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DESIGN EDUCATION | AFRIKA | 4TH INDUSTRIAL REVOLUTION

## **Dismantling boundaries: Does a transdisciplinary and multi-disciplinary tertiary education approach support the development of creative and critical thinking for an Afrikan design and business context?**

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### **Abstract**

In this paper, we examine the impact that transdisciplinary and/or multi-disciplinary educational approaches have in developing critical and creative thinking competencies in a bachelor's degree context. Strategies relating to integrated assessments within research-based modules are used to explore how transcending disciplinary boundaries in different fields are approached – one a business qualification and the other a creative/design-based qualification. This is also particularly significant in terms of an emerging call to contextualise curricula for Afrika, including adopting more decolonised transdisciplinary research approaches. Focus will fall on the educator rather than the student experience in this regard, as educators not only design and assess these modules, but are being called on to facilitate student experiences on new and innovative teaching platforms. In particular, we hone in on how the convergence of developing critical and creative thinking competencies through integrated assessment strategies prepares students for the contexts of the fourth, and emerging fifth, industrial revolutions and how these, in turn, require real-world approaches to various problem-solving contexts. Through this, we seek to determine how liberating students from disciplinary boundaries, as envisaged by a transdisciplinary and/or multi-disciplinary approach, enables a focus on the application of knowledge and competencies with greater impact.

Semi-structured interviews with educators from two private higher education institutes are used, triangulated by a review of module outcomes and curriculum documents related to specific research-based modules, in order to explore the constructed and enacted theory of educators. This paper further explores whether professional development is needed to better equip educators with the necessary tools to align their knowledge and competencies to transdisciplinary strategies that would enable a more confident integration within virtual platforms.

**Keywords:** Creative thinking, critical thinking, fourth industrial revolution, transdisciplinarity, multi-disciplinary

### **Introduction**

Marshall (2014, p. 104) asks the question “If our goal is to make education more dynamic, integrated, and meaningful for students, what models should we follow? What qualities should we embrace?” In higher education in South Africa, there is no doubt that the Afrikanisation of curriculum and more contextually sensitive approaches to empowering and enabling our students must be part of what we

embrace. For example, the Report on the Second National Higher Education Transformation Summit (DHET, 2016) affirms that higher education in South Africa has “played a fundamental and critical role in giving expression to the rights and values in the South African Constitution and Bill of Rights”. At this event, the then Deputy President, Cyril Ramaphosa, emphasised that quality higher education was essential for economic development, social development, cohesion, and a requirement for transformation (DHET, 2016). Minister of Higher Education and Training, Blade Nzimande, picked up on this theme and emphasised the role of higher education in promoting and protecting multiculturalism (DHET, 2016). Further policy expressed in the NDP 2030 (The Presidency, 2011), and the National Framework for Enhancing Academics as University Teachers (DHET, 2018) affirms this and reminds us that “[e]ffective undergraduate and postgraduate student learning requires a scholarly and professional approach to teaching”.

This paper is approached in light of this context and mandate, in examining the impact that transdisciplinary and/or multi-disciplinary educational approaches have had in developing critical and creative thinking competencies in a bachelor’s degree context. Within qualifications focused on fields with associated professional practices, students are required to demonstrate integrated knowledge and problem solving to reflect on and address complex problems critically, and to apply evidence-based solutions and theory-driven arguments (SAQA, 2012). Third-year research-based modules are benchmarked against these exit-level outcomes, often as alternatives to work-integrated learning modules.<sup>1</sup> Strategies relating to integrated assessments within research-based modules are used to explore how transcending disciplinary boundaries in different fields are approached within both a business qualification and creative/design-based qualification. This study is also particularly significant in terms of an emerging call to contextualise curricula for Afrika, including adopting more decolonised transdisciplinary research approaches. Focus falls on the educator rather than the student experience in this regard. Educators not only design and assess these modules but are also being called on to facilitate student experiences on new and innovative teaching platforms and take responsibility for further professional development – more so now with the need to operate within virtual learning environments.

We consider how the educator’s ability to liberate students from disciplinary boundaries through the requirements of the research modules that draw on a predominantly transdisciplinary approach, enables a greater scope of knowledge and competency application. Key to this is understanding how the convergence of developing critical and creative thinking competencies through integrated assessment strategies prepares students for the contexts of the fourth, and emerging fifth, industrial revolutions<sup>2</sup> (here referred to as 4IR and 5IR respectively), and how these, in turn, require real-world approaches to various problem-solving contexts.

