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TECHNICAL REPORT



Revalidating the Human Capability Standards Using AI-Driven Alignment of Global Skills Frameworks

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8 May 2025

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Content

Summary	5
Introduction.....	5
The Human Capability Standards	5
Approach.....	6
Research Questions.....	6
Methodology	6
Data Set: The Comparative Frameworks.....	7
Findings: Capability Alignment and Convergence	8
Validation and Enhancement Opportunities	9
Capability Gaps and Repositioned Elements.....	9
Skill Dependencies and Nested Capability Formation	10
Dual versions: HCS25-E and HCS25-C.....	10
Addressing Digital Skills.....	11
Discussion	14
Revisiting the Research Questions.....	14
Limitations and Future Research	15
Conclusion	15
References	16
Appendices	19



Research Report

Revalidating the Human Capability Standards Using AI-Driven Alignment of Global Skills Frameworks

Marcus S. Bowles & Paul T. Wilson

Summary

This paper presents a revalidation of the Human Capability Standards 2025 (HCS25) through the application of advanced artificial intelligence (AI) techniques, specifically semantic analysis using high-dimensional text embeddings. HCS25 is benchmarked against 21 widely adopted international frameworks spanning Australia, the United States, and Europe. The findings confirm strong global alignment across core durable capabilities—including critical thinking, communication, collaboration, and adaptability—while also identifying capability gaps in digital fluency, self-awareness, and intercultural competence. The application of transformer-based language models represents a methodological advance in capability mapping, offering scalable, objective, and conceptually rigorous comparison. HCS25 emerges as a validated and globally relevant reference model, with demonstrated utility for curriculum alignment, workforce development, and lifelong learning. This research contributes to the emerging field of AI-supported human capital development and reinforces the centrality of non-technical capabilities in preparing individuals for a rapidly evolving world of work.

Introduction

Workforce systems around the world are undergoing transformation in response to automation, digital disruption, and changing social expectations. In response, organisations and educators have sought frameworks that capture transferable, human capabilities capable of supporting career adaptability and lifelong learning. The Human Capability Standards (HCS), first introduced in 2012 and updated in 2016 and 2020, were developed in Australia to provide a structured reference for evaluating and developing non-technical, durable skills across sectors. These standards group capabilities into four domains: Head (cognitive), Heart (social-emotional), Hands (applied), and Lead (leadership and strategic impact).

Past validations of HCS—including the 2016 and 2020 reviews—used expert judgment and semantic analysis methods such as Latent Dirichlet Allocation (LDA) (Bowles, Harris & Wilson, 2016). These techniques, while informative, were limited by their inability to preserve deep contextual relationships between concepts. In this 2025 revalidation, we apply transformer-based natural language processing (NLP) models to embedding entire frameworks into a shared semantic space. This approach enhances the accuracy, objectivity, and interpretability of both alignment and divergence across frameworks.

This paper addresses a critical challenge in workforce and education systems: how to define and benchmark durable, non-technical capabilities that remain relevant amid rapid technological, economic,

and social change. As organisations and educators adopt increasingly diverse skill taxonomies and ontologies, a pressing need has emerged to validate and align these models to support coherence, relevance, and practical utility. The Human Capability Standards (HCS), developed in Australia and widely adopted since 2012, offer one such model. This study revalidates the HCS25 using OpenAI's embedding models, complemented by dashboards, semantic clustering, and expert review. By comparing the HCS25 against 21 leading international frameworks, this paper provides a transparent, data-driven assessment of its ongoing relevance, identifies skill and capability gaps, and proposes refinements to ensure the framework remains globally credible, pedagogically sound, and fit for purpose in shaping future-ready talent.

The Human Capability Standards

The previous 2020 edition of the Human Capability Standards Reference Framework (HCS20) defines 13 capabilities organised into four domains:

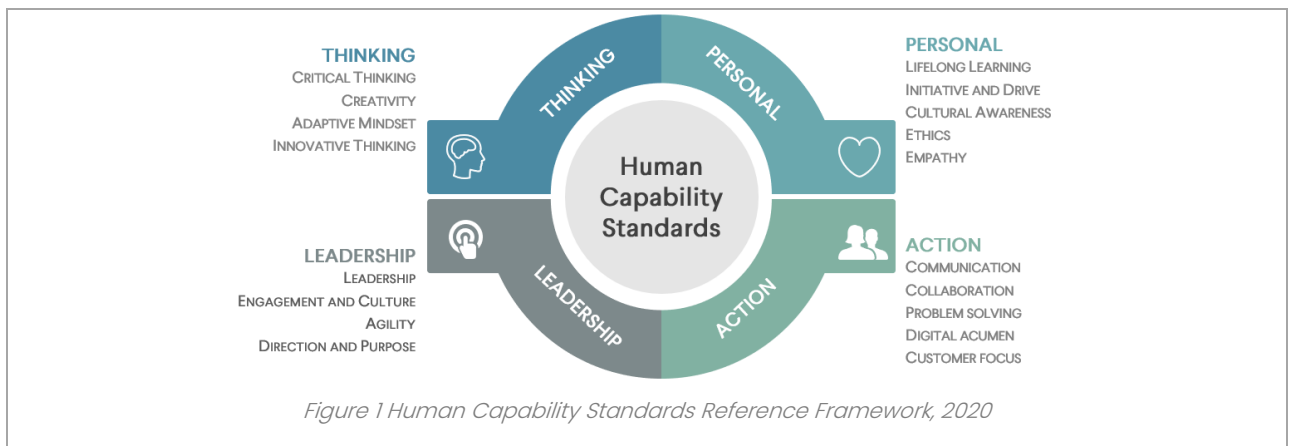
Thinking (HEAD): Critical Thinking, Adaptive Mindset, Creativity

Personal (HEART): Empathy, Ethics, Collaboration

Action (HANDS): Communication, Problem Solving & Data, Customer Focus

Leadership (LEAD): Leadership, Engagement & Coaching, Agile & Innovative, Direction & Purpose





Each capability is described across either seven or five levels of proficiency, enabling application from entry-level roles to executive leadership. The HCS2020 version included *Digital Acumen* that has been moved to a new “emerging” domain in the Common Capability Reference Framework (see Table 1); these “emerging” capabilities being actively tracked but have not been adopted into the top 10–14 human capabilities at this time. While precise details vary, this is generally because they apply to most, but not all roles, are more technical in nature, or lack evidence of durability and transferability.

The capabilities are clustered into five domains. Each capability focuses on a distinct but complementary balance between cognition and how a person thinks, personal emotions and values, contextual skills and knowledge, leadership; and capacity to deploy digital technology..

Approach

Research Questions

Four primary research questions guided this study:

- A. Does the existing Human Capability Standards Reference Framework (HCS2020) include the most important non-technical, generalist, transferable future skills and capabilities?
- B. Should any identified capabilities or skills be included in the revised HCS25?
- C. Should any capability or other element (skill or behaviour) be updated, replaced, or removed from the revised HCS25?
- D. How can the revised HCS framework enhance the prioritisation or recognition of human capabilities across sectors?

To answer the research questions precisely, the study used AI-enhanced language modelling. This aimed to validate the HCS framework and evaluate if global developments in transferable skills frameworks

needed updates. Due to the complex and large data set, traditional methods were inadequate. Natural language processing techniques systematically analysed textual definitions across multiple frameworks. This approach supports reproducibility and aligns with best practices in AI application for policy, education, and workforce development.

