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Mapping Futures: Comparative Analyses of International Design and Technology Education Curricula

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Abstract

South African Technology Education (TE) is designed to equip learners with broad knowledge, skills, and values that they can apply in solving real-world problems, implying substantial potential in its curriculum to prepare learners for their futures beyond school. The same could be true for comparative Design and Technology (D&T) subjects internationally. Although small comparative studies have been conducted across TE, D&T and similar subject curricula, those have been limited in scope and context. The vast potential of international Design and Technology Education (IDTE) to prepare learners for their futures has not yet been explored on a large international scale. One key purpose of this study was, therefore, to explore how learners are being prepared for their futures through IDTE curricula in various countries worldwide. In anticipation of a large international curriculum benchmarking study to address the overarching goal, several pre-determined themes were set for the larger study, but the finer details needed refinement to enhance the validity and reliability of the study. Therefore, an exploratory literature review was conducted to identify patterns in existing studies on learners' future readiness that could contribute themes for the thematic curriculum analyses. The current paper reports on the findings of the exploratory literature review, providing insights regarding themes currently reported in relation to learners' futures, or their 21st-century readiness. Key findings include that context is a key determinant of content and skill preferences in relation to future readiness, and that there exists a gap regarding D&T's contributions to prepare learners for their futures.

Key Words: Curriculum Benchmarking, Future Readiness, International Comparison, Intended Curriculum

1 INTRODUCTION

Technology education (TE) in this paper refers to the school subject Technology (in South Africa), which is also called 'Design and Technology' (D&T) in other countries. It must be noted that TE focuses on knowledge and skills development regarding technological concepts and problem-based learning, which should not be confused with digital technologies, information and

communication technologies (ICT) or 'computer technologies'. In this regard, the Senior Phase[1] curriculum document defines TE in South Africa as using "*knowledge, skills, values and resources to meet people's needs and wants by developing practical solutions to problems, taking social and environmental factors into consideration*" (DBE, 2011b, p. 8). From this definition, TE is intended to provide learners with broad knowledge, skills, and values that they should be able to apply in solving real-world problems. Problem-based learning, which supports self-directed learning, promotes higher-order thinking skills and the application of knowledge in practical (or lived) contexts (European Union, 2025, p. 11) and is recognised as a core teaching-learning strategy for TE (Du Toit & Gaothlobogwe, 2017:154). The inclusion of problem solving and 'social and environmental factors' in the South African definition of TE, together with overarching curriculum topics such as "Technology, Society and the Environment" (DBE, 2011b, p. 10), also hints at the subject's potential to contribute to addressing the United Nations' Sustainable Development Goals (SDGs). The SDGs aim to contribute to improving and positively transforming the real or lived lives of people across the world, highlighting their intention to enable better futures for all (United Nations, 2015, p. 2).

Against this background, there seems to be substantial potential embedded in South African TE to prepare learners for the real world or their futures after school. TE is, however, not unique to South Africa and many countries across the globe offer similar or comparable subjects such as D&T. These other similar subjects probably hold the same potential to contribute to learners' future readiness. As these subjects are often compulsory, the learning intended in those curricula must continuously be interrogated for its usefulness and relevance in preparing learners for their futures. Yet, this potential has not yet been explored on a large international scale.

This paper reports on one part of a large international study that is currently analysing Design and Technology education national curricula from more than 15 countries and territories. This larger study (i.e. International Design and Technology Education – IDTE) is benchmarking numerous aspects regarding IDTE (see Hardy and Du Toit, 2026 – this conference). The current paper focuses only on the exploratory work that was conducted to determine themes for analysing IDTE's contribution to learners' future readiness - one of the aspects within the larger study.

Constructivism underpins the IDTE study, as researchers from the Global South and Global North collaboratively constructed a shared understanding of concepts, codes, and constructs that would be used in the subsequent extensive international study. Preliminary informal discussions when planning the study highlighted that researchers held various, different, or nuanced views regarding the concepts under investigation. It also emerged that the contexts in which Technology or D&T education is facilitated vary more extensively than what was initially anticipated. Clarifying and delineating concepts, ideas, and constructs was therefore critical before commencing the larger study. One of these constructs was future readiness.