#### *4IR and Afrika*

The 4IR,<sup>3</sup> as building towards the 5IR, provides the contextual backdrop of our study. Though regarded as universal phenomena with global impact, in considering the two private higher education institution (PHEI) contexts, the scope of consideration of the impact of 4IR and 5IR is limited to their emergence within Afrika. While the 4IR has seen the intensification of smart technology, greater automation, and increased connectivity (Schwab, 2016), in countries like South Africa, there is

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<sup>1</sup> Ethical clearance was received from both Institutions to evaluate courseware material, related policy documents for reference purposes, and to interview the relevant educators with informed consent.

<sup>2</sup> Agreed definitions and characteristics of the 5IR are still emerging in literature as new trends evolve and research is initiated. Therefore this is not prescribed or addressed and is not the focus of this paper.

<sup>3</sup> Schwab (2016) defines 4IR as a way of describing, “the blurring of boundaries between the physical, digital, and biological worlds” and “a fusion of advances in artificial intelligence (AI), robotics, the Internet of Things (IoT), 3D printing, genetic engineering, quantum computing, and other technologies”.

inconsistency in how these aspects are both available and appropriated. There are those who are able to fully access the growing digitisation and those who cannot access this due to more rural locations. In addition, there are areas that are leapfrogging parts of the Third Industrial Revolution, such as fixed networks, to use benefits available from satellite and other connectivity developments through both the 4IR and the 5IR. Interestingly, discussions regarding the 5IR focus more on the human-technology interface, the impact of the growing digitisation on humanity and how we, as Africans, can harness the impact of technology for humanity. These discussions range from sustainability to digital addiction to the impact of the pandemic for remote work, globalised work competition and the calls for a 'new normal' and greater wellness. This bodes well for educational contexts as being more human-oriented, in terms of application, but more versatile in terms of modes of connectivity.

In addition, the reactions to the 4IR and the COVID-19 pandemic (and the resulting impacts) seem to align well with Afrikan values, such as more humane approaches to work and community, and Ubuntu philosophies where the awareness that we are in community (i.e. social accountability) and what we do affects one another has been amplified during the pandemic. Assié-Lumumba (2017) refers to Goduka (2000) in describing Ubuntu as a worldview that embraces "oneness of humanity, a collectivity, community, and set of cultural practices and spiritual values that seek respect and dignity for all humanity". In coupling this with the Report on the Second National Higher Education Transformation Summit and the call for transformation within higher education associated with decolonising curricula, the 4IR offers opportunities to establish connectivity and collectivity in being, as Hughes (2021) describes, "more inclusive, and more interculturally responsive". There is, therefore, an opportunity to shape and align the emerging 5IR in the Afrikan context as more aligned to Afrikan values.

Curricula are typically focused on as points of investigation into how to transform the higher education landscape. The capacity of the educator as motivating the student to critically and creatively engage – not only with the work of their discipline, but to direct this towards the greater needs of community through collaboration – should not be underestimated.

#### *Disciplinarity, multi-disciplinarity, and transdisciplinarity*

In having contextualised our study within the context of the 4IR and Afrika, we must also consider how best to define disciplinary approaches that are typically enacted within PHEI contexts. For our purposes here, three approaches will be identified and defined in relation to the curricula that are enacted through them: a discipline-based curriculum approach; a multi-disciplinary approach; and a transdisciplinary approach. Though there are a variety of definitions and interpretations of, in particular, what transdisciplinarity is – proposed by the likes of Nicolescu (1997; 2010) and Leavy (2011) – the definitions provided by UNESCO (2021) provide the most suitable platform for understanding the distinction between these approaches.

A discipline-based curriculum approach, according to UNESCO (2021), may be defined as follows:

*The term 'discipline-based or 'subject-based covers the full range of distinct subjects or fields of study... The instructional emphasis of discipline-based curriculum tends to be on specific, current, and factual information and skills as it emerges from the discipline experts.*

This is the most typical way in which higher education engages students in their qualification studies and around which faculties, departments and schools are organised.

A multi-disciplinary approach is regarded as "an approach to curriculum integration which focuses primarily on the different disciplines and the diverse perspectives they bring to illustrate a topic, theme, or issue. A multi-disciplinary curriculum is one in which the same topic is studied from the

viewpoint of more than one discipline” (UNESCO, 2021). Perspective, rather than collective action, drives this approach.