Methodology

A rigorous, AI-enabled methodology was adopted to revalidate and benchmark the Human Capability Standards 2025 (HCS25) against 21 prominent global capability and skills frameworks. This approach was designed to ensure objectivity, reproducibility, and conceptual transparency in mapping human capabilities across jurisdictions and purposes. It draws on recent advances in semantic vector encoding using transformer-based language models, which enable more precise comparisons of capability descriptors than traditional qualitative methods (Bommasani et al., 2021; Devlin et al., 2019; Reimers & Gurevych, 2019; OpenAI, 2023).

This study responds to the challenge of aligning frameworks that vary significantly in purpose, terminology, and structure. Whereas many prior validations relied on manual coding or topic modelling (e.g., LDA) (Blei et al., 2003; Blei & Lafferty, 2009) the present study uses high-dimensional text embeddings to preserve relational meaning across diverse linguistic expressions of capabilities. This represents a substantial methodological advance for capability mapping and taxonomy integration (Kuper et al., 2022; OECD, 2021) and moves beyond a key limitation of LDA with respect to large vocabularies (Dieng et al., 2020).

The methodology followed a structured, four-phase workflow:

1. Text Extraction: Capability definitions and related descriptors were extracted from each selected framework. This included full-text content from national, sectoral, and organisational frameworks

across Australia, the EU, and the US. All text was standardised to preserve semantic and contextual integrity prior to vectorisation.

2. **Semantic Embedding:** Using OpenAI's purpose-optimised embedding models, each capability definition was encoded into ~3,000-dimensional vectors that represent the underlying semantic content. These embeddings capture complex meaning relationships, including synonymy, analogy, and conceptual adjacency (Mikolov et al., 2023; OpenAI, 2023).
3. **Quantitative Comparison:** Cosine similarity was used as the principal metric to compare the angle between vectors, providing a robust measure of semantic similarity. For the purposes of this analysis, this approach is superior to Euclidean distance—which is sensitive to magnitude—and to Jaccard similarity, which only captures lexical overlap. Cosine similarity is well-suited to comparing high-dimensional text embeddings (Reimers & Gurevych, 2019).
4. **Thematic Mapping and Interpretation:** Similarity matrices were visualised and clustered into interpretable thematic groups. These clusters were reviewed by domain experts and mapped against the HCS25 domains (HEAD, HEART, HANDS, and LEAD). This enabled conceptual validation while maintaining transparency and traceability of mapping logic.

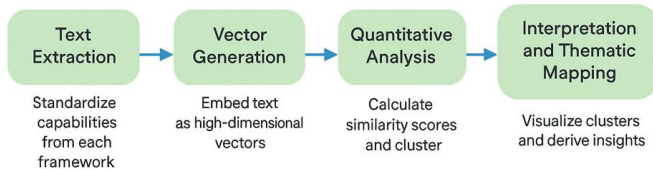


Figure 2 AI driven workflow for aligning skill and capability frameworks using semantic embeddings

By comparing semantic proximity across frameworks, this methodology identified not only direct alignments, but also adjacent capability clusters. This provided a basis for recognising nested skills, capability adjacencies, and opportunities for the creation of micro-credential pathways.

Unlike traditional validation approaches reliant on human coding, this method reduces interpretive bias and supports greater scalability and replication across datasets and jurisdictions. The use of transformer-based language models also allows for continual reanalysis as new frameworks or improved embedding models emerge.

This AI-enabled approach thus represents a significant advance in comparative framework analysis. It facilitates the integration of capability

standards across education, policy, and industry systems and supports evidence-based decision-making in curriculum design, workforce strategy, and global credential recognition.

Data Set: The Comparative Frameworks

The semantic embedding approach described above was applied to a curated selection of international capability and skills frameworks. These were chosen not only for their prominence but also for their relevance to either education or workforce readiness, and their frequency of use in policy, curriculum, and professional development initiatives globally.

While this research builds on over a decade of global capability mapping, it deliberately did not revisit some earlier frameworks already examined in previous four-yearly validation cycles. These foundational studies remain significant in tracing the evolution of capability thinking, but were excluded here to maintain focus on newer frameworks that best reflect contemporary thinking, approaches, and capability priorities. These earlier models shown in *Appendix 2: Comparative Mapping to global research into future skills*, include:

1. Frey, Osborne, and Holmes (2016), *The future of skills: employment in 2030* (Oxford-Martin School)
2. DeakinCo. *Professional Capability Standards* (2016)
3. World Economic Forum, *Top 10 Future Skills Australia* (2018)
4. Partnerships 2, *Framework for 21st Century Learning* (2015)

In contrast, the current study focused on the following frameworks, representing the most recent global efforts to define and advance non-technical, transferable, or durable capabilities:

1. Battelle for Kids, Partnership21, *Framework for 21st Century Learning* (P21, 2022)
2. European Union, Be21Skilled (Lice, et al, 2023)
3. National Association of Colleges and Employers, *Competencies for a Career-Ready Workforce* (NACE, 2024)
4. European Union, *DigComp 2.2*: (Vuorikari, et al, 2022)
5. Education Design Laboratory, *Durable Competency Framework* (2021, revised 2024)
6. Durable Skills Advantage, *Durable Skills Advantage Framework* (America Succeeds 2024)
7. World Economic Forum (WEF), *Education 4.0* (2023b, 2025b)



8. McKinsey, *Foundation Skills for the Future of Work* (Dondi, et al, 2021)
9. Find Fusion, Transferable Skills, *Fusion Employability Skills* (2025; & City of London, 2019)
10. Next Skills, *Future Skills – Germany* (Kirchherr, et al., 2018, 2022)
11. WEF, *Future-Ready Workforce Skills* (2023; 2025)
12. WEF, *Future of Jobs: Survey 2018* (2018).
13. European Union (EU), *Key Competencies for Lifelong Learning* (2018, revised 2020)
14. UNICEF, *Comprehensive Life Skills Framework* (2019; 2021)
15. OECD, *Transferable Competencies* (OECD, 2021a)
16. Skills Framework for the Information Age (SFIA), *Behavioural Factors & Generic Attributes* (version 9, Oct 2024)
17. Child Trends Publication, *Workforce Connections: Key “Soft Skills”* (Lippman, et al., 2015)
18. Next Skills, *Future Skills: A Framework for Higher Education* (Ehlers 2022)
19. American Association of Colleges and Universities (AACU), *VALUE rubrics* (2023)
20. Australian Curriculum, *General Capabilities* (ACARA, 2018)
21. *Australian Core Skills for Work Developmental Framework [CSfW]* (DEEWR, 2020)

To ensure completeness and conceptual breadth, additional research literature and synthesis studies were also consulted. These include comparative reviews and studies identifying future skills, competencies, and capabilities (e.g., Weise et al., 2018; Delisle, 2019; Pretti et al., 2021; Kotsiou, 2022; Singapore Ministry of Education, 2020; Lice et al., 2023; Poláková et al., 2023; Klein & Wilton, 2023; Deckha et al., 2025; WEF, 2025).

Findings: Capability Alignment and Convergence

The comparative analysis of 21 global frameworks reveals a striking degree of convergence around a core set of non-technical, transferable, and durable capabilities. Despite variations in structure, terminology, and intended application, most frameworks prioritise the same high-value human capabilities—particularly, as later analysis will show, those related to adaptability, critical thinking, communication, and collaboration.

Of the frameworks analysed, eleven exhibited strong semantic alignment with HCS25, particularly within the domains of Head, Heart, and Hands. These

include models with a clear orientation toward career readiness, human-centric skills, and workforce development, such as:

- America Succeeds *Durable Skills* (–1.66 Z-score)
- SFIA Generic Attributes, v9 (–1.65 Z-score)
- European Union, Be2ISkilled (–1.56 Z-score)

By contrast, lower alignment was observed with frameworks focused more heavily on technical, digital, or task-specific competencies, such as:

- European Union, Digital Competence 2.2 (+2.164 Z-score)

These results are visualised in *Appendix 5: Overall similarity and comparability of every skill or capability framework*, which presents the relative alignment of each framework with HCS25 and each other based on average cosine distances normalised into Z-scores. Frameworks that align most closely with HCS25 tend to prioritise durable capabilities—those that transfer across industries, occupations, and stages of career progression.