Therefore, the question that guided the research reported here was 'Which main themes are currently reported in relation to school learners' future readiness?'

[1] In the Senior Phase, learners are around 13-15 years of age.

2 CONCEPT CLARIFICATION

(Design and) Technology are key school subjects in many countries across the world. For example: "Technology education is vital if we are to instil technological literacy in South African learners to prepare them for their future and develop their knowledge and 21st-century skills" (Mulaudzi et al., 2023, p. 129). Furthermore, TE and D&T subjects are intended to stimulate learners to be innovative, critical and creative thinkers and problem-solvers, to support the optimal use of resources and to prepare learners for the world of work (Du Toit & Gaothlobogwe, 2017, p. 149). There is, therefore, clear potential in TE and D&T curricula to prepare learners for the future. But how should the concept of future readiness be understood?

2.1 Future readiness

Future readiness encompasses abroad field of research and information. Among other aspects, the development of scales, indices, frameworks, education, and assessment of, or for, future readiness has been explored (Fletcher et al., 2018; Ng & Chua, 2023; Stone & Lewis, 2012). No single accepted definition of the construct 'future readiness' exists, but it broadly refers to anticipating change and being prepared for emerging realities (Tan, 2024). She laments that most research on future readiness is dominated by practices and views from the Global North and that research on future readiness in the Global South is lacking. This is an important point as the IDTE study involves countries and territories from both the Global North and South.

Ng and Chua (2023, p. 634) associate future readiness with *future value*, which they define as "the future readiness of learners that will contribute to the future development of society, environment, and lifework". They emphasise that learning "must be relevant and aligned to new realities that emerge over time" and that these realities are dependent on context, which Tan (2024) affirms. Although we agree with these descriptions, we believe that *existing* realities should not be disregarded as part of future readiness. Our reasoning is underpinned by the idea that current problems do not necessarily disappear in the future, and that what we learn from current realities might very well be transferable or relevant to future realities.

Ab Jalil et al. (2022) posit future readiness as a 21st-century skill. They claim that, together with agility (another 21st-century skill), these skills help prepare learners for a VUCA world. VUCA is an acronym used to describe the volatile, uncertain, complex, and ambiguous circumstances or world experienced globally, and education across all levels should endeavour to prepare learners for a VUCA future (Du Toit et al., 2025). We also view the future as being VUCA, but we disagree with Ab Jalil et al. (2022) that future readiness is a skill. Rather, we assert that several (21st-century) skills and competencies are needed to enhance future readiness. We therefore viewed future readiness as learners' potential to navigate shifting contexts and unforeseen challenges, rather than merely as the development of a set of skills or competences.

For our research, we viewed learners' *future* as life after formal schooling, including (but not limited to) the world of work. The Merriam-Webster dictionary (2026) describes *readiness* as "the quality or state of being ready", including one's "state of preparation" or "prompt willingness". We therefore viewed *readiness* as learners' competence in a combination of

knowledge, skills, and values to efficiently address current and emerging context-specific realities.

3 METHODS

As stated before, this paper reports only on one part of a much larger ongoing international study that explored and benchmarked numerous aspects of IDTE. Therefore, only the methods relevant to this small part of the research are unpacked. Exploratory desk research was conducted to identify potential themes that could be used for analysing those curricula studies as part of IDTE's contribution to learners' future readiness.

A basic literature review using Google Scholar served as an exploratory tool for this introductory investigation. The search was broad to identify the main aspects that needed to be considered to address the research question, and to spark ideas for potential sub-themes, categories or codes that would contribute valuable insights to this goal. The first Google Scholar search ("future readiness" + "technology education" OR "design and technology education" + school + curriculum OR syllabus + "21st-century readiness") yielded only six results, suggesting a potential research gap. After the initial exploratory search on Google Scholar, the same search was repeated using EBSCOhost, which returned 91 items. This search was narrowed to peer-reviewed items published in the last 10 years, resulting in 44 items. The following exclusion criteria were then applied:

- not focused on school-level learners or – education
- focused only on design education, and not Design and or Technology education
- focused only on computer applications or digital technologies (ICTs)
- focused on other subjects' curricula, such as law studies, chemistry and social studies
- focus on leadership or management, rather than curriculum, teachers or learners.