UNESCO (2021) defines a transdisciplinary approach “to curriculum integration which dissolves the boundaries between the conventional disciplines and organises teaching and learning around the construction of meaning in the context of real-world problems or themes”. The value of the transdisciplinary approach lies in its ability to transcend traditional disciplinary boundaries for a common cause and so demonstrates a stronger capacity to generate connectivity and collectivity through fostering a collaborative environment. Many scholars, including Nicolescu (1997; 2010) and Leavy (2011) advocates for the value of adopting a transdisciplinary approach. Nicolescu, further notes that “transdisciplinarity is nourished by disciplinary research” and that “disciplinary research is clarified by transdisciplinary knowledge in a new, fertile way” (2018, pp. 74). So, transdisciplinarity positions itself as amplifying existing knowledge-building potential because it invites participation holistically and inclusively. Nicolescu identifies two types of education amplified through transdisciplinarity: ‘learning to know’ and ‘learning to do’ (2018, pp. 75–76).

Nicolescu (2018, pp. 75) describes ‘learning to know’ as being able to distinguish “what is real from what is illusory, and to have intelligent access to the fabulous knowledge of our age”, which aligns with the development of critical thinking competencies in students as aspired to by HEI’s (Goode, 2020). In this context, we align with UNESCO (2020) defines critical thinking as a process involving:

*[A]sking appropriate questions, gathering and creatively sorting through relevant information, relating new information to existing knowledge, re-examining beliefs and assumptions, reasoning logically, and drawing reliable and trustworthy conclusions.*

In addition, when weighing up knowledge-building against transdisciplinarity, Nicolescu equates this to “establishing bridges – between the different disciplines, and between these disciplines and meanings and our interior capacities” that will result in the “emergence of continually connected brings” who are able to adapt themselves to the changing exigencies of professional life” (2018, pp. 75–76).

In ‘learning to do’, Nicolescu (2018, pp. 76) proposes that specialisation within the current context is problematic and that we should rather acquire a “flexible, interior core” with the capacity to access key competencies. He goes on to promote ‘learning to do’ as “an apprenticeship in creativity” that “signifies discovering novelty, creating, bringing to light our creative potentialities” (2018, pp. 76). This aligns well with the development of creative thinking competencies in driving towards innovation: where organisations like UNESCO (2020), comment that “[t]raditionally creativity has been seen as an ability to respond adaptively to the needs for new approaches and new products”. Creative thinking is thus frequently defined as “the ability to bring something new into existence purposefully” (UNESCO, 2020) and is applied in this way at both PHEIs. Transdisciplinary approaches also require collaboration or inclusion of community participation, and so non-academic or non-professionally aligned stakeholders are encouraged to participate in problem solving.

Within institutions that identify as either transdisciplinary or multi-disciplinary, how educators enact the dismantling of disciplinary boundaries in their teaching and learning practice is, therefore, worth considering as an act of Ubuntu. Another aspect worth considering is how presenting the Ubuntu values of Afrika drive the imperative to activate multi-disciplinary and/or transdisciplinary communities within the context of the 4IR, in the global sense, and the two PHEIs, in a narrower sense. For transdisciplinarity, this is certainly affirmed by Veldhuizen (2012, p. 53), who posits the value of transdisciplinary collaboration in terms of its alignment to “the nature of knowledge, notions of causality and ‘inference’, as well as processes of knowledge creation in Africa”. Veldhuizen (2021, pp. 53) also determines that new knowledge is collectively and holistically created and disseminated as an act of Ubuntu.

## Research question and aim

For the purposes of our research, here in focusing on the narrower context of two South African PHEIs, the following research question emerged as driving the primary research undertaken:

*Does the application of transdisciplinary or multi-disciplinary approaches in higher education enable the development of critical and creative thinking competencies and the contextualisation of curricula for Afrika in a bachelor's degree-research context?*

The aim was to explore a bachelor's degree research-module context and the impact of educator practices fostering student learning of research practices. The applicable degrees assume a professional context where fixed disciplinary boundaries may obstruct problem solving and understanding of the respective fields. These two qualifications – one within a business field and the other across various design fields – draw on an integrated assessment approach. These integrated assessments are normally required within a research-type module and the respective institutions affirmed transdisciplinary or multi-disciplinary curriculum approaches respectively. In affirming a transdisciplinary or multi-disciplinary approach, the core curiosity point was how these approaches were affirmed from the educator's perspective and through their enacted teaching and learning practice.

In response to the literature reviewed and the research question above, this research, therefore, took a qualitative approach, using semi-structured interviews with relevant educators from the two PHEI. These interviews were triangulated through a review of module outcomes and curriculum documents related to specific research-based modules in order to explore both the constructed and enacted theory of educators. As explored by Goode (2020), educators construct their theory and practices in relation to their professional experience, qualifications, and professional development, as well as to the requirements of the modules. This study further hopes to encourage teaching and curricula reflection in anticipation of new and innovative approaches required within these third-year research modules. This is because the context through which research is enacted is shifting, and new research methodologies are constantly emerging.

## Institutional contexts and population

Both PHEIs draw on practice-based or practical workplace preparations for employability and specialisation purposes. This means that modules within the respective bachelor degrees include discipline-based modules and practice-based modules, as well as modules that transcend disciplinary norms and apply a transdisciplinary or multi-disciplinary approach.

The institutions concerned have been anonymised by the dominant field of study offered, i.e. a design education institution (D1) and a Business Management Institution (B1). The design education institution (D1) identifies as multi-disciplinary and offers a range of qualifications from higher certificates, diplomas, degrees, advanced diplomas, and honours programmes. The module names are anonymised to sustain the ethics of confidentiality and impartiality. The Business Management Institution (B1) identifies as transdisciplinary and offers qualifications at all higher education levels, from higher certificate, bachelors, and PGDip to master's and doctoral programmes with a transdisciplinary business management focus. These PHEIs, like their public counterparts, seek to offer education that is relevant and applicable within the Afrikan contexts. Both institutions implicitly and explicitly incorporate key aspects of the 4IR, such as the technology of things, and the B1 already surveys the emergence of trends beyond the 4IR.

This research sought to engage in semi-structured interviews with at least three educators directly involved in the teaching of these research-based modules per institution, though only two educators

agreed to participate from D1. As these roles are fulfilled by qualified educators and appointed by the PHEIs, participant selection was thus purposive within the constraints of ethical clearance, permission from the relevant institutions and informed consent from the respective participants. In addition, to reveal the constructed theory of these educators, the related course module outcomes and curriculum documents were reviewed to explore whether the inclusion of transdisciplinarity, creativity, and critical thinking are integral and how these are assessed.

The participants were interviewed through online platforms and recorded audio-visually, transcribed, and then analysed thematically in the form of words. Prior to the interviews, participants were approached to obtain informed consent. At the onset of the interview, the interviewer confirmed consent and responded to any queries before the interview commenced. Responses were compared across participants and institutions. The respective institutions and research participants were anonymised through the use of pseudonyms. Data that identifies participants is stored confidentially using passwords before anonymisation.

The demographic profile of participants (anonymised) is summarised as follows:

Table 1: Demographic profile of participants

Pseudonym	Educational background	Professional specialisation	Lecturing experience (in HE) in years	Lecturing experience related to Research module	Highest qualification	Publication history
<b>Institution: Design D1</b>						
Amanda, female	Commerce	Marketing Management	Five years	Four years	Master's	Dissertation, non-academic
Sarah, female		Graphic Design (specialising in Illustration)	Six years,	Four years	Master's	Dissertation
<b>Institution: Business B1</b>						
Mike, male	Commerce	Business Management,	Six years, prior history of guest lecturing and corporate speaking, consulting	Six years	MBA, Busy with PhD	Articles, Dissertation, non-academic, Course material and resources
Paul, male	Commerce	Business Management with specialisations in Organisational Development, People Development, Change management	20+ years, consulting	Six years	PhD, MBA, BCom (Hons), BCom;	Dissertation, non-academic, Course material and resources
Sam, female	Humanities	Corporate communication		3 years	BA, BA Hons, PGDip Business Management, Busy with Master's	Non-academic

					degree in Business	
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## Aligning the bachelor’s research modules to SAQA level descriptors