Non-technical capabilities are central to thriving in a rapidly changing world of work

Beyond similarity scores, the analysis also confirmed the most frequently cited human capabilities across all 21 frameworks, based on comparative frequency counts (*Appendix 3: Comparative Mapping to U.S. research into future skills & Appendix 4: Comparative analysis and mapping of capabilities and skills against global skills framework*). These eight capabilities were the most consistently represented:

1. Communication
2. Creativity
3. Collaboration
4. Critical Thinking
5. Problem Solving
6. Lifelong Learning
7. Initiative and Drive
8. Innovative Thinking

While frequency alone does not imply conceptual similarity, the overlap strongly aligns with both HCS25 and recent meta-analyses of future skills frameworks (Kotsiou et al., 2022; WEF, 2025). This consistency supports the argument that these core capabilities represent a global consensus on what constitutes future-ready human capability and allows alternate



skill, curriculum or occupational taxonomies to still be benchmarked for similarity (See *Appendix 6: Comparative clusters*).

The findings reinforce HCS25's utility as a unifying reference framework, bridging capability models across education, employment, and policy systems. Its structure—organised into Head, Heart, Hands, and

Lead—maps effectively across capability taxonomies regardless of jurisdiction or use case. This cross-system relevance makes HCS25 a strong candidate for workforce planning, curriculum reform, micro-credential design, and international capability recognition.

Capability is more than a skill—it's how we think, relate, and adapt

Validation and Enhancement Opportunities

The 2020 release of the Human Capability Standards (HCS), along with the 2023 corporate update, focused on the top 14 of 16 capabilities most frequently aligned across jurisdictions. These showed strong cross-framework affinity:

HEAD

- Critical Thinking
- Creativity
- Adaptability/ Resilience

HEART

- Empathy
- Ethics
- Collaboration

HAND

- Communication
- Customer Focus
- Problem Solving and Data

LEAD

- Leadership
- Engagement and Coaching
- Agile and Innovative
- Direction and Purpose (previously Deliver Results)

In addition to the capabilities listed above, the LEAP (school-to-work transition- Learn, Engage, Aspire, Progress) domain was previously used to categorise four capabilities—Lifelong Learning, Cultural Awareness, Initiative and Drive, and Innovative Thinking—that are commonly emphasised in school and tertiary education settings but were not ranked by employers among the top 14 most important capabilities (VeriSkills, 2022). In 2023, an HCS update for corporate users omitted the LEAP domain and

introduced an optional EMERGING (Digital) domain, which included Digital Acumen, Data Fluency, and AI Fluency. Although frequently in demand, these digital capabilities were classified as technical and non-durable and were therefore incorporated into the Common Capability Standards Reference Framework (see Table 1; Working Futures, 2022). Furthermore, the Collaboration capability was repositioned from the HAND domain to HEART, based on evidence indicating stronger dependencies with social disposition and empathy (Working Futures, 2020).

All remaining durable capabilities—excluding those in the Emerging domain—are not only foundational within education systems but also central to workforce development strategies globally (OECD, 2021; WEF, 2025). The international shift away from narrow technical specialisation toward transferable, human-centred capabilities—particularly those related to empathy, adaptive mindset, creativity, and ethical judgement—underscores the continuing relevance of the HCS. This alignment highlights HCS25's value as a common reference point that helps translate and align capability-building efforts across education, employment, and policy domains.

Capability Gaps and Repositioned Elements

Despite strong alignment, several frequently cited capabilities in other frameworks were either absent, implicit, or not located in the HCS23:

- **Digital/Technology Literacy** – strongly represented in NACE (2024), WEF (2025), and McKinsey (2018)
- **Self-Awareness** – highlighted in the Durable Skills Framework (2024), Education Design Lab (2021), and BE21Skilled (Lice et al., 2023)
- **Intercultural Fluency** – featured in OECD Transferable Competencies (OECD, 2021b), EdDesign Lab (2021), and WEF Global Skills Taxonomy (2025)
- **Meta-skills** such as Lifelong Learning and Career Management – emphasised in NACE (2021)

While not retained in the core HCS25 framework, these capabilities were migrated to the *Common Capability Standards Reference Framework* in 2023, based on insights from 40 corporate and professional body implementations between 2018–2023. For example, Digital Acumen was recategorised as technical and non-durable, though frequently required across all roles and industries (Working Futures, 2022). Other elements—Self-Awareness, Intercultural Fluency, and Career Management—are



respectively covered under existing HCS capabilities: *Initiative & Drive*, *Cultural Awareness*, and *Lifelong Learning*. These were originally present in HCS2020 (Working Futures, 2020), but reclassified under the LEAP domain due to limited employer adoption.

Skill Dependencies and Nested Capability Formation

Recent research by Hosseinioun et al. (2025) has highlighted the structured, hierarchical nature of skill development, revealing that human capital is not simply an accumulation of discrete abilities but a system of interdependent, nested skill sets. Foundational, generalist skills—such as critical thinking, communication, and problem solving—often serve as prerequisites for acquiring more specific, technical, or role-dependent competencies. This sequential dependency mirrors the structure of the Human Capability Standards, and any future version should continue to define capabilities as observable clusters of skills and behaviours that progress in complexity, autonomy, and influence.

By aligning to these nested pathways, HCS25 provides more than a descriptive taxonomy—it offers a developmental scaffold for lifelong learning and capability progression. This structure is particularly valuable for employers, who seek to build pipelines of adaptable, future-ready talent.

Dual versions: HCS25-E and HCS25-C

The Human Capability Standards Reference Framework is designed to define, measure, and develop durable, transferable capabilities applicable across a wide range of roles, sectors, and contexts. Grounded in longitudinal research, the framework emphasises the demonstration of observable behaviours and the recognition of capability in real-world settings. It supports integration across employment, education, and credentialing systems to enable future-ready capability development.

HCS has never sought to be just another list of skills grouped under a capability title. Its strength lies in understanding the relationships between skills and distilling the myriad of taxonomies and ontologies into a more prioritised hierarchy. It is as much about recognising interdependencies and dismantling false silos as it is about mapping capability. In this sense, HCS is akin to the Pantone Colour System—once you identify the base colours, you can mix combinations to create any other colour or, in this case, capability.

Comparative analysis indicates that divergence in framework design is primarily shaped by its intended application—whether to inform curriculum and assessment in education, or to build workforce capability in organisational settings. This distinction reinforces that the way skills are described and

Table 1 Human Capability Standards packaging into HCS25-E and HCS25-C

Human Capability	Cluster/ Domain	Education Version	Employer version
Critical Thinking	HEAD	✓	✓
Creativity	HEAD	✓	✓
Adaptive Mindset	HEAD	✗	✓
Ethics	HEART	✓	?
Empathy	HEART	✓	?
Collaboration	HEART	✓	✓
Communication	HANDS	✓	✓
Problem Solving & Data	HANDS	✓	✓
Customer Focus	HANDS	✗	✓
Digital Acumen	HANDS	✓	✗
Innovative Thinking	LEAP/ HEAD	✓	✗
Initiative & Drive	LEAP/ HEAD	✓	✗
Cultural Awareness	LEAP/ HEART	✓	✗
Lifelong Learning	LEAP/ HANDS	✓	✗
Leadership	LEAD	✗	✓
Empowerment & Coaching	LEAD	✗	✓
Agile and Innovative	LEAD	✗	✓
Direction & Purpose	LEAD	✗	✓
TOTAL		12	10-13



clustered will necessarily differ depending on the context.