For each result, the title was carefully scrutinised for relevance (level 2), yielding 11 items. This second search confirmed our initial suspicion that there was little, if any, research focusing on future readiness and IDTE. Level 3 analysis involved carefully reading the abstract and keywords of these 11 items and the six initially found by Google Scholar (17 items in total). The researchers identified emerging themes and deliberated their potential relevance to the larger study, as well as to construct a shared understanding of these terms or constructs through intercoder agreement. The broad findings of the investigation up to level 3 analyses are presented in the next section. Keep in mind that this is not a comprehensive literature analysis; rather, it was exploratory to help us identify potential areas for deeper investigation within the larger study.

No artificial intelligence (AI) was used in the development or write-up of this paper, except for Grammarly, a language-editing application. Grammarly was used with care to correct minor language and grammar issues, and each recommendation was considered individually before acceptance to maintain the authors' voice and cadence in our writing.

4 FINDINGS AND DISCUSSION

As could be expected, several studies reporting scales, indices, frameworks, education, and assessment of, or for, future readiness were found (for example, Ab Jalil et al., 2022; Fletcher et al., 2018; Ng & Chua, 2023; Stone & Lewis, 2012; Tan, 2024). As no studies were found that explicitly focused on an international understanding of TE and D&T curricula's impact on learners' future readiness, some of these more generic publications could be explored individually or collectively to analyse the contributions of TE and D&T to learners' future readiness. However, despite the broadness of future readiness as a construct, and to adhere to the research question, five main themes that emerged from the literature reviewed are discussed in this section.

4.1 21st-century skills for future readiness

The literature review showed that future readiness has been explored in relation to various school subjects, including Mathematics, STEM subjects (in general), and design education, with many studies highlighting the contributions of various 21st-century skills to this goal. Using the search string (described in the methods section of this paper) did not return a single publication that focused on exploring learners' future readiness in relation to TE or D&T education. Yet, countless scholars have noted the contributions of TE and D&T to the development of learners' 21st-century skills and competencies (e.g. Du Toit & Gaotlhobogwe, Galeboe et al., 2025; Grönman et al., 2025; Hardy, 2022; McLain, 2022; Schooner et al., 2017; Snape, 2017). Despite Schooner et al. (2017) mentioning claims that so-called 21st-century skills have been around for decades or even centuries, many others – including ourselves – believe that these skills are (still) critical for supporting learners to thrive in current and future realities. Therefore, this finding confirms a gap in existing scholarship and underscores the need to conduct research into how IDTE contributes to learners' future readiness, especially regarding the 21st-century skills embedded in them.

4.2 A need for concept clarification

During the level 1 analysis, it became apparent that 'design education' (as opposed to 'design and technology education') appeared in many of the titles returned in the literature search. After deliberation and to ensure intercoder agreement, the following delineations were selected and used:

- Design Education is a broad field focused on creative problem-solving, material intelligence and systems thinking, considering user needs, and (especially green) innovation (Design Council, 2024).
- Design and Technology (D&T) Education specifically emphasises the practical application of science and math, focusing on tangible products, materials, manufacturing, and technical knowledge within defined briefs. D&T refers to a subject in which "pupils design, make, prototype and test products that solve real problems within a variety of contexts, considering their own and others' needs, wants and values…which teaches applied creativity and empathy" (Design Council, 2024, p. 9). It "emphasises the interconnected nature of design **and** technology while implying a concept broader than either alone" (Hardy, 2024, p. 5; *emphasis added by authors*).

