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A Framework for Diagnosing the Transformative Development Nature of a University ICT Curriculum

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Abstract: The socioeconomic development of individuals, communities, nations and regions hinges on right competences. ICT competences are indispensable in this regard. Thus, university ICT graduates should understand various development paradigms to properly analyse and apply ICT to contribute to socioeconomic development. However, it is generally unclear whether university ICT curricula in developing countries pay due attention to appropriate development paradigms. Previous research on embedding development paradigms in university ICT curricula has mainly focused on the curricula implementation stage, when it is the curricula design stage that dictates the implementation. We studied the inclusion of development paradigms in 15 revised ICT curricula at the University of Dar es Salaam, Tanzania, to understand the kind of development paradigms considered during curricula development and to propose a framework for diagnosing the transformative development nature of university ICT curricula. Some paradigms were found to be more dominant than others, suggesting the need for context-sensitive balancing.

Keywords: ICT curriculum and development, development paradigms, ICT curriculum in developing countries, curriculum-based transformative development

1. Introduction

Information and Communication Technologies (ICT) have demonstrated the ability to radically transform the lives of individuals, societies, nations and indeed the world [1]–[3]. They have transformed institutional, economic, social and political structures. For example, ICTs have facilitated financial inclusion through applications such as M-PESA and others [4]–[6]; they have also improved effectiveness and efficiency in collecting government revenue [7]–[9]. All these ICT-enabled efforts have contributed to lifting millions of people out of poverty and to the overall socioeconomic development of countries [6]. However, to effectively participate and benefit from the transformative potential of ICT, people require appropriate ICT skills [1]. Because some crucial ICT skills are developed in schools and universities, ICT curricula are key in facilitating the transformative development of individuals, societies, nations. Thus, ICT curricula need to be designed and implemented in ways that enable learners to make substantial contributions to socioeconomic development. However, university ICT curricula could sometimes be designed and implemented without clear developmental agendas, limiting their transformative potential.

There are different development paradigms that can be used to define the kind of development envisaged in a particular context [1], [10]. The following are different development paradigms that can be used to define the kind of development envisaged in a particular context [1], [10]. The Neoliberal development paradigm presupposes that markets and market relations are key for economic development. It believes that individuals, society and politics should be reformatted in accordance with the market logics, the quest for profits, and principles of individual responsibility. In this regard, desirable ICT-enabled

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transformation is expected to facilitate market stabilization, and reducing government expenditure; enabling privatization through the transfer of property ownership from the public to the private sector; and achieving more market liberalization by reversing state regulation, government subsidies, and other interventions to the private sector and markets. To bring about the development desired in the Neoliberal paradigm, ICT is used to facilitate the formation and availability of markets in all sectors, change the way markets function by datafying and enabling machine readability of market processes and actors, make the private sector more responsible for the delivery of public services, and improve the efficiency of the other functions in the public sector. The Structuralist development paradigm presupposes that certain socioeconomic structures hinder development. This could include unequal relationships between parties (e.g., countries, regions, or immaterial geographies), or unequal exchange relationships between capital and labour. Desirable ICT-enabled transformation in the context of the Structuralist development paradigm is one that can facilitate breaking and/or replacing the exploitative socioeconomic structures, bring about economic independence through "localised systems of production and consumption" [10], and use structures that encourage common ownership to replace capitalism. To bring about the desired kind of development, ICTs are used to facilitate radical change in structures, enabling localized production and/or ownership structures similar to cooperatives. The Sustainable development paradigm focuses on ensuring that the current use of resources does not compromise the ability of future generations to meet their resource needs. In the Sustainable development paradigm, desirable ICT-enabled transformation is the one that can facilitate major reductions in the amount of used resources and pollution from social and economic processes, improve the efficiency of processes that consume resources, and enable rigorous evaluation of how economic growth occurs at the expense of the environment. To facilitate the desired sustainable development, ICTs can facilitate change in terms of how resources are used; reduction of pollution from social and economic processes, including polluting outputs of ICTs themselves; and the mapping and monitoring of the environment, to track sustainability progress.

The Human Development paradigm perceives development as freedom (e.g., social, economic, political, security and informational) for all to be and lead their own lives, leaving no one behind. In the Human Development paradigm, ICTs are used to enable equality of opportunity and choice, particularly for those left behind. Apart from accessibility, ICTs must be usable and customizable to suit the contexts of different individuals, enabling them to live, do and become what they wish [1], [10]. The Decolonization paradigm focuses on reversing the legacy and current negative effects of colonization [10], [11]. It involves identifying, challenging, revising and replacing the values, assumptions, ideas and practices of the dominating influences of colonizers, e.g., Eurocentric influence. The aim is to enable indigenous people to have sovereignty over (and self-determine) the kind of cultural, political, and economic systems they want. In the Decolonization paradigm, ICT-enabled development means that ICTs should not only be accessible, but they should also be usable and customizable to and/or by indigenous peoples, facilitating self-determination, localized control and use of digital assets such as infrastructure and data. Apart from controlling access and extraction of value from digital assets, the decolonization approach to ICT development and use also facilitates digital sovereignty. As detailed next, these development paradigms have shaped ICT curricula in different contexts.

Studies on development paradigms in ICT curricula can be divided into three categories. The first category of studies focuses on the critical importance of competent human resources to socioeconomic development [1], [12], [13]. For example, emphasizing the critical role of human capital in sustainable development, Qureshi [1] posits that the capabilities, ICT access, and appropriate competences are key in ensuring that digital

transformation produces the desired impact instead of reinforcing the existing asymmetries. Underscoring the importance of the Human Development paradigm in ICT education, Qureshi [1] asserted that “Offering technical education is important so that people can be able to use ICTs to lead the lives they chose to live” (p. 424). However, while accentuating the role of competent human capital in socio-economic development, the studies in this group do not provide the specifics of how to design and implement the ICT curricula to produce the human capital capable of effectively contributing to the desired socioeconomic development.

The second category of studies focuses on the use of ICT in facilitating teaching and learning, which can be put under the umbrella of Education Technology [14]–[19]. Chung [15], for example, demonstrates that the interests of specific development paradigms can manifest during curriculum implementation, and argues that education technologies are key perpetuators of neoliberal interests. However, while the education technologies used to support curricula implementation are important in achieving the educational learning outcomes desired in various development paradigms, it is at the curriculum design stage where developmental aspirations are first inculcated in a curriculum. As such, a curriculum that does not consider appropriate development paradigms at the time of design is unlikely to deliver appropriate developmental outcomes, irrespective of whether more sophisticated education technologies are used at the time of curriculum implementation. Thus, studies that mainly focus on education technologies do not offer insights into the design-time inclusion of development paradigms in a curriculum.

The third category of studies on development paradigms in ICT curricula focuses on the inculcation of specific development paradigms at the time of design and delivery of curricula [20]–[25]. For instance, motivated by the fact that epistemic traditions can stand in the way of effective learning, preventing thinking beyond certain epistemologies, ontologies and futures, Engineer [21] studied what epistemic diversity means in the context of computer science education and how to embed it in a course on algorithm ethics. This led to the redesigning of the course on algorithm ethics to accommodate epistemic diversity. Relying on the Black Critical Theory [26], Sadler [20] makes a critical appraisal of antiblackness manifestations and impact in computing education, and subsequently proposes a framework for learning environments that promote radical imagination, empowerment, joy, and emancipatory fantasy. Moreover, revisiting the structures of power in a computer science classroom and aiming to produce graduates with an appropriate sense of agency and mandate to transform the society for better, Mayhew [22] proposes an ontology of critical pedagogy in computer science education. Four aspects were identified as being important for embracing critical pedagogy in computer science education: meeting students at their positions, revisiting student-teacher dynamics, making students understand power and how to identify it, and taking appropriate action and being reflexive. The study further observes that embracing critical pedagogy in computer science education makes students conscious enough to recognize oppression structures, enabling them to use technology in their activism, and integrating political and social forces in computer science education. A study conducted by Ryoo [23] to understand what high school students in rural Mississippi and urban California consider to be a desirable computer science pedagogy found out that, apart from desiring a culturally responsive computer science education, high school youths also wanted computer science education to consider issues of ethics, equity, in-field under-representation, and social responsibility. These studies are examples of how to accommodate the Decolonization and Structuralist paradigms in computing education, enabling learners to deal with the legacies of colonialism and break structures of oppression in ICT education. With the Sustainability paradigm in mind, the work of Zalewski and Sybramanian [25] demonstrates how to incorporate green aspects in a computer science program. A study by Goulart et al. [24] found a mismatch between the skills required by

ICT companies in Brazil and the skills possessed by graduates produced by universities in that country. This highlights the fact that some university graduates tend to fall short of the market dictates espoused by the Neoliberal development paradigm. However, while these studies focus on embedding specific development paradigms in ICT curricula, they do not offer insights into how to ensure that all the important development paradigms are embedded into an ICT curriculum, to avoid missing any important development paradigm in an ICT curriculum. Also, generally, little is known about whether and how ICT curricula in developing countries accommodate appropriate development paradigms.

2. Objectives

The objective of this study was to determine whether and how ICT curricula in developing countries accommodate appropriate development paradigms. The specific objectives of the research were to identify important development paradigms in undergraduate and postgraduate ICT curricula at the University of Dar es Salaam (UDSM), and to propose a framework for embedding various development paradigms in a university ICT curriculum.

3. Methodology

This study employed a qualitative approach, relying on interpretivism to identify important development paradigms in the studied undergraduate and postgraduate ICT curricula at UDSM, and to propose a framework for embedding various development paradigms in a university ICT curriculum. The study was conducted in the context of the World Bank funded project called Higher Education for Economic Transformation (HEET), which aimed at strengthening the delivery of higher education through a combination of university-level investments in improving the quality of learning environments and programs, and Ministry-level interventions that enhance the management of the higher education system and support a conducive policy environment [27], [28]. The present study was conducted from 2022 to 2024 during the review of 15 undergraduate and postgraduate ICT programmes at the College of Information and Communication Technologies (CoICT), UDSM, in Tanzania.

The data for this study was collected through the analysis of various HEET project documents (e.g., the Project Appraisal Document [27] and the Project Information Document [28]), documents of new and reviewed university ICT curricula, and the consultation with various industry and university stakeholders. Specifically, the tracer study was conducted, involving 808 CoICT graduates across 19 regions of Tanzania and 316 employers representing 176 organizations across Tanzania and beyond. A university-industry stakeholders workshop was conducted to validate the findings of the tracer study. Programme-level and course-level SWOC (Strengths, Weaknesses, Opportunities and Challenges) analysis was also conducted by 74 instructors across 97 courses at CoICT. Additionally, benchmarking was performed against established international, regional and national standards such as ACM/IEEE and others. Apart from informing the curricula development process, this consultation process enabled us to glean various development paradigms that were considered important by different stakeholders of university ICT curricula. The stakeholders consultation process led to the development of 15 ICT programs (5 undergraduate and 10 postgraduate) at UDSM, out of which 13 are revised programs and 2 are new programs. Authors of the present paper were participant observers in the whole process of tracer study, SWOC analysis, stakeholders consultation, and curricula development and presentation before stakeholders for discussion and feedback.

4. Findings

4.1 Developmental attributes desired by stakeholders of university ICT curricula

The feedback on university ICT curricula were collected from four stakeholder categories: graduate, employers, university and society. Various stakeholders preferred different aspects in the university ICT curricula, and such preferences could be linked to specific development paradigms. As can be deduced from the following sample quote from the surveyed graduates, most of the surveyed graduates preferred industry-facing ICT curricula that accommodated the most recent developments in their respective fields. *"Courses should be teaching students current things and to prepare students in the current job market or how to be innovative in the current situation"*. Other graduates remarked on the need for specialization within the university ICT programs, to resonate with various ICT specializations in the job market. The importance of soft skills in getting employed after graduation was also stressed by graduates. Most of the preferences of graduates were therefore linked to the neoliberal development paradigm. They emphasize the need to produce graduates who can function effectively in the presence of market logics. One graduate, however, was concerned that the program they studied at the University was not sensitive to national priorities and level of development: *"Most courses in the programme does [do] not seem to have environment for practicability in relation to a national priorities and development level"*. While not explicit in terms of development paradigm, this desire for context-sensitive university ICT curricula could be linked to other development paradigms such as the Structuralist and Decolonization paradigms.