As stated above, this research aimed to examine two PHEI’s transdisciplinary educational approaches in a bachelor’s degree context and their impact in developing creative and critical thinking competencies. These draw on the use of an integrated assessment in two differing qualifications: one a business management qualification and the other a design-based qualification. These integrated assessments are normally required within a research type module. Preparing students for the contexts of the 4IR and emerging 5IR requires real-world approaches to context exploration and problem solving. Liberating students from disciplinary boundaries as envisaged by a transdisciplinary approach enables a focus on the application of knowledge and competencies. One of the PHEIs has a clearly articulated commitment to transdisciplinary approaches, while the other assumes an implicit multi-disciplinary approach as required in design educational approaches. These modules are offered in the context of the SAQA NQF level descriptors at level 7 in the third year. At this level, the scope of knowledge requires that students demonstrate integrated knowledge of the central areas of their fields, disciplines, or practices, including an understanding of and the ability to apply and evaluate the body of knowledge relevant to the field of studies and the larger disciplinary or field contexts (SAQA, 2014). Both PHEI approaches emphasise the imperative of ensuring real-world problem solving and application of knowledge in the national context.

Both PHEI research modules are offered as integrated assessments (SAQA, 2014, p. 16), where students’ conceptual understanding of their field of study is evaluated through the approach they take in applying it practically within this research project. Students are expected to research a current challenge, innovate, and/or conceptualise solutions for a real context. Recommendations or insights are presented through their research. These modules are, therefore, aimed at assessing applied competence.

The current regulatory context of higher education in South Africa supports disciplinary boundaries and policies such as CESM (DOE 2008; DHET 2018b), which make the registration and accreditation of transdisciplinary approaches challenging. While policy like the earlier Education White Paper 3: A Programme for Higher Education Transformation (DOE 1997) identify transdisciplinary, which can be upheld in SAQA level descriptors (2014), the orientation of bachelor qualifications remains towards applicability within a career, field or discipline using the CESM disciplinary categories.

The module offered at D1 explicitly includes creativity and critical thinking in the assessment criteria, however, the outcomes imply a greater emphasis on critical thinking through “well-formed arguments” (2021). Creativity, indicated as one of the thematic criteria for evaluation, is only implied through design decisions, communication, and the context of the field of study. Stronger critical thinking-based descriptors are indicated under the theme of creativity, which makes an alignment to the distinction between creativity and criticality more problematic. Based on the wording of key outcomes and assessment criteria, despite creativity being a key criterion, there is a stronger emphasis on honing critical thinking skills and prioritising these in key tasks. However, this does seem to be aligned to the research focus of the module in complementing the more creatively aligned modules in concept development.

The module at B1 includes components of critical thinking (Goode, 2020) such as ‘define’, ‘analysis’, ‘judgment’, ‘predictions’, but refers explicitly to creative thinking, not critical thinking. However, the assessments focus more on critical thinking and the application of theory.

The material at D1 has not recently been updated, while B1 has recently re-curriculated and re-accredited their BCom in the past three years and is in the process of rolling out updated material

courseware set to the third-year students. In the curriculum process, feedback is being solicited from educators on the first offerings to third-year students for refinement.

## Summary of findings

Though several key thematic points of interest emerged during the analysis of the interviews, below are the three most significant findings concerning the research question posed:

### *Descriptions of professional practice*

When asked “How do you describe your professional specialisation or expertise?”, the educators from B1 referred to non-academic descriptions, which overlap between professional competence and academic work. For example, Mike describes his consulting and academic work as follows:

*[M]y business is about challenging thinking and that's the consulting business, and that's my competitive advantage. I suppose I go in as someone who doesn't know your process, but I certainly know that you can think about your process differently, and my job is to help you do that.*

In contrast, Paul referred extensively to facilitation displacing lecturing and andragogy in his discussion, and Sam described that her corporate work and experience informs her lecturing by keeping her in touch with her field of expertise. It became evident that the educators from B1 not only align to the B1 brand but also have developed a unique branding for their teaching pedagogy as derived from their corporate experience. This was not noted in either of the research educators for D1 who position their teaching pedagogy squarely within the PHEI brand with no alignment to their own 'brand'.

Within the context of D1, both Amanda and Sarah derived their academic expertise and experience in relation to their professional qualifications and grounded their knowledge-confidence in this. Both educators indicated that their teaching experience has required that they diversify in accessing and developing other core competencies that deviated from their initial academic specialisation. In this sense, both position themselves as design educators and appear to draw on multiple disciplines instead of integrating and going beyond disciplinary contexts. Thus, they align more strongly with the multi-disciplinary focus of the institution.

The approach to identifying professional expertise as educators is not grounded within a specific context of application, but rather in relation to their own competency development and agility in incorporating new skills. No specific Afrika-centred context is given for this and most educators interviewed tend to regard their professional expertise and the development thereof within a global context.