Accordingly, the 2025 Human Capability Standards will be published in two tailored versions:

- HCS25-E: Education version, designed to support learner development, curriculum design, and general capability acquisition across schooling and tertiary sectors.
- HCS25-C: Commercial (Employer) version, aligned to workforce needs, career development, and organisational capability frameworks.

While both versions share a common conceptual core, capability titles and behavioural indicators may vary slightly to reflect audience-specific priorities.

Like a colour system, you mix capabilities to create what's needed

Importantly, the behavioural and skill adjacencies have been designed to preserve a coherent flow—from capabilities specific to education through to those prioritised by employers—ensuring alignment across the learning-to-employment continuum.

This dual packaging preserves coverage of the most frequently demanded capabilities (see Appendices 3, 4 & 6), while allowing clearer alignment with frameworks focused on either education (supply) or employment (demand) (see Appendix 5).

The educational variant (HCS25-E) would exclude the LEAD domain and the *Customer Focus* capability and should use substitutes more aligned to school-to-work transitions: *Digital Acumen*, *Innovative Thinking*, *Cultural Awareness*, *Self-Direction*, and *Lifelong Learning*. These same capabilities have their strongest similarity and relevance in frameworks developed to:

- support student development and curriculum design.
- Issue micro-credentials and badges that show students have obtained generalist capabilities employers seek
- Encourage curriculum design to move beyond knowledge transfer to stimulate outcomes-based education and training.
- Allow organisations using skills or capability frameworks to find and utilise learning courses that support workforce and leadership development, and talent mobility.

The HCS25-C, employer version would include LEAD and titles associated with capabilities and associated skills and mindsets in demand by employers. The framework is intended to provide commercial support for employers across all types of organisations to:

- Specify the behavioural expressions and performance markers of human capabilities across varying occupational roles, contexts, and levels of career advancement.
- Design workforce capability models that go beyond specialist technical skills to include highly transferable, durable, generalist skills, mindsets, and behaviours.
- Benchmark and recognise capability attainment using consistent standards that span level of proficiency and career development.
- Provide the capabilities that improve the readiness of people to work together, adapt, and respond to rapid changes in how we work and use technology, such as AI.
- Enable targeted learning, career development, and succession planning by identifying capability gaps and development priorities.
- Looks beyond a job to discover potential and develop talent so it can be mobilised to fill critical shortages in emerging work roles and careers.

Addressing Digital Skills

The handling of digital skills or capabilities is a vexing issue (Bowles, 2023; WEF, 2025). Many frameworks treat them as 'soft skills', or 'durable skills'. They are neither (Mwita, et al., 2024). HCS updates in 2023 removed *Digital Acumen* and placed it with *Data Fluency* and *AI Fluency* that were added to the *Common Capability Reference Framework* in 2020 (Working Futures, 2022). They were clustered with other high demand, emerging digital capabilities such as *Cybersecurity* and *Data Analysis* in a new domain titled, "Emerging" digital technology (See Appendix 1). The capabilities as detailed in the comparative analysis align very well with these capabilities. They are often written as either foundation literacies or technical skills or competencies. The question is not about demand or importance to future work (See figure 3 below), it is about how they are defined and clustered to optimise learner and workforce outcomes. Current data analysis with clients is showing security, data and AI skills require renewal every 18 to 32 months



(Bowles, 2024:8). This removes them as long-term, durable skills or capabilities.

The comparative analysis included frameworks focused on computing, data, and artificial intelligence capabilities. Notably, the European Union's *Digital Competence Framework for Citizens* (DigComp 2.2) outlines what it means to be digitally competent in contemporary society (Vuorikari et al., 2022). It defines five core competence areas: (1) Information and data literacy, (2) Communication and collaboration, (3) Digital content creation, (4) Safety, and (5) Problem solving. These are further divided into 21 competencies, each mapped across eight proficiency levels, intended to guide curriculum design, self-assessment, and workforce development across EU member states.

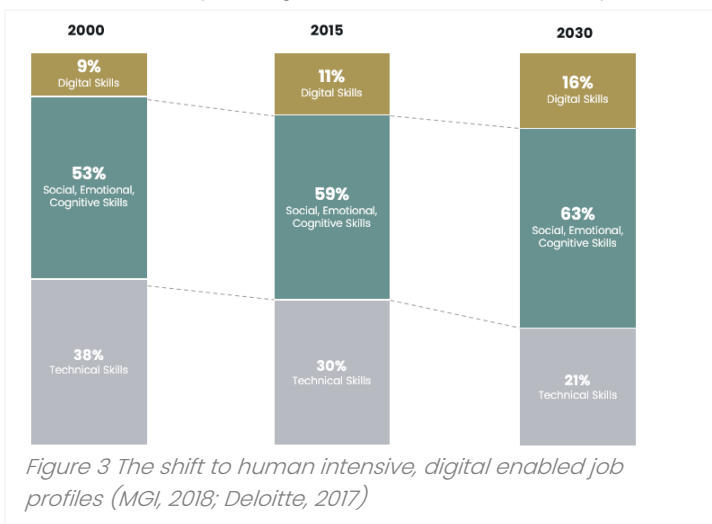
DigComp is a technical-digital framework. Unlike human capability frameworks such as HCS25, it focuses narrowly on digital behaviours—from daily

DigComp is compared against the Common Capability Standards' emerging digital domain (Working Futures, 2022).

In contrast, the Skills Framework for the Information Age (SFIA) aims to balance specialist ICT professional skillsets with general behavioural attributes (SFIA, 2024).

SFIA Version 9 (2024) separates behavioural attributes from technical skill profiles, using one or two core dimensions to define levels. In contrast, HCS integrates behaviours directly into its capability definitions, resulting in a more holistic, human-centric model. While SFIA includes factors like Decision Making, Influence, and Communication, HCS defines parallel capabilities such as Critical Thinking and Leadership through progressive behavioural indicators.

Human capability builds in layers—it's a system, not a checklist



online interaction to cybersecurity and ethical technology use. As a result, DigComp exhibits limited semantic similarity with broader human capability models. However, partial alignment is observed in areas such as communication, problem solving, and responsible digital conduct. Greater alignment emerges when HCS includes Digital Acumen or when

Both frameworks use seven proficiency levels and apply the dimensions of Autonomy, Influence, and Complexity—supported by aligned skills and knowledge—to describe development across career stages. These shared dimensions create a common foundation for workforce capability assessment and benchmarking.

The pairwise cosine analysis in Table 3 confirms the strength of alignment between HCS capabilities and SFIA behavioural factors. It also underscores how HCS places greater emphasis on behavioural development, particularly in support of adaptability and ethical judgment. Nonetheless, the two models are structurally compatible and complementary—well-suited for integrated application in global workforce development, career progression, and education-to-employment systems.