Employers, on the other hand, generally preferred university ICT graduates who have a good mix of hard and soft skills. Similar to graduates, most of the employers' preferences are also linked to the Neoliberal development paradigm because employers prefer graduates who can operate according to the dictates of the job market. This similarity is not surprising given the symbiotic relationship between graduates and employers. Moreover, wishing to remain both locally and internationally relevant, UDSM aims to produce graduates who can contribute to both local and international development, as detailed in its various strategic documents. For instance, stressing the importance of producing graduates who can contribute to national development, part of the UDSM Strategic Action Plan- 2020/21 – 2024/25 states the following: *"The University of Dar es Salaam has a noble obligation to contribute to the national development through teaching, research, innovation and public services"*. The University also emphasizes on technology-facilitated programmes, through modes such as blended and online delivery, to ensure continuity of learning even in the presence of major disruptions to face-to-face learning such as what happened during the COVID-19 pandemic. Since all these do not communicate clear development paradigms to which the university subscribes, it can be assumed that UDSM aims to produce graduates inclined to various development paradigms, given its diverse disciplines and the universal nature expected of a university. The University therefore expects ICT curricula developers to translate this vision into the curricula. Meanwhile, the SWOC analysis, in which the perspectives of university academics on the existing ICT curricula were captured, stressed the importance of an ICT curricula to respond to both local and international demands, and to be comparable with similar programs internationally; and the need to allocate more weight to practical assessment than written examinations such as tests and university examinations, mainly to produce graduates who can effectively navigate the dynamics of the ICT job market. However, embedding development paradigms into the university ICT curricula can be tricky in the absence of clear frameworks and guidelines, as the curricula developers may fail to embed the development paradigms into the curricula to the desired levels.

Other developmental needs of the broader society were articulated in various HEET project documents developed by the Tanzania's Ministry of Education, Science and Technology and the World Bank. They include competence-based curricula, gender equity and equality, consideration of learners with special needs, and responding to challenges posed by climate change. These societal needs embrace various development paradigms. For instance, the competence-based curricula can be linked to the Human Development paradigm, because, using active learning can produce a competent workforce of university ICT graduates who can lead their own lives and spearhead their nations and societies to do so. This is also true of university ICT curricula that stress gender equity and equality. At the same time, embedding climate change issues into the university ICT curricula is in line with the Sustainable Development paradigm.

4.2 Development paradigms in the revised ICT curricula at the University of Dar es Salaam

Based on the development perspectives of various curricula stakeholders, the revised curricula had 8 key attributes, which we mapped to the respective development paradigms as shown in Table 1. Assigning curriculum attributes to different curricula attributes enables us to understand the different competing institutional logics behind the revised curriculum, helping us to determine the dominant logics that could shape the fate of graduates resulting from the curriculum. Such a mapping also helps us to identify important development paradigms that have received little or more emphasis during curricula development.

Table 1: Attributes and the associated development paradigms in the developed ICT programs

Sn	Curricula attribute	Neoliberal	Structuralist	Sustainable	Human Development	Decolonisation
1	Context-sensitivity	No	Yes	No	No	No
2	Innovation and entrepreneurship	Yes	No	No	No	No
3	International recognition	Yes	Yes	No	Yes	No
4	Interdisciplinarity	No	Yes	No	No	No
5	Gender and diversity	No	Yes	No	Yes	No
6	Climate change	No	No	Yes	No	No
7	Digital delivery	No	Yes	No	No	No
8	Financial literacy	Yes	No	No	No	No

4.3 Framework for diagnosing the transformative development nature of an ICT curriculum

Table 2 presents the proposed framework for diagnosing and embedding various development paradigms in a university ICT curriculum. For each perspective representing a particular set of stakeholders, we propose sample key developmental attribute questions, which could be answered by curriculum development practitioners and/or researchers.

Table 2: Framework for diagnosing development paradigms in a university ICT curriculum

Perspective	Curriculum developmental attributes
Employers	• Whether the curriculum has sufficient developmental attributes that best serve the interests of employers. • Whether the curriculum strikes the balance between employer and cross-paradigm developmental needs. Some developmental needs may be in conflict with (or could require going beyond) employer needs. For example, some employers may not be interested in the intricacies of the Decolonization and/or Structuralist paradigm(s).

	• Whether all employer needs embedded in the curriculum can be linked to specific development paradigms. This could help curricula teams to identify employer needs that are not developmental in nature, or identify new development paradigms relevant to employers and the curricula, which could inform the work of researchers in curriculum and development studies. • How can a sufficient level of developmental attributes that best serve the interests of employers be embedded in a curriculum?
Graduates/Learners	• Whether the curriculum has sufficient developmental attributes that best serve the interests of graduates/learners • Whether the curriculum strikes the balance between graduate/learner and cross-paradigm developmental needs. Some developmental needs may be in conflict with (or could require going beyond) graduate/learner needs. For example, some graduates/learners may not be interested in the intricacies of the Decolonization and/or Structuralist paradigm(s). • Whether all graduate/learner needs embedded in the curriculum can be linked to specific development paradigms. This could help curricula teams to identify graduate/learner needs that are not developmental in nature, or identify new development paradigms relevant to graduates/learners and the curricula, which could inform the work of researchers in curriculum and development studies. • How can a sufficient level of developmental attributes that best serve the interests of graduates/learners be embedded in a curriculum?
Universities	• Whether the curriculum has sufficient developmental attributes that best serve the interests of universities • Whether the curriculum strikes the balance between university and cross-paradigm developmental needs. Some developmental needs may be in conflict with (or could require going beyond) university needs. For example, some universities may not be interested in the intricacies of the Decolonization and/or Structuralist paradigm(s). • Whether all university needs embedded in the curriculum can be linked to specific development paradigms. This could help curricula teams to identify university needs that are not developmental in nature, or identify new development paradigms relevant to universities and the curricula, which could inform the work of researchers in curriculum and development studies. • How can a sufficient level of developmental attributes that best serve the interests of universities be embedded in a curriculum?
Society	• Whether the curriculum has sufficient developmental attributes that best serve the broader community, national, regional and international interests • Whether the curriculum strikes the balance between societal and cross-paradigm developmental needs. Some developmental needs may be in conflict with (or could require going beyond) some societal needs. For example, some nations or regions may not be interested in the intricacies of the Decolonization and/or Structuralist paradigm(s). • Whether all societal needs embedded in the curriculum can be linked to specific development paradigms. This could help curricula teams to identify societal needs that are not developmental in nature, or identify new development paradigms relevant to the society and the curricula, which could inform the work of researchers in curriculum and development studies. • How can a sufficient level of developmental attributes that best serve the interests of the society be embedded in a curriculum?

4.4 Discussion

Similar to past studies [20]–[25], the present study also found deliberate attempts to embedded various development paradigms in the studied undergraduate and postgraduate ICT curricula at UDSM. However, different from past studies, the present study has established that other development paradigms can easily conceal the Decolonization paradigm in the university undergraduate and postgraduate ICT curricula. Therefore, when developing ICT curricula, universities, especially those in developing countries, need to ensure that overemphasis on other development paradigms such as Neoliberalism does not

come at the expense of the Decolonization paradigm, which is equally important in spurring the creation and use of ICTs in bringing about the development desired by most low and middle-income countries. Without accentuating the Decolonization paradigm in university ICT education in developing countries, these countries will continue to be on the receiving end of the ICTs created elsewhere, which could fail to bring about the desired development because of the design-reality gaps inherent in imported ICTs. Downplaying the Decolonization paradigm is likely to make university ICT graduates in developing countries continue to lack appropriate tools to interrogate the existing epistemics and discourses that shape the global development and use of ICTs. This could, in turn, hinder developing countries' efforts to achieve the level of digital sovereignty they desire. Moreover, while most of the past studies have focused on accommodating development paradigms at the time of implementing the university ICT curricula, we suggest that development paradigms should first be embedded in university ICT curricula at the time of design to support the actualization of such paradigms at the time of curricula implementation. Thus, both the curricula design and implementation stages are critical for inculcating development paradigms in university ICT curricula.

Different from the frameworks offered by past studies, which mainly focused on the implementation stage of ICT curricula [20], [22], [23], the proposed framework facilitates the diagnosis and embedment of development paradigms in university ICT curricula at the design stage. Also, while previous studies that considered development paradigms at the curriculum design stage focus on individual courses within a university ICT curricula (e.g., the work of Engineer [21]), the proposed framework facilitates embedment of development paradigms in an entire university ICT curriculum.

5. Conclusions

This study has empirically contributed a framework for diagnosing and embedding various development paradigms in a university ICT curriculum, and has provided a detailed account of how a university ICT curriculum can be developed in a way that ensures that it brings about relevant transformative development. Apart from informing development-sensitive university ICT curricula, these contributions could inform theorisation on analysis, explanation and prediction of the presence of development paradigms in university ICT curricula. However, ICT curricula in only one university were analysed. Thus, future research can, among other things, analyse ICT curricula from more universities, focus on how to strike a balance between various development paradigms in a university ICT curriculum, and apply and evaluate the effectiveness of the proposed framework in diagnosing and facilitating the embedment of development paradigms in university ICT curricula. More development paradigms could also be considered.

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