligned with industry change through analytics and AI supports ongoing relevance (Ayeni *et al*., 2024; Kalendra, 2024).

The literature shows progress in defining structural, technological and institutional attributes of future-proof online education, but highlights a gap: limited focus in research on pedagogical processes that enact these principles. Ultimately, these attributes depend on the pedagogical choices made by learning designers who translate institutional strategies into meaningful learning experiences. Understanding how they conceptualise and operationalise future-proof dimensions within course design is critical to advancing both theory and practice in sustainable online education.

Learning designers are a particularly relevant professional group for this inquiry because they sit at the intersection of institutional strategy, educational technology and pedagogy. In many universities, they translate strategic intentions (e.g. quality, accessibility and scalability) into concrete course architectures, assessment designs and learner experiences, often coordinating standards and review processes across academic teams. Prior research shows that collaboration between faculty and instructional/learning designers strengthens pedagogical coherence and design efficiency (Yuan and Carliner, 2020), while design frameworks and rubrics guide consistency and quality in online course production (Martin and Bolliger, 2022). Understanding how learning designers conceptualise and operationalise "future-proofing" therefore offers a direct window into how strategic ambitions become sustainable pedagogical practice.

Aim of the study

This study explores how learning designers in higher education conceptualise and implement future-proof dimensions in online course design from a pedagogical perspective. By examining their understandings, strategies and decision-making, it seeks to reveal how design practices foster resilient, adaptive and sustainable online learning environments in higher education.

Methods

Design

A phenomenographic research design was adopted to investigate how learning designers conceptualise and enact future-proof dimensions in online course design. Phenomenography examines the relationship between individuals (the subjects) and the phenomena they experience, focussing on qualitatively different ways people understand or approach the same

phenomenon (Marton, 1981; Sjöström and Dahlgren, 2002). Here, the phenomenon was future-proof online course design, and the subjects were learning designers.

Phenomenography was chosen because the study sought to capture variation in conceptions and practices, rather than identify a single, universal essence of experience. Unlike phenomenology, which seeks invariant meanings (van Manen, 1990; Giorgi, 2000), phenomenography maps the range and structure of differing understandings within a collective group (Marton, 1986). This distinction aligns with the study's purpose: to examine diverse ways in which learning designers conceptualise and apply future-proof pedagogical principles in online higher education.

Recent scholarship reaffirms phenomenography's suitability for higher education research. Åkerlind (2025) notes that it is the only methodology developed within higher education to investigate variation in understanding of educational phenomena such as teaching and learning. Its pedagogical utility lies in revealing structural relationships between qualitatively different conceptions, informing curriculum design (Prosser and Trigwell, 1997; Åkerlind, 2025). Moreover, its focus on collective patterns of awareness provides a direct bridge between research and educational improvement: critical for future-proofing pedagogical design.

Phenomenography has long informed research on conceptions of learning, teaching and instructional design (Yoon and Na, 2015) and continues to underpin studies of professional practice and pedagogical development (Åkerlind, 2007, 2008, 2025). Accordingly, this approach offers a robust framework for examining how learning designers interpret and apply future-proof principles in digital learning environments. By categorising qualitatively different conceptions, the study aims to generate insights into how pedagogical resilience and adaptability are constructed in practice.

The study adhered to the Standards for Reporting Qualitative Research (SRQR) (O'Brien *et al*., 2014), ensuring transparency and rigour in design, recruitment, data collection and analysis.

Research question

The research is driven by the following central question: how do learning designers in higher education institutions conceptualise and implement future-proof dimensions in online course design from a pedagogical perspective?

In this study, the term future-proof dimensions refers to the interrelated attributes identified through the literature review as foundational to sustainable and adaptive online education: relevance, adaptability, quality, scalability, efficiency, inclusion and access and employability.

Data collection

Data were collected between 15 August and 5 September 2025 using an anonymous open-ended survey administered through Qualtrics, a secure platform licenced by the host institution. The use of Qualtrics ensured that responses could be provided confidentially while also supporting accessibility for participants using assistive technologies.

Participants

Participants were learning designers (also referred to as instructional designers in some universities) from a UK higher education institution. Their professional responsibilities typically included the following.