### *Multi and transdisciplinarity as fostering holistic development*

The responses to the consideration of how the holistic development of third-year students is enacted produced various insights. For the less experienced educators within the research modules, there was a stronger focus on working within a prescribed framework that sets clear boundaries. Within the context of D1, the boundaries enacted were restricted in terms of directing students towards conceptualisation within a specialised design field. Both Amanda and Sarah noted this, though Amanda indicated that the reason was that students were more likely to want to extend beyond their respective design specialisations in trying to impact a greater scope of change than they are necessarily capable of. Sarah also elaborated that the possible reason for the more fixed scope of application of research was because of students' lack of research capacity at the third-year level. This



could indicate that, within a multi-disciplinary context, the need for disciplinary boundaries emerges more in terms of regulating student learning from the perspective of the educators interviewed. In restricting what Nicolescu (2018, pp. 75–76) refers to as ‘learning to know’ in terms of critical engagement, ‘learning to do’ is also restricted in terms of a creative application being directed towards and refined within a framework of specialisation. Disciplinarity, therefore, emerges as dominating the approach advocated in the research module and responds directly to the specialised design field within which the concept is developed.

In the context of B1, Sam found it difficult to articulate what constituted the holistic development of students but did note that being able to apply learning is critical. However, she also noted that this competency in translating research into application required a specific type of student to value the research journey. The two more experienced educators at B1, Mike and Paul, were more confident in extending what defined the holistic development of students. Although both referenced the ability to apply what has been learned, as was indicated by Sam for B1 and Sarah for D1, Paul specifically noted that holistic development should also be measured against the students’ ability to be agile in applying their learning. Paul’s observation aligns well with Nicolescu’s understanding of transdisciplinarity in relation to both ‘learning to know’ as grounded in criticality and ‘learning to do’ as grounded in creativity (2018, pp. 75–76). Agility is prioritised and, therefore, affirms the value of transdisciplinarity within B1. Paul’s competence and confidence as an educator, therefore, enables him to align the research-based curriculum more meaningfully to the institutional values. Mike, as an equally experienced educator, was able to do the same but extended the value of applying learning to greater community responsibility and engagement: another characteristic of transdisciplinarity that promotes the inclusion and participation of community stakeholders. Mike, therefore, actively aligns his teaching pedagogy to the institutional values of B1, but further honours the spirit of Ubuntu in extending the application of learning with a wider context.

#### *Lack of distinction between multi and transdisciplinarity*

While there is a lack of clear distinction between multi- and transdisciplinarity definitions by the educators interviewed, all describe approaches that are clearly more non-disciplinary in emphasising a problem-based approach and tend to support students as they evolve towards a transdisciplinary approach. This is more clearly seen in D1 where vocational fields and specialisations are used to describe curriculum streams more than disciplinary boundaries for modules and subjects. Educators link these approaches to volatile and dynamic contexts of the 4IR, which require constant evolution of content applicability. The 4IR context seems to account for the more broad assessment criteria being applied to these modules in order to remain flexible in anticipation of this quickly evolving context and the diversity of research topics explored by students.

Research by authors like Brodin (2018) has shown that different teaching strategies and interdisciplinary were pointed out as factors that enhance creativity. On the other hand, the participants described the perceived benefits of a multi- or transdisciplinary approach as enhancing the application of both creative and critical thinking to enable students to think “outside the box”: more specifically beyond disciplinary boundaries. Educators at B1 reported that students considered impacts of recommendations beyond their department or role. For D1, Sarah particularly noted that the critical thinking required in engaging in design research has a creative conceptual goal, as knowledge is used to influence and justify key design choices made.

Building on this, all participants strongly felt that both multi and transdisciplinary research approaches are associated with systems thinking. This affirms the holistic development of students and the contextual awareness of the research undertaken. This finding has not been well documented in the literature, other than authors like Marshall (2014; 2016), who align a transdisciplinary approach with systems thinking. The emphasis on systems thinking is intriguing, as this is aligned to the SAQA CCFOs

(pre-2009) and later level descriptors (SAQA, 2014) but seldom seems prioritised or articulated as clearly in undergraduate degrees.

The B1 institution has realised that there are varying definitions and understandings of transdisciplinary approaches to knowledge creation and has been clarifying descriptions of transdisciplinary and related core constructs in the process of updating policies and educator professional development documents (for example, the Teaching and Learning policy, [Private Institution B1], 2021). This needs to be further implemented in the learning material, which is starting a revision cycle.