Showing a similar lack of decisive distinction, Design is a subject separate from TE in South African schools (DBE, 2011a). Yet, one of the aims in the Design curriculum is to "develop knowledge, technical abilities and skills in the conceptualisation, production and context of design" (DBE, 2011a, p. 8). This, and several other references to 'technical' skills in the Design curriculum shows how interwoven (and sometimes confusing) design education and D&T or TE can be. The current finding therefore confirms the perpetual misperceptions or misunderstandings that exists regarding the unique contributions of TE and D&T, as it also emerged as an issue in the current literature review. The researchers believe that the continued lack of emphasis (some even call this a lack of recognition) on *technology* in publications highlights the need to explore and report the valuable contributions of subjects such as D&T or TE to learners' development. When developing themes for the larger IDTE study, the research team could explore how design is incorporated into D&T subjects, but they would have to ensure that *technology* is not marginalised in their investigations.

Similarly, the literature search also returned many results that focused on digital or computer technologies. This reiterates the issue reported for design education, where clarity of which type of technology is investigated should be emphasised, and the value and contribution of D&T or *technology as a subject* should be highlighted and publicised. The larger IDTE study must, therefore, ensure that it differentiates the contributions of technologies (such as digital and computer technologies) and the *technology-based subjects* under investigation to learners' future readiness. Such an approach will enhance the perceived uniqueness and benefits associated with TE and D&T subjects.

4.3 Artificial intelligence is a conclusive part of future readiness

It also emerged that many publications on future readiness include investigations into the roles and contributions of artificial intelligence (AI) in learners' preparation. This was not surprising given the sudden and extensive expansion of AI since its launch in 2022. However, in line with the authors' view that future readiness should not exclude current realities, we cautioned the research team in the larger IDTE study not to focus too much or too narrowly on AI. Many problems relevant in TE and D&T education existed before the rise of AI and will continue to be issues into the future, despite the potential of AI to contribute to addressing them (Deane, 2017). AI was, therefore. noted as one of several themes that need to be critically explored as part of IDTE's contributions to prepare learners for their future.

4.4 Problem-solving for future readiness

It emerged that several studies exploring future readiness of learners in other subjects emphasised the value of problem-solving in their investigations. Developing novel solutions to problems are critical in preparing for the future (Ab Jalil et al., 2022). Problem-solving is a core 21st-century skill and forms the foundation of problem-based and project-based teaching-learning strategies. Problem-solving is also a core competency and a central pedagogical principle in TE (Du Toit & Gaothlobogwe, 2017; Grönman et al., 2025; Mulaudzi et al., 2023). In addition, problem-based learning supports self-directed learning and higher-order thinking skills, both of which are key competencies for survival and thriving in a VUCA world (Du Toit et al., 2025). The role and

impact of problem-solving must therefore be a key theme when investigating the contributions of TE and D&T to learners' future readiness.

4.5 Context impacts future readiness

Problem-based learning is often used to apply knowledge in practical (or lived) contexts (European Union, 2025, p. 11). Future realities and problems will often be context-situated, context-dependent, or context-specific (Ng & Chua, 2023; Tan, 2024). In other words, different contexts will mean different views of the future and which knowledge, skills or values are needed to prepare learners for it in a particular context. Therefore, it was unsurprising that context emerged as another key theme to explore in future readiness. Discrepancies in the contexts in which learning takes place are vast. These discrepancies include access to resources, digital competencies, teacher training, socio-political factors and many more. When education and related activities are contextualised, learning becomes more meaningful, and learners' motivation and their engagement in the process are enhanced (Snape, 2017). Furthermore, contextual differences between the Global North and Global South are often compared, which will also be done in the larger IDTE study with regard to the contexts in which TE and D&T are facilitated. It is, therefore, clear that contextual factors will critically impact what is viewed as requirements for learners' future readiness, and to what extent various factors are evident in the technology subject curricula explored.

5 CONCLUSION

The five main themes identified here will also be contextually dependent. For example, digital competence or AI might be more contextually important in the future of learners in countries where digital access is equal and freely available. We conclude that these five themes will serve as high-level ideas to initiate and structure the exploration of IDTE's contribution to learners' future readiness. We also acknowledge that finer sub-foci will emerge across various curricula, based on and reflecting the unique contexts of different countries. Still, the potential of TE and D&T to enhance learners' future readiness is vast, and it must be explored and reported to underscore the value and importance of technology subjects in school education.

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