Table 2 Structural alignment of SFIA behaviours against HCS capabilities

SFIA Behavioural Factor	HCS Capability	Similarity (Cosine)	Qualitative Alignment Observations (expert review)
Adaptability	Adaptive Mindset	0.326	Adaptability emphasises resilience and represent a progression from personal flexibility to shaping organisational agility.
Collaboration	Collaboration	0.229	Direct match in terminology, structure, and progressive emphasis on teamwork, influence, and building trust.
Communication	Communication	0.238	Strong alignment in emphasis on clarity, audience engagement, and use of different mediums. Influence is separated out for the SFIA definitions.
Creativity	Creativity	0.238	Both SFIA and HCS define creativity as a progressive, applied behaviour essential for innovation and problem-solving. However, HCS offers clear developmental skill levels while SFIA focus on foundational, anchor attributes.
Decision Making	Critical thinking	0.419	The SFIA behaviour focuses on the <i>act</i> of choosing the right course of action, and coming to a logical, appropriate solution. This broadly aligns with HCS <i>Critical Thinking</i> but has a more distant relationship to evidence-based problem solving.
Digital Mindset	Digital Acumen	0.312	This SFIA generic attribute focusses on embracing and effectively using digital tools and technologies to enhance performance and productivity.
Improvement Mindset	Adaptive Mindset	0.436	SFIA behaviour spans innovation and adaptive mindset as it focussed on continuously finding, not actioning, the opportunities to refine work practices, processes, products, or services for greater efficiency and impact.
Leadership	Leadership	0.297	SFIA <i>Leadership</i> aligns directly with HCS <i>Leadership</i> . Both frameworks emphasise strategic vision, influence, and modelling behaviour to enable team and organisational success
Learning and Development	Lifelong Learning	0.340	Strong developmental alignment but HCS goes deeper into mindset and behavioural traits that include reflective practice and self-directed growth.
Planning	Direction & Purpose	0.460	SFIA <i>Planning</i> has closest distance to HCS <i>Direction & Purpose</i> , as both emphasise structured action toward defined goals. But the HCS capability has a much broader and deeper emphasis on context and impact.
Problem Solving	Problem Solving & Data	0.293	SFIA's <i>Problem Solving</i> emphasises logical analysis, option evaluation, and resolution—core elements also central to HCS <i>Problem Solving & Data</i> .
Security, Privacy, Ethics	Ethics	0.369	Indirect overlap; SFIA lists the behavioural factor but does not provide detail, but HCS <i>Ethics</i> emphasises ethics and integrity aspects.

Key: The numbers are cosine distances, so in this case 0-1 range. 0=exact match, 1 = unrelated

0- 0.25 Very strong alignment of concepts and context
 0.26 - 0.35 Strong alignment of concepts and context
 0.36- 0.45 Good alignment of concepts and context
 0.46 -0.55 Generally related concepts and/or context
 0.56 - 1 Some related concepts and/or context, with 1 meaning unrelated



Discussion

The findings of this study confirm the ongoing relevance and validity of the Human Capability Standards (HCS25) as a globally aligned reference framework for defining durable, transferable capabilities. The semantic comparison of HCS25 against 21 international frameworks reveals a high degree of conceptual congruence across core human capabilities—particularly in the domains of cognition, communication, collaboration, ethics, and leadership. This alignment reinforces HCS25's utility as a translator across the fragmented landscape of capability frameworks used by educators, employers, and policymakers (Bowles, Ghosh & Thomas, 2020; Working Futures, 2022; UNESCO, 2022).

The comparative analysis confirms that HCS25 not only continues to capture the essential human capabilities recognised across global models, but also offers finer behavioural resolution. Its enduring structure, based on four domains (HEAD, HEART, HAND, and LEAD), remains pedagogically sound and conceptually robust when tested against new and evolving frameworks developed by policy makers or agencies endeavouring to produce national solutions (City of London & NESA, 2019).

Importantly, the findings also clarify the divergence in purpose between education-oriented frameworks—which often emphasise foundational literacies and learner progression—and employer-facing models that prioritise behavioural capabilities related to adaptability, strategic judgement, and value creation. HCS25, by bridging these logics, offers a means of translation between these domains of practice and extending the school-based frameworks beyond the entry to work or further learning (VeriSkills, 2022).

The application of semantic embeddings represents a significant methodological advancement in framework validation. Unlike traditional classification or manual mapping techniques, the embedding-based analysis captures contextual and relational meaning, enabling more precise, scalable comparisons across diverse capability definitions (Kuper et al., 2022). This approach not only validates the HCS structure but also supports the development of nested skill clusters, stackable credentials, and outcome-based assessment systems aligned to workforce and education needs (Bowles, 2024; UNESCO, 2022).

Revisiting the Research Questions

Each of the four research questions posed at the outset of the study is directly informed by the analysis presented.

- RQ A: The semantic alignment confirms that the HCS25 includes nearly all of the core human capabilities prioritised by international frameworks, substantiating its continued relevance for employability and lifelong learning (NACE, 2021; America Succeeds, 2020).
- RQ B: A small number of underrepresented capabilities—particularly digital literacy, intercultural competence, and self-awareness—emerged as gaps when only those capabilities in demand with corporate clients were assessed. These areas may warrant further refinement or extension of coverage of HCS intended for educational or career advisory organisations (Bowles, 2024; World Economic Forum, 2025).
- RQ C: While no existing capabilities required removal, the analysis did indicate that some skill components—particularly in Adaptive Mindset, Empathy, and Ethics—could benefit from updated language or structure to reflect evolving global interpretations (Bowles, 2024; UNESCO, 2022).
- RQ D: The use of semantic clustering demonstrated that capability descriptors often co-occur within adjacent skills or behaviours. This supports the design of integrated capability clusters, which may inform curriculum modularisation, stacking of micro-credentialing, and career development pathways (Working Futures, 2022; Bowles, 2024).

The Human Capability Standards remain focused on moving beyond narrow technical skills for the next job and vague notions of 'soft skills', toward clearly defined, generalist, transferable, and durable capabilities that underpin adaptability and long-term career success.



Limitations and Future Research

This study presents several methodological and conceptual limitations that warrant consideration. First, the comparative analysis relied exclusively on publicly available textual documentation of capability frameworks. Consequently, the findings are constrained by the quality, granularity, and currency of those source documents, which may not capture internal or practice-based nuances within organisations or education systems. Second, while semantic embeddings offer a powerful means of assessing conceptual alignment, they are influenced by the vast and diverse corpus used to train large language models such as GPT. Given the high computational cost of retraining, these models may exhibit subtle biases toward historical language patterns, potentially overlooking recent shifts in terminology or emerging concepts—particularly in specialised or rapidly evolving fields.

Moreover, the study did not include empirical validation of the updated Human Capability Standards (HCS25) through field research or stakeholder consultation. Although expert reviews and AI-supported modelling provide robust triangulation, future studies should incorporate mixed-methods approaches—such as curriculum audits, workforce capability mapping, and interviews with educators, learners, and employers—to confirm how capabilities are interpreted and applied in diverse settings. In addition, the study focused primarily on formal capability frameworks and did not address the growing prevalence of informal, experiential, or micro-credentialed learning pathways.

Future research should explore the interoperability of HCS25 with emerging recognition models, such as digital credentialing ecosystems, recognition of prior learning (RPL), and AI-assisted personalised learning systems (Bowles & Ghosh, 2022; UNESCO, 2022). There is also a need to investigate how durable human capabilities are developed and assessed within non-traditional contexts, including cross-border employment, industry-embedded education, and AI-augmented work environments. Such investigations would further enhance the generalisability, transferability, and impact of the Human Capability Standards across sectors and geographies.

Conclusion

Five years after its last validation, the HCS25 framework has been re-examined using advanced AI-driven methods. The findings confirm its continued relevance and strong alignment with leading global skill, competency, and capability models. More significantly, the use of semantic embeddings marks a methodological step-change in how diverse taxonomies can be analysed, compared, and applied to define non-technical, transferable, and durable human capabilities.

This study not only validates two decades of developmental work but also extends the practical utility of HCS25. It demonstrates how its four domains—Head, Heart, Hands, and Lead—can structure capabilities and behaviours in ways that support alignment across education, employment, public policy, and lifelong learning. The future value of HCS25 lies not just in what it defines, but in how flexibly its skill sets and behaviours can adapt to AI-informed workforce priorities.

The proposed 2025 redesign of the HCS framework aligns with global shifts away from narrow technical expertise and vague notions of ‘soft skills’ toward clearly defined, durable capabilities—cognitive, emotional, and interpersonal—that underpin adaptability and career sustainability. Across education systems and labour markets in Australia, the EU, Asia, and the US, frameworks consistently prioritise collaboration, critical thinking, creativity, communication, problem-solving, empathy, and ethical judgement.

HCS25 distils these capabilities into a coherent structure, anchored by clearly defined levels of proficiency and underpinned by behavioural traits. Its broad international alignment reinforces the imperative to prioritise human capabilities as the foundation of future-ready workforces—capabilities that endure even as specific technical skills become obsolete within shorter cycles of technological change.



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Appendices

Appendix 1 Common Capability Standards by Domain 2023 (Working Futures, 2023)

HEAD	Lifelong Learning	Initiative & Drive	Resilience & Courage	Judgement & Decision Making	Innovative Thinking
HEART	Cultural Awareness	Sustainability	Environmental & Social Responsibility	Workplace Safety	Stakeholder Engagement
HANDS	Innovation & Improvement Risk Management	Governance Process Improvement	Financial Fluency Project Management	People & Performance Management Relationship Selling	Policy & Regulatory Excellence Supply Chain Management
LEAD	Champions Change	Teamwork	Accountability	Ruthless Prioritisation & Results	Coach & Mentor
EMERGING	Digital Acumen Data Fluency	AI Fluency	Cybersecurity Fluency	Cybersecurity (Specialist)	Data Analysis

Appendix 2 Comparative Mapping to global research into future skills, 2020

	Comparative International Non-Technical Enduring Skills Frameworks Organisation, Framework and Components				
Human Capability Standards (2020, 2023)	Oxford Martin School (Frey & Osborne, 2016)	SFIA Behavioural Factors & Generic Attributes (2020)	DeakinCo. Professional Capability Standards (2014)	World Economic Forum Top 10 Future Skills Australia (2018)	Partnerships 21 - Framework for 21 st Century Learn (2015)
1. Communication	• Sense-making	• Communication Skills • Influence	• Communication		• Communication
2. Collaboration		• Collaboration	• Teamwork		• Collaboration • Social skills
3. Critical Thinking	• Cognitive load management		• Critical Thinking	• Critical Thinking & Analysis	• Critical thinking
4. Adaptive Mindset	• Novel and adaptive thinking			• Resilience, Stress Tolerance & Flexibility	• Flexibility
5. Customer Focus					
6. Problem Solving and Data		• Problem Solving	• Problem Solving	• Reasoning, Problem-solving & Ideation • Complex Problem-solving	
7. Creativity	• Design mindset	• Creativity		• Creativity, Originality & Initiative	• Creativity
8. Ethics		• Security, Privacy and ethics	• Professional Ethics		
9. Empathy	• Social Intelligence		• Emotional Judgement	• Emotional Intelligence	
10. Leadership (LEAD)		Leadership		• Leadership and Social Influence	• Leadership
11. Engagement and Coaching (LEAD)					
12. Agile and Innovative (LEAD)			• Innovation	• Analytical Thinking & Innovation	
13. Direction and Purpose (LEAD)		• Execution Performance • Planning • Delegation			
Aligned in Common Capabilities (in brackets, if different)	• Cross-cultural competency (Cultural sensitivity) • New media literacy (Digital Acumen)	• Decision Making (Decision Making & Judgement) • Learning and Professional Development (Lifelong Learning)	• Self-management (Initiative & Drive) • Global citizenship (Cultural Sensitivity) • Digital literacy (Digital Acumen)	• Active learning & learning strategies (Lifelong Learning)	• Information literacy (Digital Acumen) • Media literacy (Digital Acumen) • Technology literacy (Digital Acumen) • Initiative (Initiative & Drive) • Productivity (Initiative & Drive)
Unaligned	• Trans-disciplinarity (work across disciplines) • Virtual collaboration • Computational thinking			Technology Design & Programming	

Appendix 3 Comparative Mapping to U.S. research into future skills, 2025

	Comparative U.S. Non-Technical Generalist Skills Frameworks Organisation, Framework and Components				
Human Capability Standards (2023)	America Succeeds, Durable Skills (2021)	Education Design Lab – Durable Competencies (2023)	American Assoc. of Colleges and Universities - VALUE rubrics (2021)	National Assoc. of Colleges & Employers - Career Readiness Competence Framework (2016)	McKinsey - Foundation Skills (2021)
1. Communication	• Communication	• Oral communication	• Oral communication • Reading • Written communication	• Communication	• Communication
2. Collaboration	• Collaboration	• Collaboration	• Teamwork	• Teamwork	• Developing relationships
3. Critical Thinking	• Critical Thinking	• Critical Thinking	• Critical Thinking • Inquiry & Analysis	• Critical Thinking	• Critical Thinking
4. Adaptive Mindset	• Growth Mindset • Fortitude	• Resilience			• Mental flexibility
5. Customer Focus					
6. Problem Solving and Data		• Creative problem-solving	• Problem Solving		
7. Creativity	• Creativity		• Creative Thinking		
8. Ethics			• Ethical Reasoning		
9. Empathy	• Mindfulness	• Empathy			
10. Leadership (LEAD)	• Leadership			• Leadership	• Mobilising systems
11. Engagement and Coaching (LEAD)				• Equity & Inclusion	• Teamwork effectiveness
12. Agile and Innovative (LEAD)					
13. Direction and Purpose (LEAD)					• Planning & ways of working • Goal Achievement
Aligned in Common Capabilities (in brackets)	• Metacognition (Initiative & Drive) • Character (Initiative & Drive)	• Intercultural fluency (Cultural Sensitivity) • Self-awareness (Initiative & Drive)	• Foundation Skills for Lifelong Learning (Lifelong Learning) • Information Literacy (Data Fluency) • Intercultural Knowledge & Analysis (Cultural Sensitivity) • Quantitative Literacy (Financial Fluency) • Civic Engagement • Global Learning • Intercreative Learning	• Career & Self Development (Lifelong Learning) • Technology (Digital Acumen)	• Self-awareness & self-management (Initiative & Drive) • Entrepreneurship (Innovative Thinking/ Innovation) • Digital literacy & citizenship (Digital Acumen) • Understanding Digital Systems (Digital Acumen)
Unaligned					• Software & development (SFA)



Appendix 4 Comparative analysis and mapping of capabilities and skills against global skills framework

Sources		Skills Sets/ Capabilities																				TOTALS
		P21 Framework (2021)	Be21Skilled (Lise, 2023)	NACE Career Readiness Competencies (2021)	DigCom EU (2018)	Durable Competencies (EdDesign Lab 2021)	Durable skills (Durable Skills, 2021)	Education 4.0 (WEF, 2023)	Foundation Skills for the future (McKinsey, 2021)	Future Ready Skills (WEF, 2023)	Fusion Skills Framework (City of London, 2019)	Future Skills –Germany (Next Skills, 2019)	Framework for 21 century Learning (BfK, 2019)	Global Skills Taxonomy (WEF, 2025)	Key Competencies (EU, 2018)	Life Skills Framework (UNICEF, 2019)	Transferable Competencies (OECD, 2021b)	SFA, Behaviour & Generic Attributes (V9, Oct. 2024)	Soft Skill Meta-Analysis (Polakova, 2023)	VALUE Rubrics (AACU, 2023)	ACARA, General Capabilities (2018)	
1.	Communication (interpersonal, listening & oral comm., writing, sensemaking)	●	●	●		●	●	●	●	●		●	●	●	●	●	●	●	●	●	●	18
2.	Creativity/ Design Mindset/ Creative Thinking		●		●	●	●	●	●		●		●	●		●		●	●	●	●	16
3.	Collaboration/ Teamwork/ Cooperation		●	●	●	●	●	●	●		●	●				●	●		●		●	15
4.	Critical Thinking/ Analytical Thinking/ Rationality		●	●		●	●	●		●		●	●	●		●	●	●	●	●		15
5.	Problem Solving/ Decision Making/ Judgement/ Reasoning	●	●	●		●	●	●	●	●			●		●	●	●				●	15
6.	Lifelong Learning/ Self-Directed Learning/ Growth Mindset	●	●	●		●	●	●	●	●		●		●				●		●	●	15
7.	Initiative & Drive/ Self-Management/ Self-Awareness. Independence		●	●		●	●	●	●	●	●		●	●	●			●		●		14
8.	Innovative Thinking/ Curiosity		●	●		●	●	●	●	●		●	●	●		●		●	●		●	14
9.	Digital Acumen/ Technology/ Digital Literacy		●	●	●			●	●		●	●			●		●	●		●		13
10.	Adaptive mindset/ Adaptability/ Flexibility/ Resilience/ Entrepreneurial	●	●			●	●	●	●	●		●	●	●				●	●			13
11.	Ethics/ Civic Engagement		●	●				●			●		●	●				●	●	●	●	11
12.	Cultural Awareness/ Global Citizenship Intercultural Fluency			●		●	●	●	●		●	●	●	●					●	●		11
13.	Agile & innovative/ Innovation		●			●	●	●	●		●	●	●	●		●		●				10
14.	Leadership/ Influence		●	●		●	●		●			●	●	●			●	●	●			10
15.	Direction & Purpose/ Drive Results/ Planning		●	●					●		●						●	●			●	8
16.	Empathy/ Emotional Intelligence		●			●	●	●	●				●			●						8
17.	Engagement & Coaching/ Team Building			●				●				●	●									5
18.	Data Fluency/ AI Fluency/ Information Literacy				●				●		●						●					3
19.	Customer Focus/ Service					●	●														●	3

Appendix 5 Overall similarity and comparability of every skill or capability framework (Z-scores of average minimum cosine distances)

About

This Table is designed to show similarities, accounting for the variations in the number of model elements (skill descriptions). Variation is accommodated using Z-scores. Columns are sorted by the column average Z-score.

Z-score?

Z-score shows how far a value is from the average, measured in standard deviations. It tells you whether a value is higher or lower than expected relative to a group. In this case, across all the models.

Interpretation of the Heat Map

Z = 0 → Typical / average

Z < 0 → Lower than average (better match, more similar)

Z > 0 → Higher than average (weaker match, more distant)

Z < -2 or Z > +2 → Unusually strong or weak match (outlier)

The darker the green the greater the similarity, the darker the red, the greater the dissimilarity across all elements.

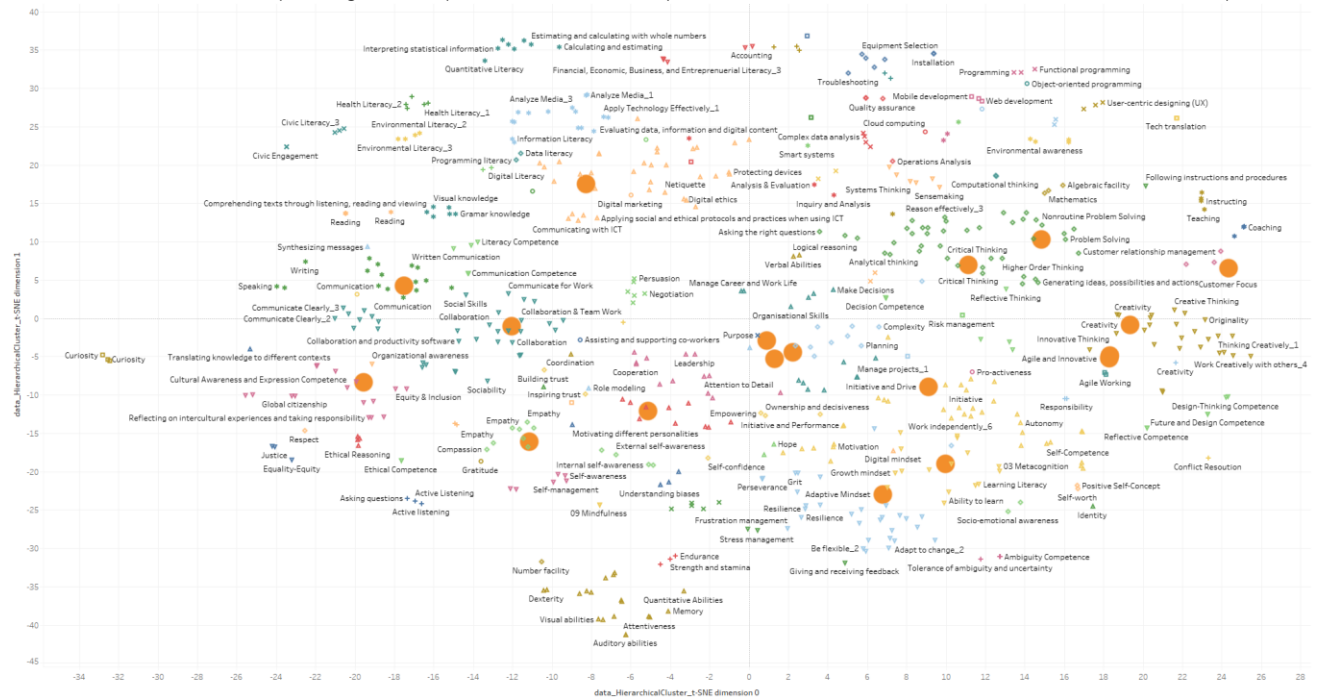
Framework similarities read from left to right in the heat map.

Model short Title	compared_model_shortTitle / Z_Score_ModelToComparedModel columnAverage																								
	HCS (WfF 2025)	Foundational Skills (McKinsey; Dondi et al 2021)	Education 4.0 (WEF 2025)	Global Skills Taxonomy (WEF 2025)	Be21Skilled (EU, Lice et al 2023)	Fvk for 21st Century Learning (BfK 2019)	Durable Skills (America Succeeds 2024)	Future of Jobs (WEF 2018)	Future Skills (Next Skills, Ehlers 2019)	SFA Generic Attributes (v9, Oct 2024)	Durable Skill Micro-Credentials (EdDesignLab 2025)	Career Readiness Competencies (NACE 2024)	ACARA General Capabilities (2018)	OECD 2030 Learning Compass - Construct Notes (2024)	Fusion Skills (Fnd Fusion, 2025)	Workforce Connections (ChildTrends 2015)	Future Skills - Germany (Winde & Schroder 2019)	21st Century Skills (NRC 2010)	DEEWR CoreSkillsForWork (2013)	Future Skills (Next Skills, Ehlers 2022)	Life Skills Framework (UNICEF 2025)	AACU Value Rubrics (2022)	Key Competencies (EU 2019)	Digital Competence 2.2 (EU 2022)	
21st Century Skills (NRC 2010)	-1.064	-0.921	-0.910	-0.783	-0.729	-0.548	-0.221	-0.142	-0.133	-0.129	-0.023	-0.003	0.076	0.119	0.124	0.208	0.289	0.312	0.336	0.344	0.660	0.696	1.076	1.367	
AACU Value Rubrics (2022)	-0.345	-0.900	-1.385	-0.619	-1.958	-1.016	0.250	-0.356	0.004	-0.791	-0.079	-0.296	0.594	-0.306	-0.364	0.059	0.293	0.218	0.640	0.632	1.394	1.906	2.428		
ACARA General Capabilities (2018)	-1.646	0.057	-1.716	-0.545	-0.856	-0.633	0.073	-0.223	0.564	0.334	-0.600	0.363	-1.756	-0.258	-0.760	0.410	1.190	0.754	1.235	-0.245	1.701	0.886	1.670		
Be21Skilled (EU, Lice et al 2023)	-1.100	-0.082	-0.296	-1.298	-0.569	-1.424	0.243	0.291	0.697	0.964	0.664	0.482	0.465	-0.054	0.646	1.270	0.838	-0.196	0.292	1.787	-1.973	-2.030	0.383		
Career Readiness Competencies (NACE 2024)	-2.269	-0.952	-0.950	0.144	0.236	-1.488	0.932	0.181	-0.352	-0.561	0.442	-0.332	-1.040	-0.380	-0.073	1.006	-0.217	0.931	-0.173	1.127	1.020	0.440	2.327		
DEEWR CoreSkillsForWork (2013)	-1.825	-0.638	-0.783	-0.572	-0.149	-1.782	-1.179	0.079	0.369	-0.680	-0.652	0.535	1.659	0.640	-0.676	0.579	0.380	-0.596	1.101	0.657	0.738	1.689	1.435		
Digital Competence 2.2 (EU 2022)	-2.003	-0.543	-0.172	0.082	-0.556	-1.552	-0.233	0.673	0.369	-1.370	0.526	-1.452	-0.408	1.479	-0.630	0.153	0.668	-0.481	0.869	0.669	1.465	1.564	0.887		
Durable Skill Micro-Credentials (EdDesignLab 2025)	-0.470	-1.618	-0.658	-0.518	0.440	-1.216	1.237	0.497	-0.427	-0.374	1.137	-0.209	-1.102	1.034	0.776	1.201	-1.551	1.197	-1.003	1.419	0.766	0.565	-1.122		
Durable Skills (America Succeeds 2024)	-2.516	-0.475	-1.364	-0.207	-1.059	-0.375	-1.150	0.837	0.198	-0.256	-0.553	0.161	-0.129	-0.597	0.725	0.898	0.344	0.844	-0.148	0.829	0.614	1.193	2.185		
Education 4.0 (WEF 2025)	-2.030	-0.103	-0.954	0.246	-1.435	0.199	0.118	0.527	-1.426	-0.837	-0.486	0.102	-1.128	-0.014	-0.427	0.797	0.488	0.697	0.384	0.653	0.758	1.748	2.124		
Foundational Skills (McKinsey; Dondi et al 2021)	-0.960	-1.590	-2.223	-0.664	-0.619	-0.256	-1.173	0.115	0.474	-0.168	0.550	0.688	-1.364	0.115	0.332	0.095	0.464	0.738	1.028	0.138	0.942	1.555	1.781		
Fusion Skills (Fnd Fusion, 2025)	-1.091	-1.747	-0.364	-0.793	0.112	-0.858	-0.816	0.101	0.118	-0.203	0.825	0.152	0.610	0.106	-0.957	0.816	0.363	0.761	-0.704	1.631	1.770	1.791			
Future of Jobs (WEF 2018)	-1.580	-0.539	-1.194	-0.457	-1.178	-0.915	-0.917	0.256	1.425	-0.956	-0.905	1.062	0.123	-0.844	0.684	0.534	-0.058	0.175	0.853	1.156	-0.172	1.746	1.702		
Future Skills - Germany (Winde & Schroder 2019)	0.234	-1.201	-1.273	-0.757	0.377	-0.937	0.150	-0.130	0.423	0.703	-0.167	0.585	0.427	0.500	-0.437	-0.478	-0.151	0.225	1.212	-0.464	1.051	1.569	0.909		
Future Skills (Next Skills, Ehlers 2019)	-0.512	-2.004	-0.886	-1.917	0.354	-0.939	0.887	-0.790	-0.437	-0.162	0.591	0.103	0.818	0.898	0.570	0.530	0.531	0.144	0.550	0.549	1.118	0.945	-0.326		
Future Skills (Next Skills, Ehlers 2022)	-0.001	-0.859	-0.309	-0.319	-0.438	-0.560	0.473	0.065	-0.273	-0.030	0.299	0.788	0.501	0.597	0.120	0.001	0.084	0.788	-3.977	0.239	0.987	0.080	1.200		
Fvk for 21st Century Learning (BfK 2019)	-0.193	0.112	0.108	0.571	-0.851	0.225	0.028	0.793	-0.094	0.251	-0.277	0.559	0.184	-0.098	0.191	-0.004	0.878	-0.073	0.669	0.961	0.203	-0.747	0.523		
Global Skills Taxonomy (WEF 2025)	-0.103	-1.211	-1.084	-1.249	-0.719	0.753	-1.327	-0.437	0.592	0.031	-1.367	-0.257	1.647	-0.231	0.768	-1.463	0.638	0.220	1.540	0.124	0.826	1.778	0.531		
HCS (WfF 2025)	-0.302	-1.674	-1.233	0.347	-0.983	0.554	-2.911	0.108	0.347	0.740	-0.180	0.192	0.257	0.549	-0.199	-0.869	0.352	0.466	1.331	0.019	1.276	1.368	0.434		
Key Competencies (EU 2019)	-0.761	-0.730	-0.488	-1.568	0.083	-1.661	0.404	0.573	-1.652	-1.181	-0.313	0.122	-0.495	-0.202	-0.400	0.881	0.901	-0.182	0.601	0.845	0.675	1.551	2.164		
Life Skills Framework (UNICEF 2019)	-0.442	-0.004	-0.285	-0.329	-1.503	0.167	0.621	1.425	-1.807	0.624	-0.003	0.637	-1.265	1.223	0.964	0.539	0.623	0.101	0.442	-2.328	1.431	-0.675	-0.157		
OECD 2030 Learning Compass - Construct Notes (2024)	-0.627	-1.698	-1.596	-1.671	0.067	-0.764	-0.204	-1.279	-0.221	-0.236	-0.120	0.043	-0.448	-0.254	0.589	0.154	0.685	0.321	0.237	1.105	1.472	1.933	1.615		
SFA Generic Attributes (v9, Oct 2024)	-1.334	-1.169	-1.510	-1.163	-1.877	0.753	-0.854	0.461	0.520	0.247	-0.339	0.962	-0.432	-0.033	-0.813	1.115	0.399	0.991	0.027	0.568	0.335	1.261	1.886		
Workforce Connections (ChildTrends 2015)	-2.596	-0.999	-0.439	0.102	-1.171	-0.206	-1.763	0.054	0.470	-0.106	-0.205	0.604	-0.016	-0.221	0.559	0.145	-0.162	-0.157	0.826	0.774	1.219	2.029	1.258		
	-0.825	-1.330	-0.596	-0.803	-1.440	0.435	-0.750	-1.237	-0.497	0.688	0.722	-0.146	0.540	-1.084	0.235	0.307	-0.295	0.490	-0.074	0.719	0.529	1.728	2.683		



Appendix 6 Comparative clusters (T-SNE of model elements with HCS highlighted)

This image shows a dynamic model that shows relationships between Model elements and their proximity to each other – in terms of concepts (e.g. their explanation of creativity) – are located close to each other in this T-SNE map.



NB: This map is a dimension-reduced version of the text embeddings, indicating their relatedness in 2 dimensions instead of ~3000 dimensions. There is some randomness in this dimension-reduction process, so proximities are not as precise as cosine distances.