(1) planning and ideating new or refreshed online courses;

(2) supporting faculty with pedagogical design and assessment development;

(3) facilitating learning design workshops;

(4) storyboarding and preparing learning content for online publication;

(5) liaising with media developers from a pedagogical perspective; and

(6) contributing to quality assurance processes and continuous course improvement.

A total of 25 invitations were distributed, yielding 21 completed responses. The average completion time was 39.5 minutes, as reported by Qualtrics analytics. Although phenomenographic studies do not prescribe an optimal sample size, prior research indicates that participant numbers can range from small-scale exploratory studies with as few as five participants to larger projects involving up to ninety (Zhao, 2015; Säljö, 1979). What is critical, as Åkerlind (2025) emphasises, is not numerical representation but the degree of variation in experience within the sample, since phenomenography aims to capture the range of qualitatively different ways in which a phenomenon is understood.

Instrument and procedure

The survey consisted of five structured sections designed to capture participants' conceptions and practical enactments of future-proof pedagogical design across seven dimensions: relevance, adaptability, quality, scalability, efficiency, inclusion and access and employability. Drawing on recommendations from Åkerlind (2025), questions were open-ended to elicit variation in meaning and awareness. This approach follows the phenomenographic principle of exploring the "what" and "how" of experience (Marton and Booth, 1997; Zhao, 2015), encouraging participants to articulate both their conceptual understanding (what future-proofing means to them) and their enactment in practice (how they implement it). While semi-structured interviews are the most common form of data collection in phenomenography, Åkerlind (2025) demonstrates that open-ended survey responses can also yield rich phenomenographic data when designed to prompt reflection on participants' actions, decisions and reasoning. This method allows for a broader, more inclusive sample while maintaining the analytic depth required for phenomenographic interpretation.

Following Åkerlind (2025), the survey questions were intentionally framed to.

(1) allow respondents to focus on aspects of future-proofing most salient to them;

(2) elicit examples of their design practice and reflections on decision-making and

(3) reveal variation in awareness of the underlying dimensions shaping their conceptions.

This data collection strategy aligns with the second-order perspective central to phenomenography, which seeks to describe how individuals experience and understand phenomena rather than measuring their frequency or intensity (Marton, 1981; Åkerlind, 2025). By using an open survey format, participants were afforded time and cognitive space to reflect deeply on their pedagogical practices, an important consideration when exploring conceptual variation among professional practitioners.

Moreover, the survey format was consistent with recent methodological adaptations in higher education research that employ phenomenographic surveys to study variation in conceptions across geographically or professionally distributed groups (Åkerlind, 2025). This design facilitated anonymity and inclusivity while preserving the rigour of phenomenographic inquiry, ensuring that responses reflected authentic understandings unmediated by social desirability or hierarchical relationships.

Ethical considerations

The research ethics committee granted approval for this study (Ethical Clearance Reference Number: MRA-24/25–51388). The study adhered to ethical standards, including principles of confidentiality, informed consent, protection from harm and voluntary participation (Kumar, 2019).

Data analysis

Data were analysed manually without the use of qualitative data analysis software. Survey responses were exported from Qualtrics and organised in a working document/spreadsheet to support iterative comparison, coding and category refinement. Manual analysis involved repeated reading, highlighting meaning units and iteratively grouping these into provisional categories, which were then refined through comparison across the dataset. The data were analysed using the phenomenographic method, refined through the interpretive procedures (Marton, 1986; Booth, 1992; Dean, 1994). Phenomenography's validity is not judged by correspondence with an objective reality, but by the persuasive and coherent representation of how participants experience the phenomenon (Booth, 1992). In this study, the analysis focused on identifying and describing the qualitatively different ways in which learning designers conceptualised and implemented future-proof dimensions in online course design.

The analytical process followed the seven iterative steps commonly employed in phenomenographic research (Dean, 1994; Åkerlind, 2005). Each stage was conducted systematically and collaboratively to ensure conceptual clarity and internal consistency.

Throughout this process, the researchers conducted analysis both independently and collaboratively. Initial coding and categorisation were performed separately to preserve interpretive breadth, followed by iterative discussions to achieve consensus on the meaning and structure of categories. This collaborative validation process enhanced the trustworthiness and analytic transparency of the findings (Åkerlind, 2025).

Given that the dataset comprised written survey responses rather than interviews, particular attention was paid to maintaining the depth of interpretation typically achieved through dialogue. Following Åkerlind's (2025) recommendations, textual analysis focused on the variation of expressed meaning rather than frequency, ensuring that even brief but conceptually distinct statements were represented in the final categories. This approach preserved the phenomenographic emphasis on collective variation in understanding rather than individual experience.

The resulting categories of description and the associated outcome space thus capture the range of qualitatively different ways in which learning designers conceptualise and implement future-proof principles in online higher education, reflecting both shared and divergent pedagogical perspectives.

Findings

Analysis of the open-ended survey data yielded 47 initial meaning units, which were iteratively grouped into 10 categories of description. These categories were subsequently organised into two overarching groups.

(1) Perception, representing the cognitive and conceptual ways in which learning designers understand future-proofing; and

(2) Strategy, representing the practical and operational ways in which they translate these conceptions into design action.

This dual structure reflects Marton's (1986) phenomenographic distinction between referential (what is experienced) and structural (how it is experienced) aspects of awareness. The categories collectively form a hierarchically related outcome space (Åkerlind, 2005), illustrating both variation and progression in how learning designers conceptualise and enact future-proof pedagogical design.

Within the perception, five categories were identified, representing a progression from pragmatic awareness of institutional constraints to more holistic, learner-centred conceptions of future-proofing: durability and efficiency, currency and relevance, design for change, inclusion and access, employability and authentic practice.

These categories were further interpreted across three hierarchical levels: awareness, valuing and assuring, reflecting a deepening understanding of what sustains educational resilience over time.

Within the strategy, five categories represented a progression from procedural stabilisation to advanced continuous-improvement mechanisms: operational efficiency, modular design, Universal Design for Learning (UDL) and multimodal access, authentic and career-linked assessment and quality, analytics and selective use of AI.

These were organised across three corresponding levels: identifying, introspecting and concretising, illustrating a developmental movement from establishing foundations to embedding sustainable, data-informed practices.

Perception

Category P1: durability and efficiency. Many participants initially conceptualised future-proofing in terms of durability and resource efficiency. A future-proof course, in this sense, was one that "lasted" and "required minimal ongoing maintenance" (Participant 4). The emphasis lay on designing stable, well-documented structures that could operate effectively within institutional resource constraints:

> Future-proofing means making something that lasts. If the structure is sound, the content and activities won't need endless reworking. Using consistent templates saves so much time in the long run. (Participant 4)

This category reflects a pragmatic orientation to sustainability, viewing future-proofing as an operational necessity to manage workload and maintain course continuity.

Category P2: currency and relevance. A second conception focused on keeping learning content current and pedagogically aligned with contemporary disciplinary and professional trends. Designers emphasised regular review cycles and content refreshes to maintain alignment with emerging research or industry developments:

> A course can't be future-proof if it's frozen in time. We build in review points so materials reflect current thinking, not what was true five years ago. (Participant 9)

Here, durability is reconceptualised not as permanence but as capacity for renewal, marking a transition from static sustainability to dynamic relevance.

Category P3: design for change. At a more complex level, participants described future-proofing as architectural adaptability, designing modular course systems that can evolve with minimal disruption.

> We try to make everything modular – activities that can be swapped out, pages that can be reused across modules. That way, when policy or technology changes, we just replace a block instead of rewriting the course. (Participant 12)

This conception represents a systemic awareness of design for evolution, positioning adaptability as the core mechanism for ensuring sustainability and scalability.

Category P4: inclusion and access. Several participants framed future-proofing as inseparable from inclusivity and accessibility. They emphasised Universal Design for Learning (UDL) principles, equitable participation, and platform-agnostic content delivery:

> If it's not accessible, it's not future-proof. Accessibility isn't an add-on, it's the condition for sustainability. We always include captions, transcripts, and low-bandwidth versions from the start. (Participant 7)

This conception integrates ethical, pedagogical and technical awareness, positioning inclusive access as a precondition for educational resilience.

Category P5: employability and authentic practice. The most comprehensive conception located future-proofing in the enduring value of learning outcomes. Participants described

designing authentic, transferable learning experiences that prepare students for evolving career contexts:

> Our goal is to help students build skills they'll still use in five or ten years. If they can apply what they learn in changing contexts, then the course itself is future-proof. (Participant 16)

This category represents the highest level of perceptual awareness, integrating efficiency, adaptability, inclusion and relevance into a learner-centred and developmental understanding of sustainability.

Strategy

Category S1: operational efficiency. At the most pragmatic level, designers enacted future-proofing through workflow optimisation and standardisation. They described using design templates, reusable content blocks and shared maintenance logs:

> We now have a template library and a maintenance log for each module. It saves time, prevents duplication, and makes sure no one needs to reinvent the wheel every year. (Participant 5)

This strategy operationalises durability and efficiency, ensuring procedural stability and continuity.

Category S2: modular design. A more advanced strategy involved building modular course architectures that supported iterative updates and scalability:

> We treat each course like a system of blocks. If something changes, say, an assessment type or tool, we only update that block instead of the entire module. (Participant 13)

This strategy transforms adaptability into a design principle, promoting sustainable evolution through structural flexibility.

Category S3: universal design for learning (UDL) and multimodal access. Many participants embedded UDL principles to future-proof inclusivity. They described ensuring multimodal access and flexible pathways for engagement:

> Accessibility is never a later fix. Every video has captions, every image has alt-text, and we test pages on phones as well as laptops. That's what makes our courses resilient to change. (Participant 2)

This approach reframes accessibility as an ongoing condition of resilience rather than a compliance task.

Category S4: authentic and career-linked assessment. Several designers described integrating authentic, workplace-relevant assessments as a long-term sustainability mechanism:

> We replaced quizzes with projects where students build something they can show employers. It keeps the course relevant even as tools and platforms evolve. (Participant 11)

This strategy links employability to pedagogical longevity, ensuring courses remain meaningful beyond the institutional context.

Category S5: quality, analytics and selective use of AI. At the most advanced strategic level, participants employed data-informed decision-making and responsible AI integration to sustain course quality:

> We use analytics to decide what to refresh and an AI assistant to check broken links or flag outdated terminology, but final review is always human. It keeps the course living but controlled. (Participant 17)

This strategy reflects continuous improvement and reflective governance, embedding adaptability, quality and efficiency into a self-sustaining design cycle.

Outcome space

Together, the ten categories form a hierarchical outcome space illustrating the variation and developmental progression in how learning designers experience and enact future-proof online course design (Figure 1). The perception categories capture increasing awareness of pedagogical and ethical depth, while the strategy categories reflect a parallel growth in operational sophistication.

Consistent with Marton's (1986) model and later applications in higher education research (Åkerlind, 2025), this structure demonstrates that future-proofing is not a singular concept but a continuum of awareness and enactment, ranging from efficiency-oriented conceptions to integrative, learner-centred approaches that embody adaptability, inclusion and lifelong relevance.

Discussion

This study examined how learning designers in higher education conceptualise and implement future-proof dimensions in online course design from a pedagogical perspective. Through phenomenographic analysis, the findings revealed ten categories organised into two hierarchically related groups: perception and strategy, which collectively describe the variations in how participants understand and enact sustainable, adaptable and inclusive online learning design. These findings contribute to a growing body of work that situates pedagogical adaptability and design thinking as central to the long-term resilience of higher education (Kalendra, 2024; Salama and Hinton, 2023; Price, 2023).

The perception categories illustrated a developmental trajectory from pragmatic understandings of durability and efficiency toward more integrated, learner-centred conceptions grounded in inclusion, relevance and employability. This progression reflects the increasing complexity of awareness, a core feature of phenomenographic outcome spaces (Marton and Booth, 1997; Åkerlind, 2005). At the most basic level, participants described future-proofing as course stability, ensuring templates, documentation and efficiency mechanisms that reduce workload. However, higher-order conceptions positioned future-proofing as a living pedagogical system, where adaptability and inclusivity are prerequisites for sustainability.

This variation parallels the shift described in Åkerlind's (2008) model of teaching conceptions, where educators move from teacher-centred to learner-centred awareness.

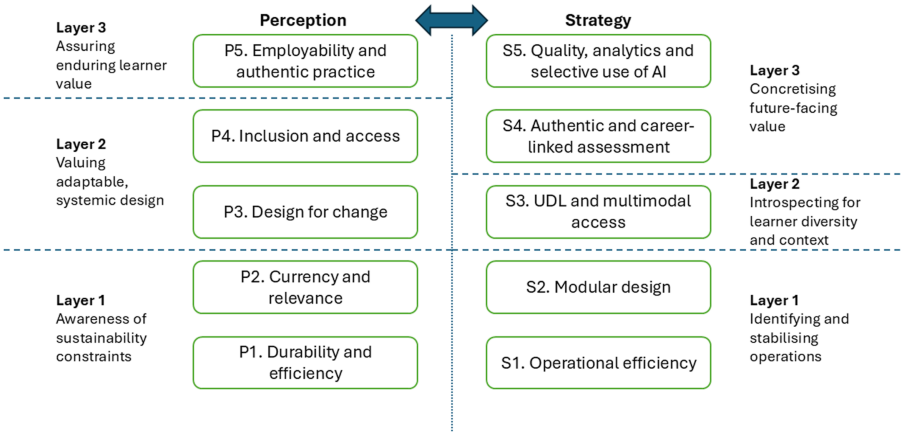

Figure 1. Outcome space of perceptions and strategies in future-proof online course design. Source: Authors' own work, informed by phenomenographic principles (Marton, 1986; Åkerlind, 2005, 2025)

Similarly, learning designers in this study demonstrated an evolution from institutional maintenance perspectives toward relational understandings of design as a vehicle for learner empowerment and employability. Such variation underscores that future-proofing is not a fixed design condition but a developmental awareness of interdependent pedagogical, technological and ethical dimensions.

Importantly, the highest perceptual category, employability and authentic practice, synthesised all preceding categories, representing an inclusive awareness of the enduring purpose of learning. This finding resonates with Moreira *et al*. (2024), who link future-oriented curricula to the cultivation of transferable, socio-technical competencies such as AI literacy and data ethics. In phenomenographic terms, this category reflects awareness of a wider set of dimensions, technological, societal and human, indicating a more complex conception of pedagogical sustainability.

The strategy group demonstrated how conceptual understanding translated into practice through five distinct but related approaches. The hierarchy from operational efficiency to quality, analytics and selective use of AI, illustrates increasing sophistication in how learning designers institutionalise resilience and adaptability. Early-stage strategies centred on workflow optimisation and replication, while more advanced ones integrated modular architectures, UDL frameworks and the use of analytics and AI.

This developmental pattern aligns with the variation theory of learning (Marton and Booth, 1997; Åkerlind, 2025), which posits that new dimensions of awareness emerge when practitioners discern variation along a given dimension, in this case, between stability and responsiveness. As designers encountered new challenges, such as accessibility or evolving technologies, their strategies expanded to incorporate variation, resulting in richer, more inclusive design practices.

The inclusion of UDL and multimodal access as a recurring strategy across several levels confirms the centrality of inclusion as both an ethical stance and a practical resilience mechanism (Martin and Bolliger, 2022; Xie, 2025). Participants who recognised accessibility as foundational rather than supplementary demonstrated what Åkerlind (2007) calls a "higher-order awareness" of pedagogy, seeing inclusion not as an external requirement but as integral to course viability.

At the most advanced level, quality, analytics and selective use of AI exemplified a meta-strategic understanding, where participants described iterative systems of monitoring, data-driven improvement and cautious technological integration. Such conceptions signal a shift from reactive maintenance to anticipatory governance, aligning with current discussions about responsible AI and data ethics in higher education (Ayeni *et al*., 2024). This level of awareness reflects a move toward institutional reflexivity, where future-proofing becomes embedded in continuous improvement cycles rather than discrete design interventions.

The relationship between the perception and strategy dimensions reflects a dynamic interplay between cognitive and operational awareness. Designers who viewed future-proofing primarily through durability tended to implement procedural efficiencies, while those with broader conceptions, integrating inclusion, adaptability and employability, developed more holistic, learner-focused design strategies. This finding echoes the pedagogical insight from phenomenographic research that awareness of additional dimensions enables qualitatively richer practice (Åkerlind, 2015; Kullberg and Ingerman, 2022).

From a pedagogical perspective, this suggests that professional development for learning designers should not only enhance technical proficiency but also foster awareness of variation across future-proofing dimensions. Structured reflection on how design decisions affect equity, sustainability and employability could cultivate more complex and responsive design practices. This insight parallels how phenomenographic approaches have informed academic development by revealing how teachers' conceptions of teaching shape their effectiveness (Prosser and Trigwell, 1997; Kandlbinder and Peseta, 2009).

Moreover, the identified outcome space demonstrates that future-proofing is best understood as a relational construct, balancing operational stability with pedagogical

flexibility. Institutions that privilege efficiency at the expense of inclusivity or innovation risk narrowing designers' awareness, limiting their capacity for adaptive response. Conversely, fostering reflective dialogue across design teams can expand collective awareness, aligning institutional strategies with pedagogical purpose.

These findings align with current scholarship emphasising the need for adaptive sustainability in higher education systems (Celbis *et al*., 2025). Just as Celbis *et al*. (2025) describe institutional resilience as the capacity to evolve under disruption, participants in this study understood future-proof design as the ongoing ability to adjust courses, policies and practices to shifting contexts.

The study also reinforces calls by Naidu and Roberts (2018) for flexible institutional frameworks that accommodate technological evolution without sacrificing educational integrity. The modular and data-informed approaches described by participants exemplify such flexibility in practice, demonstrating how local design strategies can operationalise institutional adaptability. Similarly, the focus on authentic assessment and employability connects to global discourses on higher education's role in preparing graduates for uncertain futures (Brockhaus *et al*., 2023; Chamba and Chikusvura, 2024).

By applying a phenomenographic lens, this research extends the conceptualisation of future-proofing from a predominantly technological and policy discourse to a pedagogical and experiential one. The study demonstrates that the sustainability of online education ultimately resides in variations of professional awareness, how designers see and act upon the relationships between stability, inclusivity and learner relevance. In this sense, future-proofing is an evolving form of pedagogical knowing, akin to the "expansion of awareness" described by Marton (2014) and Åkerlind (2025).

This theoretical reframing underscores that resilience in higher education is co-constructed through the distributed agency of designers, educators and institutions. Future-proofing is not a static state achieved through design templates but a collective capability continually renewed through reflection, dialogue and learning.

Limitations and future research

As with most phenomenographic studies, findings describe variation within a specific institutional context rather than generalisable trends. However, the patterns identified provide a conceptual framework that could guide further comparative research across universities or national systems. Future studies might employ longitudinal or mixed-method designs to examine how designers' awareness evolves over time or how institutional policies shape the development of future-proof practices. Additionally, exploring learners' perspectives on these same dimensions could reveal how pedagogical intentions translate into learning experiences.

Given the emergence of S5 (quality, analytics and selective use of AI), further research could examine how AI tools might responsibly support the ongoing content maintenance work central to future-proofing, such as identifying broken links, flagging outdated terminology or references, monitoring disciplinary change signals and supporting refresh cycles through summarisation or comparison of updated sources. Such work should also explore governance, transparency and bias risks to ensure AI-enabled maintenance enhances quality and equity rather than introducing new forms of error or exclusion (Ayeni *et al*., 2024; Moreira *et al*., 2024).

Conclusion

This study contributes to both theory and practice by mapping the qualitatively different ways in which learning designers conceptualise and enact future-proof course design. The findings suggest that sustainable online education depends on cultivating a complex form of awareness that integrates durability, inclusivity, adaptability and employability into coherent pedagogical practices. Through this lens, future-proofing becomes not merely a response to technological

uncertainty but a pedagogical orientation, a reflective capacity to design for learning that endures, evolves and empowers. These findings also highlight learning designers' pivotal role as the pedagogical architects of online provision, suggesting that institutional resilience depends in part on how their professional judgement and design capabilities are supported and further developed.

Acknowledgments

The authors wish to thank Nicole Dickinson for her valuable contribution to the literature review and for her insightful feedback on the survey questions.

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