The D1 institution, though identifying as multi-disciplinary, has not explicitly entrenched core definitions and understandings of this within the curriculum documents reviewed in relation to the third-year research modules. This can be read as needing to direct students according to their design specialisation in order to focus on solution building within this framework. However, in aligning student learning with institutional values to better position students as advocates for multi-disciplinarity, more explicit indications of this would be needed.

## Conclusion and recommendations

From the responses in the interviews, the lack of explicit direction on critical and creative thinking, and clear definitions of multi or transdisciplinary research approaches, has resulted in the educators describing filling in the gaps through their own experience and theory and enacting this through their practices. This results in non-disciplinary approaches rather than multi-disciplinary where educators seek to explicitly overcome disciplinary boundaries and draw on more than one discipline's theory and insights. However, they advocate for problem-centred approaches to research to inform methodology as opposed to clear multi- or transdisciplinary approaches. The context informs the research more than the research designs of multi or transdisciplinary approaches. This is a surprisingly successful way of scaffolding students to overcome disciplinary thinking, focusing on the problem and context to inform research approaches instead of disciplinary bodies of knowledge. When combined with a system-thinking approach, the contexts are well described and considered in multiple facets, however, this is inspired by transdisciplinary thinking, rather than enacting transdisciplinary approaches.

Therefore, this paper recommends professional development better equip educators with the necessary educational resources to develop clearer outcomes, aligned assessment criteria and additional strategies to align their knowledge and competencies towards transdisciplinarity that would enable a more confident integration with the 4IR Afrika context and the fields of study. This is amplified within virtual platforms, where the lack of explicit definitions of multi- or trans-disciplinary research approaches and related resources leaves space for variations in educator theory and practice across several groups.

From the material submitted, it is apparent that the core source of information for students in how to proceed in these modules are the educators and their own research activity. This seems to reflect an approach that holds space (i.e. non-prescriptive) for students to determine the nature and direction of their studies. However, the disadvantage of this is that, for inexperienced research educators, there is a lack of material and resources to anchor and align consistently across educator groups with different educators. From feedback to educators, as described during the interviews, some students relish the freedom of research permitted and others seem to prefer and request more guidance and direction. Further research can explore whether these preferences correlate to work experience, age, gender or field of study.

The more experienced educators, Mike and Paul, were able to articulate clearly what qualities of holistically developed students in cohesive ways, whereas the less experienced educators struggled to describe clearly this outcome of the research modules. This can be addressed in orientation or

professional development aligned to the Institutional graduate outcomes. Respondents felt that the application of transdisciplinary or multi-disciplinary approaches supports the development of critical and creative thinking competencies in a bachelor's degree context, which was explicitly assessed in B1 assessment rubrics. These educators reflected that this research module was an effective approach to achieve the development of these competencies. D1 echoed similar sentiments, though directed more towards the practical concept-based outputs into which that research feeds.

At B1, it seems that the participatory spirit within the socially accountable transdisciplinary research approach to their research module affirms the Afrikan values expressed as community-based and Ubuntu-based approaches. The spirit of Ubuntu is also present in the focus on real-world community-based problem solving within the D1 research modules. This aligns with recommendations from Mokhele and Pinfold (2020), who similarly explore transdisciplinary approaches at CPUT to overcome "the inability of professionals to comprehensively analyse community problems" and enable students as future professionals to transcend disciplinary boundaries to analyse diverse societal problems.

In light of the above, this study recommends that professional development is needed to better equip these educators to align their knowledge and competencies to transdisciplinary or multi-disciplinary strategies. Clear definitions and research approaches need to be documented for consistency across multiple lecture groups at each institution. In addition, future studies, involving classroom observation, case studies, and psychometric measurements, are also suggested.

The mandate to evaluate the multi and transdisciplinary nature continually is emphasised by authors like Mononen (2017), who comment that:

*In the prevailing society, creativity and innovation-related skills are becoming ever more crucial for designers. They have to be able to find and solve ill-defined problems in order to create new solutions, products and services ... However, as the world grows ever more complex and problems become harder to define, designers need skills to perceive wholes and contemplate phenomena from several perspectives.*

This seems appropriate to both the design and business fields and supports the continuation of offering integrated research modules that draw on multi and transdisciplinary approaches.

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