

Doctoral education and the knowledge triangle: dynamics of linkage to other sectors in doctoral programs in Uganda

Irene Etomaru

*East African School of Higher Education Studies and Development,
Makerere University, Kampala, Uganda, and*

Denis Thaddeus Ofoyuru

Faculty of Education and Humanities, Gulu University, Gulu, Uganda

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Abstract

Purpose – This study aims to explore the dynamics of linking doctoral programs to other sectors constituting future workplaces and fields of public engagement for doctoral graduates in Uganda. This is in light of the current global pressures for universities to contribute more directly to society, and changes in student demographics and career aspirations. In a number of jurisdictions, intentional linkage to other sectors is being pursued to better prepare doctoral graduates for work beyond academia. However, not much is known about the dynamics involved. Guided by the knowledge triangle framework, this paper posits that creating sufficient links between education, research and innovation through linkage to other sectors can offer a window of opportunities for attaining relevant doctoral outcomes for both students and wider society.

Design/methodology/approach – Qualitative multiple case study design was used to explore mechanisms of linking doctoral programs to other sectors in Uganda. Data was collected through in-depth interviews with 45 participants selected across all institutions providing doctoral education in Uganda. Thematic analysis was used to make sense of the data.

Findings – The study found no formal mechanisms for linking doctoral programs to other sectors. Lack of institutionalization, narrow focus in program design, cultural mismatch and resource limitations were major systemic constraints to effective linkage to other sectors in doctoral education. Institutionalization of integrated learning in collaborative university-other sector settings in doctoral education in Uganda is recommended.

Research limitations/implications – The research data is exclusively from higher education institutions, the possibility of not comprehensively reflecting the broader perspectives from other sectors cannot be overlooked. A more comprehensive study of the dynamics of innovating doctoral education in Uganda through coherent collaboration between higher education institutions and other sectors to ensure the success of linking education, research and innovation is recommended.

Practical implications – Promoting the knowledge triangle approach in doctoral education by creation of synergies between education, research and innovation through linkages to the other sectors would enhance the attainment of relevant doctoral outcomes for students and the wider society.



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Originality/value – This paper offers deeper insights into the dynamics of enhancing the relevance of doctorates and doctoral research outputs beyond the academia.

Keywords Doctoral education, Knowledge triangle, Other sectors, Student demographics, Career aspirations, Research, Innovation, Co-teaching, Co-supervision, