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A scoping review of Future Skills frameworks

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ABSTRACT

Many agree that education needs new goals that reflect the demands of the future. These are often called ‘Future Skills’, referring to the knowledge, attitudes, values, skills, and competencies intended to prepare learners for the future. The need to teach such Future Skills is often cited, justified by the perception that the future will present new challenges for society.

However, the various frameworks discussing Future Skills, often created and published without consensus, use hundreds of terms to refer to such skills and competencies, presenting a barrier to discussion of education futures. If we are to design a better future for education, then a cohesive analysis must link and synthesise these isolated frameworks published worldwide.

This scoping review utilises thematic analysis and Social Network Analysis to develop meta-categories representing clusters of future skills reported by extant research. Having started with 99 frameworks identified following a systematic search of the literature, which together included 341 different terms, our review identifies nine categories that provide a valuable overview of the field to inform the conceptualisation of Future Skills. Educational practitioners, human resource professionals, policy makers, and educational technology developers can use the meta-categories to prioritise the integration of certain skills into teaching, learning, and retraining. This will help ensure that students and professionals are better prepared to thrive in an uncertain future.

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Future skills; twenty-first century skills; competencies; curriculum; assessment

Introduction

The need to teach ‘Future Skills’ (i.e. knowledge, attitudes, values, skills, and competencies intended to prepare learners for the future) is often justified by the perception that the future will present new and potentially more severe challenges for society. For example, the accelerated rate of technological development is already leading to significant economic upheaval across many industries. Furthermore, frequent environmental disasters present clear challenges and add uncertainty to our collective security. Maybe new forms of media simply allow for greater awareness of the suffering of others, as

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past generations also faced hardship. Regardless, current ways of life simply seem less certain for the next generation. How can education systems help prepare students for an unpredictable and seemingly threatening future?

In the world of work, technological advances have already begun to make various roles redundant (Marr 2019). According to estimates, by the early 2030s, over 40% of existing jobs will be at high risk of automation in some European economies (Hawksworth, Berriman, and Goel 2018). Many employees are therefore expected to need reskilling by as early as 2025 (World Economic Forum [WEF] 2020). In this regard, lifelong learning is considered a necessary attribute for workers who must adapt to the changing demands of their work. However, there is a deficit of ideas in terms of how to deliver on the re-skilling of a workforce after the formative years of state-sponsored education (Layzell and Bennett 2021). This has led to an effort to develop and describe the skills and competencies people will need to secure new jobs that are being invented (OECD 2018). How can professional development programmes therefore, provide reskilling and upskilling opportunities to those who are part of the present and future workforce?

The uncertainty created by environmental or health crises has also brought new efforts to integrate Future Skills into curriculum and professional development programmes (UNESCO 2020). For example, the COVID-19 pandemic is pushing employers to accelerate digitisation and automation at even higher speeds (WEF 2020). Sixty-one percent of the jobs furloughed in the UK involved sectors where workers experience the highest risk of automation (Abey et al. 2020), while by 2025, the ratio of humans to machines in industry is expected to be equal (WEF 2020).

However, Future Skills are not only about preparing the next generation of workers for jobs that have yet to be created or to prepare them to problem-solve during crises. The threat of the uncertain future takes many forms, including creating issues of well-being, identity, and citizenship. Some argue that Future Skills are needed to support the next generation to move beyond the illusion of certainty as well as the fragilities this creates (UNESCO 2019). Thus it has been argued that delivering on Future Skills involves instilling agency in the next generation of global citizens (OECD 2018; UNESCO 2019).

Identifying the problem

Various entities concerned with strategic decision-making in education, including for-profit, quasi-public, not-for-profit, and government organisations, have attempted to identify what skills will be most sought after in the future. This has led to the publication of a wide variety of frameworks, often without consensus, that define and identify different Future Skills. A large number of frameworks propose hundreds of skills, meaning an overview of current thinking is difficult to ascertain.

While previous analyses of Future Skills have attempted to synthesise the proliferation of frameworks, most of these efforts only capture a small subset of the field or focus exclusively on grey literature (e.g. Explore SEL, n.d.). Furthermore, the rapid shift to remote learning and work due to the COVID-19 pandemic will undoubtedly change the types of skills that will be required for success in rapidly changing economies, making an up-to-date analysis even more urgent in order to inform ongoing and future initiatives.

Previous reviews of frameworks (e.g. Binkley et al. 2012; Chalkiadaki 2018; Dede 2010; Voogt and Roblin 2012) give an overarching view of how leading organisations conceptualise the challenges of the future and how to face them. However, these previous reviews do not include recent frameworks developed by private institutions and organisations that provide additional insights regarding the perceptions of stakeholders such as industry, technology, and human resources (e.g. WEF 2020). Furthermore, some of the frameworks included in the prior reviews (e.g. OECD 2005; Partnership for twenty-first century learning [P21] 2006) have now been updated to consider the current context (e.g. OECD 2018, P21 2019). There is therefore a need to both extend and update the findings of previous studies. In this regard, the platform Explore SEL (Explore SEL n.d) provides a broad and up-to-date description of several non-academic frameworks, which were developed by both not-for-profit and for-profit organisations. This platform is useful as it offers a uniform description of different international frameworks. However, it does not give an overview of the commonalities and points of agreement across the skills and competencies each framework advances, which is needed to inform policy and practice.

Other related and more recent reviews have been undertaken to address specific subjects such as digital skills or democratic competencies. For instance, Barrett (2016) reviewed frameworks specifically outlining skills to create a democratic society, while the DQ Institute (2019) focused on digital competencies and standards to define a globally shared understanding of this topic. However, although these frameworks tap into relevant and up-to-date topics, they do not provide the general overview which will be of most help to policy makers and practitioners.

Aims

In order to provide guidance to policymakers, practitioners, and others interested in helping to prepare learners to face the future, this review had two aims:

- (1) To undertake a rigorous scoping review of the literature to provide an accessible and comprehensive account of Future Skills frameworks. Without limits in terms of learner age or level of education, results for the first time incorporate academic articles, policy documents, white papers, and grey literature from both private and public institutions, resulting in a comprehensive review of available frameworks.
- (2) To synthesise the unwieldy and continuously expanding literature of Future Skills into discernible categories, making the potential integration of these concepts into educational practice more practicable for both practitioners and policymakers.

This scoping review utilises both thematic analysis and Social Network Analysis (SNA) to develop meta-categories representing clusters of skills cited in the literature. These condensed categories can inform the conceptualisation and integration of Future Skills in education. For instance, the analysis may contribute to the assessment of educational programmes to identify whether these skills are being addressed, identify opportunities for reskilling and upskilling in workplaces, and prompt informal educational actions to support the development of these skills.

Structure of the paper

The paper is organised into four sections:

- The term Future Skills is defined.
- The systematic scoping review and analysis methods are outlined.
- Nine meta-categories of Future Skills are presented as findings.
- A discussion focuses on the primary rationale for preparing the next generation of learners in Future Skills. It is suggested that Future Skills are about embracing uncertainty and being able to exert agency in crisis.

Defining ‘Future Skills’

Future vs Twenty-First Century Skills (C21)

Both the terms Future and C21 are used interchangeably by different stakeholders. This paper uses the term Future Skills to avoid referring to a specific point in time. Terms that reference specific centuries become less useful for a field that must reorient itself towards more distant times.

Skills vs competencies

The term ‘skill’ refers to specific learned abilities such as literacy and should not be applied more generally. An alternative term frequently used in the literature is ‘competency’. Competency typically refers to an individual’s ability to respond to a complex demand by combining their internal resources (such as knowledge, skills, values, and attitudes) to respond successfully to a given situation or context (McGuinness 2018). For example, the competency of effective communication includes the individual’s language knowledge, writing or speaking skills, and the attitude towards whom he or she is communicating (OECD 2005). However, both the terms ‘skill’ and ‘competency’ are used in many ways, making them hard to define clearly (see discussion in Winterton, Delamare-Le Diest, and Stringfellow 2006). In practice the term ‘competency’ is very often used interchangeably with the term ‘skill’ (Chen 2019).

This paper uses the term Future Skills to refer generally to the knowledge, attitudes, values, skills, and competencies that are intended to prepare learners to thrive in the face of an uncertain future. Efforts to integrate Future Skills into education are about being more aware of the future and better able to work with it to prepare, recover, and reinvent as changes occur (UNESCO 2019).

Methodology

This section provides an overview of the search and analysis strategy implemented. This was influenced by the methodological guidance outlined by Arksey and O’Malley (2005), and further clarified and enhanced by Levac, Colquhoun, and O’Brien (2010).

Searching for published frameworks

A systematic scoping review of Future Skills frameworks was conducted. Scoping reviews are a rigorous and transparent type of secondary research, representing a popular approach to appraising evidence for several years (Levac, Colquhoun, and O'Brien 2010). They include collecting, evaluating, and presenting evidence (Arksey and O'Malley 2005). This is analysed at a high level, enabling in this way the identification of clusters and gaps that may inform further research (Kitchenham, Budgen, and Brereton 2015). A key strength of the methodology is that it enables the identification of key features of a diverse body of literature in a connected way (Davis, Drey, and Gould 2009). Scoping reviews are an accepted approach for reviewing education-related research, especially when the research is aimed at being ground-breaking (e.g. Major and Watson 2017; Virtanen et al. 2017). They can be particularly useful for conducting literature reviews when a topic is dispersed and the terminology used by different authors is inconsistent (Peters et al. 2015).

Four different search strategies were used to conduct this scoping review: First, a boolean search strategy was developed, tested, and then deployed in databases covering education-relevant content (Figure 1). All team members were involved in the development and testing of the search strategy. For example, researchers identified several highly cited Future Skills frameworks. These select frameworks served as keys and were used to validate combinations of search terms, truncation strategies, and other database-specific filters. If a key title was excluded from a search result, the boolean search strategy was altered by removing a filter or adjusting the truncation of a search term to ensure the highly cited reference was included in the search results.

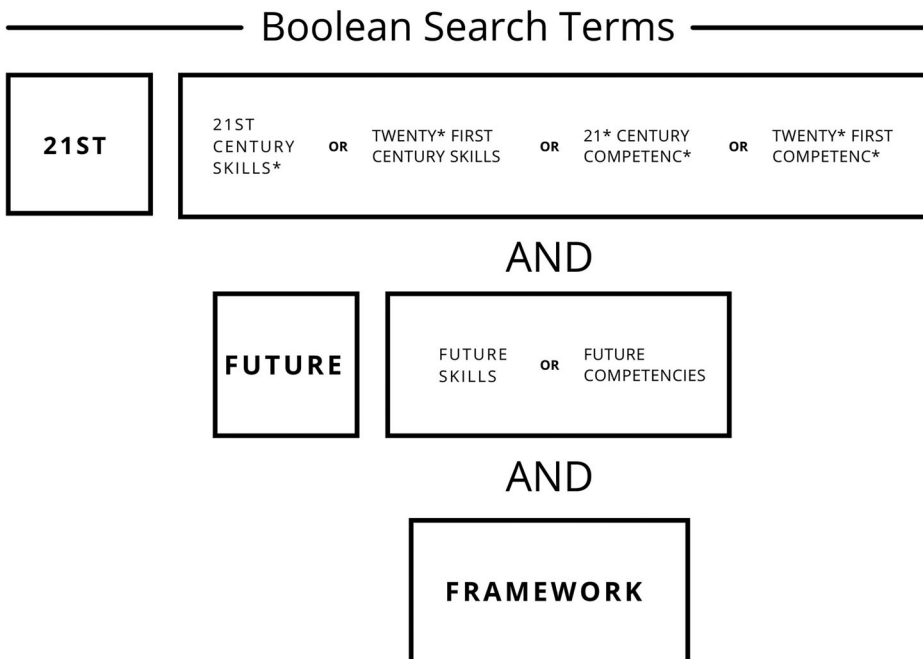


Figure 1. Boolean Search Strategy.

In the second search strategy, a search of grey literature was conducted. The research team used both Google Scholar and directed web searches of prominent public and private institutions to locate additional frameworks.

A third search strategy involved a review of reviews. Thirty-three reviews of Future Skills frameworks were identified while conducting boolean searches of databases and grey literature searches. The contents of these reviews were scanned for relevant frameworks. These first three search strategies were used to establish an initial corpus of potentially relevant frameworks.

The titles, abstracts, and keywords of this initial corpus were reviewed by single members of the research team. If the title, abstract, or keywords indicated the framework might be relevant for the scoping review, the framework was then read in full by multiple team members to determine if it met the inclusion or exclusion criteria.

The inclusion criteria were:

- Frameworks geared towards learners, regardless of age or education level.
- Reporting a new or novel interpretation of a previously published framework.
- Published in English.
- Published after 2010.

The exclusion criteria were:

- Highly specialised context or framing for the framework.
- Reporting only on subject-related knowledge and skills.

For example, one article examined conflict resolution within the context of Middle East political conflict (Cohen-Chen et al. 2014). This article was excluded from this review of frameworks because of the highly specialised context focusing on Israeli-Palestinian conflict. Furthermore, a framework by Koh et al. (2015) was also excluded from this review because it was developed specifically for teachers working in the information and communications technology (ICT) subject area.

Finally, a fourth search strategy was used to achieve saturation. Both forward and backward citation snowballing was carried out on the corpus of frameworks. This involved examining reference lists of included records for additional Future Skills frameworks.

This combination of search strategies resulted in the identification of 99 frameworks (Figure 2). Each of these 99 records were included in the following analysis. The list and specific details of each framework can be found in Appendix 1.

Future Skills analysis

Details about each framework were extracted onto a spreadsheet, including the title, publication year, national context, target age, type of organisation as well as skills, competencies, values, attitudes, and knowledge described by the framework (see Appendix 1). Having identified that multiple frameworks were often describing similar skills using different terms – such as ‘creative thinking’ instead of ‘creativity’ – one team member normalised the skills for the entire dataset, unifying similar terms under one term.

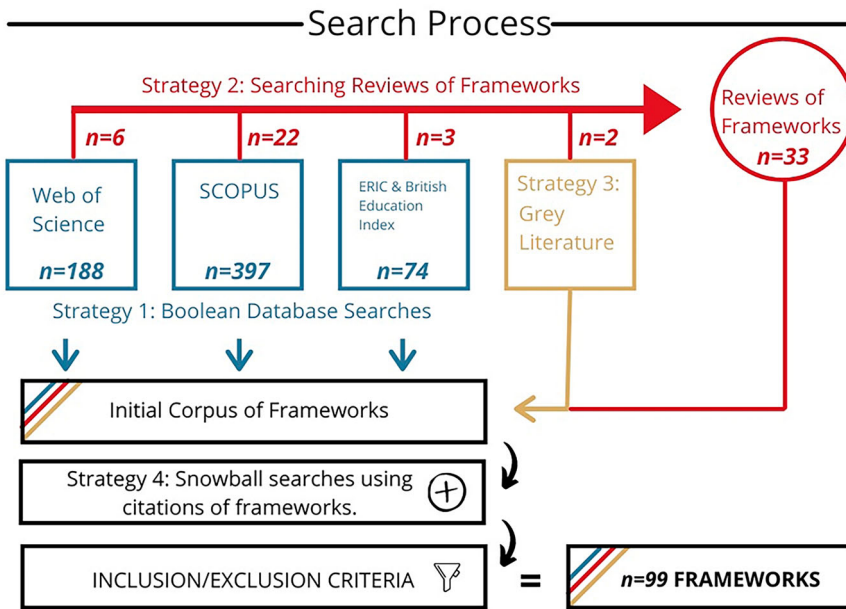


Figure 2. Outline of Search Strategy.

Subsequently, another team member checked the normalised items against the original ones. If team members disagreed with the normalisation of terms, a third member of the research team was consulted, and a resolution was reached through discussion.

The research team then employed thematic analysis on the contents of the frameworks, developing broader themes to capture similarities among mentioned skills. This process took several iterations, each time merging skills and forming higher-level categories. Through a constant comparative method employed in a recursive manner, these categories were subsequently assessed for distinctiveness and coherence (Braun and Clarke 2006).

This thematic analysis was aided by network analysis methods. Network analysis tools are commonly used by social science researchers to understand human systems. However, network methods can also be used to understand many non-human systems that also rely on relationships between different entities. For instance, phone networks have been used to detect organised crime (Ferrara et al. 2014), while attendance records from a newspaper's society pages were used to study social cliques within upper-class society in the American South (Davis, Gardner, and Gardner 1941). The application of network methods is diverse and expanding.

There are four components of modern network analysis research (Freeman 2004). Network researchers are motivated by a structural intuition; their work is grounded in the systematic collection of relational data; it draws heavily on graphic imagery such as network diagrams; and it includes the use of mathematical and computational models Freeman 2004. These components can be combined by researchers in different ways to make sense of relationships in many contexts.

The thematic analysis carried out in this review was supported by static network diagrams and descriptive network statistics. A two-mode network was created to visualise

the prominence of skills within the 99 frameworks included in this review. A two-mode network uses nodes to depict two different entities. In this instance, each grey node represents a framework, and every purple node represents a future skill. An edge connects a grey framework node with a purple skill node if the skill is mentioned in the framework.

The node labels in the network diagram were then sized relative to their in-degree centrality, i.e. a descriptive network statistic that indicates how many edges terminate with a given node. Therefore, in this network the in-degree centrality measure of a skill node is equal to how many frameworks from the corpus mention the particular skill. Node labels with larger lettering in the network diagram had comparatively more mentions among frameworks than those with smaller lettering.

Network analysis tools were chosen for this analysis in order to accelerate pattern recognition within a large corpus of Future Skills frameworks. Traditional coding and counting techniques for analysing qualitative data are becoming less practical when researchers are working with big data (Shaffer 2018). While this analysis combines two elementary network analysis tools, it represents the potential to develop more efficient pattern-recognition strategies for analysing qualitative data through the mixing of methods.

Limitations

Only studies written in English were examined. Language filters can lead to the exclusion of relevant literature written in other languages. Furthermore, our inclusion criteria were intentionally broad and we did not differentiate between different types of C21 or Future Skills frameworks. For example, a framework developed by a for-profit actor, outlining skills required for future employees, was treated the same as a Future Skills framework that focused on well-being. These inclusive criteria can lead to a greater variety in the final corpus of skills. Introducing a rating scale and weighting frameworks based on quality criteria might have altered the Future Skills recognised in the findings. However, this review aimed to map and synthesise cited C21 and Future Skills to identify commonalities rather than critique this space.

Consulting known experts in the field might have helped to ensure saturation. However, review of reviews and snowballing citation searches helped mitigate the risk of missing a prominent framework. Finally, given that several frameworks were using different terms to refer to the same skills, such as 'goal-oriented' and 'outcome-focused', the normalisation process we followed (i.e. grouping together similar terms) might have introduced some bias in the final categories developed. We attempted to mitigate the potential for bias by conducting this process with multiple members of the research team.

Findings

Common skills within the existing literature

This review identified 99 frameworks of Future Skills. These frameworks were authored by a broad sample of actors in education including academia ($N = 21$), non-profit organisations ($N = 36$), organisations with member states ($N = 22$; e.g. OECD, UNESCO, and

European Commission), industry organisations (N = 6), and governments from different countries (N = 14). The majority of the frameworks were aimed at informing international actions (N = 35), while others were developed for a specific region (e.g. European Union countries (N = 7), MENA countries (N = 1)) or for a specific country (e.g. United States (N = 30), United Kingdom (N = 4), India (N = 2), Australia (N = 2), Singapore (N = 2), Canada (N = 2), among others). Regarding target age groups, 17 frameworks did not specify age, 79 were described to be for higher education and/or under, and 3 for employment purposes, which includes higher education and professionals. A complete description of the frameworks included can be found in Appendix 1.

The first finding of this paper is that the literature describing Future Skills is prolific. Many different stakeholders in education have developed and continue to publish new frameworks. This creates complexity in the literature and a general lack of consensus as to what is meant by Future Skills, which is something this paper aims to overcome. An initial review of the 99 frameworks revealed 341 different terms that are generally referred to as skills. However, many frameworks also include attitudes and references to specific knowledge. No substantial differences were identified in terms of age or level of education, which may imply that skills can be nurtured at several levels. For instance, creativity was identified as a future skill by the Partnership for twenty-first Century Learning (2019), but also by the World Economic Forum (WEF 2020) framework, which is targeted to higher education.

The second finding of this paper is that the word *skill* is often used as an umbrella term to refer to skills but also attitudes, competencies, and knowledge. In this regard, our definition of Future Skills, previously explained, aligns with the existing literature.

A final, key contribution of this paper is to detail the skills (along with attitudes, and types of knowledge) that are frequently mentioned within the expansive literature known as Future Skills. Only two skills were mentioned in at least half of the frameworks: *problem-solving* and *communication* were mentioned in 54 and 51 frameworks respectively. However, 245 of the skills, attitudes, and types of knowledge were only mentioned in one or two of the frameworks included in this review. This may be because several frameworks refer to the same type of skills using different terms. For example, *citizenship* is also referred to as *civic knowledge*, *civic literacy*, *active citizenship*, and *informed citizenship*. By combining clearly similar terms under one term as part of our methodological approach, we were able to overcome this problem and indicate the prevalence of these normalised skills.

Overall, there was noticeable overlap across the many skills mentioned by the 99 frameworks, as can be seen in Figure 3. This network diagram reveals a core set of 12 skills that were mentioned more frequently in the frameworks that were analysed.

The set of core skills was initially identified by creating a two-mode network. Each of the 99 frameworks were represented by a grey node. The 341 skills, attitudes, and types of knowledge were each represented by a purple node. Edges connected a grey framework node with a purple node if the particular skill was mentioned by the individual framework. The purple node labels were then sized based on in-degree centrality. In this network diagram (Figure 3), in-degree centrality equals the number of mentions of each skill, attitude, or type of knowledge from frameworks. Further analysis was then conducted to determine the frequency of each skill mentioned in each of the 99 frameworks. Thirty-four of the 341 skills were mentioned by at least ten of the frameworks

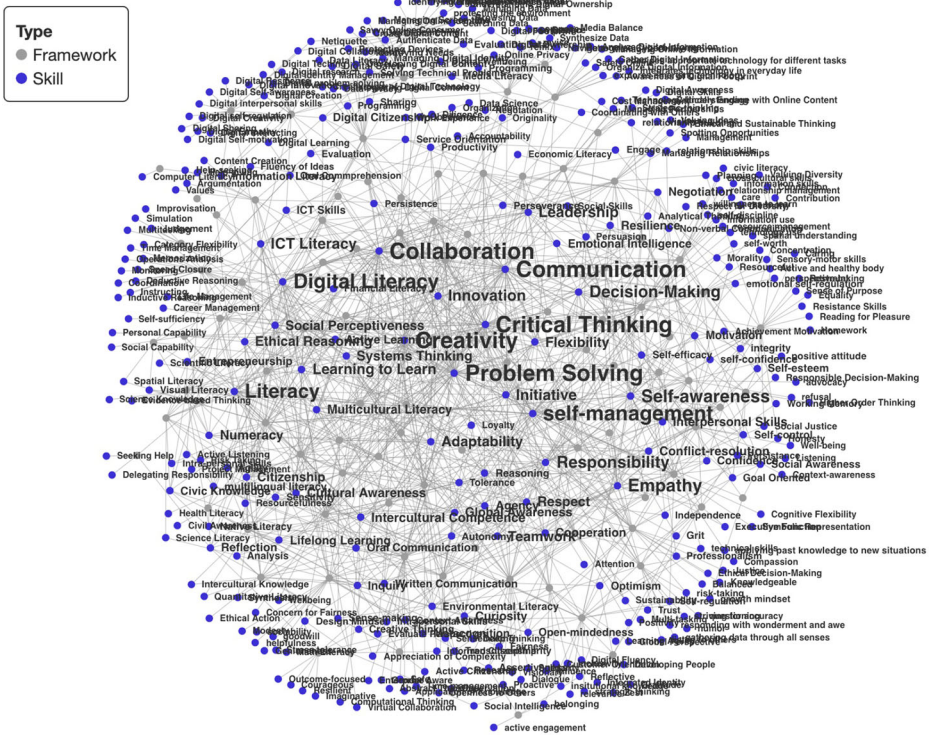


Figure 3. Two Mode Network Diagram of Frameworks and Skills.

(Figure 4). While the overall number of skills identified in this review indicates a general lack of consensus about what is meant by Future Skills, there does appear to be a core set of skills that are more commonly associated with these terms.

Meta-categories to describe Future Skills

After several iterations of constantly comparing the different skills mentioned by the frameworks, the 341 skills identified in the review of the 99 frameworks were grouped,

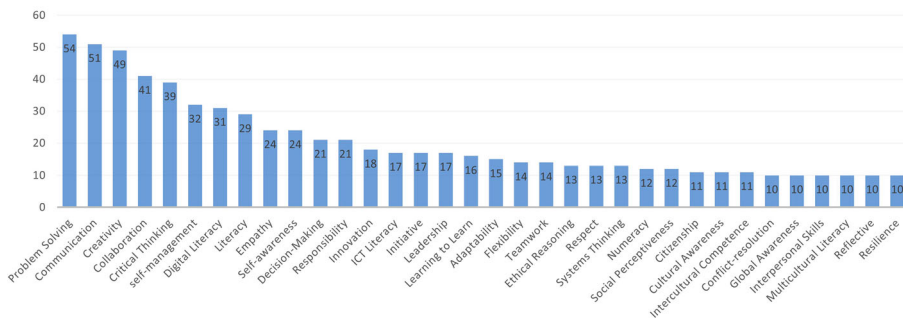


Figure 4. In Degree Frequency of Skills.

forming groups of closely related skills. These skill groups were then sorted into meta-categories. For example, the skills *caring*, *compassion*, and *sensitivity* were grouped together. While taking into account the different interpretations that each framework gives to the used terminology, these concepts have very similar definitions and multiple frameworks used them in similar ways. Hence, in our attempt to reduce the complexity of the variety of terms, we grouped them with similar concepts. This initial analysis of the 341 skills resulted in the creation of 52 groupings of similar skills.

These 52 groups of similar skills were then sorted into 9 meta-categories of related groupings. These meta-categories, alongside some examples, are presented in [Table 1](#)

Table 1. List of meta-categories and examples of commonly mentioned skills in each.

Meta-categories	Examples of commonly skills
Higher-order thinking skills	<ul style="list-style-type: none"> • Decision making • Problem solving • Critical thinking • Systems thinking
Dialogue skills	<ul style="list-style-type: none"> • Collaboration • Communication • Empathy • Listening
Digital and STEM literacy	<ul style="list-style-type: none"> • Computational thinking • Digital literacy • ICT literacy • Digital citizenship • Online Safety
Values	<ul style="list-style-type: none"> • Ethical reasoning • Citizenship • Sustainability • Global awareness
Self-management	<ul style="list-style-type: none"> • Self-awareness • Resilience • Emotional intelligence • Positive attitudes • Confidence
Lifelong learning	<ul style="list-style-type: none"> • Learning to learn • Metacognition • Willingness to learn • Active learning
Enterprise skills	<ul style="list-style-type: none"> • Creativity • Initiative • Entrepreneurship • Curiosity
Leadership	<ul style="list-style-type: none"> • Responsibility • Goal-oriented • Courage • Management
Flexibility	<ul style="list-style-type: none"> • Adaptability • Multi-tasking • Agility • Executive function

(see Appendix 2 for the full list of skills included in each group and meta-category). These categories were developed through thematic analysis implemented in an iterative manner. Each skill, attitude, and competency type were given equal consideration when developing initial groupings and the 9 meta-categories, which can be used to define Future Skills.

Discussion and conclusion

The Future Skills literature is prolific and dispersed across academia, government, and industry. In this review, we identified 99 different frameworks that were created to describe the attitudes, values, skills, and competencies intended to prepare learners to thrive in the face of an uncertain future. As shown in our analysis, the frameworks appear to overlap to an extent. However, each framework utilised different concepts, groupings, and categories to refer to similar characteristics which has the potential to lead to confusion and ambiguity. Therefore, this scoping review attempted to consolidate the many competing frameworks and make sense of overlapping terminology. As discussed above, our analysis yielded nine main meta-categories, which are: higher-order thinking skills, dialogue skills, digital and STEM literacy, values, self-management, lifelong learning, enterprise skills, flexibility, and leadership.

As Voogt and Pareja Roblin (2012) found, skills integrated into the higher-order thinking skills, dialogue skills, and enterprise skills meta-categories (e.g. critical thinking, problem-solving, creativity, collaboration, and communication) have always been considered key for learners' achievement. Our research suggests that these skills are still relevant, however, and their integration into educational curriculums and programmes should still be considered.

With the increasing accessibility of digital environments as well as remote learning and working, digital and STEM literacy have also been commonly cited as skills that learners and professionals must master to succeed in the present and future of work (DQ Institute 2019). In this review, we found that digital and STEM literacy go beyond the technical competencies of mastering how to create and use technology in a productive way and highlight the need for responsible and safe technology usage. For instance, skills such as digital safety or data privacy and security were prevalent.

An interesting finding is the way in which recent frameworks have put special emphasis on preparing learners for uncertainty (UNESCO 2020; WEF 2020). As suggested by UNESCO (2019), education should focus on helping learners embrace uncertainty and exert agency in changing and critical situations rather than trying to predict and understand what may come. Skills included in the categories of flexibility, leadership, self-management, and lifelong learning are considered especially important to prepare professionals to shift their mindset to one which enables them to thrive in uncertain futures. Some frameworks have also outlined the importance of what we call values (i.e. global awareness, citizenship, and sustainability), referring to principles embraced by an individual that tend to guide their behaviour. While not the most commonly cited across all of the frameworks, these are also future core skills across the globe, especially given the increasingly multicultural world (OECD 2019).

It is worth noting that there are some inherent limitations in the meta-categories identified in this review. Although they reflect what a wide range of actors in the field

of education think is important to education for the future and offer a good basis for understanding what is meant by 'Future Skills', this review cannot offer evidence that these really are the skills that are most important. A critical study of existing frameworks is an area for future research and would be a welcome contribution to the field. Nevertheless, policy makers, curriculum and professional development designers, educational technology developers as well as practitioners interested in understanding what is meant by the term Future Skills will find this study useful. Those looking to integrate Future Skills into their teaching or into their educational technology solutions will find this report particularly helpful as it provides succinct categories of skills to focus their efforts.

Future Skills are transdisciplinary, which implies that they have the potential to be incorporated into existing curricula and nearly all subjects. As suggested by prior research, these categories of skills can also be integrated within existing pedagogical approaches; developing Future Skills, for instance, is aligned to theories emphasising the active role of learners in the learning process (e.g. constructivism and learner-centred approach) or highlighting the ever-changing nature of knowledge (e.g. connectivism). Nevertheless, teacher professional development programmes are particularly important in ensuring that teachers are not only aware of Future Skills but also know how to best integrate them into their everyday practice (Pellegrino 2017). Such programmes should also provide practitioners with up-to-date, evidence-based guidance on how to assess and prioritise which skills to focus on based on student characteristics such as age or sociocultural background (Griffin and Care 2014; Schweisfurth 2013). For the less immediate future, more fundamental questions are raised.

The framework for Future Skills that we offer here covers a broad range from digital literacy to global citizenship. What unites them all is the belief that these are the skills individuals will need to best be able to succeed in overcoming complex and as yet unknown challenges. Its coherence comes from its orientation towards the future. This contrasts to the approach behind many traditional curricula which seem to be based on transmitting knowledge that was useful once, with the often implicit assumption that it will continue to be useful forever. While we offer this consolidated framework of Future Skills in a tentative manner, to be criticised and improved, we think that the inspiration behind it is correct. At this juncture in human history, it is time for us to stop walking backwards into the future, equipping students with the knowledge and skills that they would have needed to cope with the past. We need to turn around and face the future directly, making students more aware of challenges they will face and equipping them with the skills that they need to thrive in the context of complexity, uncertainty, and continuous emergence of the new.

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Supplemental data

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Thomas Cowhitt is a Lecturer in Educational Change and Collaborative Improvement at the University of Glasgow. His research examines how Research Practice Partnerships (RPPs) and network governance structures allow for greater participation in policymaking and innovation expression across educational systems. This work involves partnering with underrepresented stakeholders in traditional policy cycles and tracing their activities as they attempt to scale up their own initiatives to improve teaching and learning. His primary methodological approach to research most closely aligns with Mixed Methods Social Network Analysis (MMSNA).

Dr Louis Major is a Senior Lecturer in Digital Education at the University of Manchester. His research focuses on digital technology's role in the future of education, in particular, how this can enable new models of education, address educational disadvantage, and support dialogue and communication.

Professor Rupert Wegerif is a member of the Faculty of Education at the University of Cambridge and director of the Digital Education Futures Initiative at Hughes Hall, Cambridge. He is on the steering group of the Cambridge Educational Dialogue Research Group and co-convenor of the argumentation, reason and dialogue Special Interest Group (SIG) of the European Association of Research on Learning and Instruction (EARLI). He has received numerous large grants and is highly cited for his books and articles researching the use of technology in education and developing a new theory of education for the Internet age.

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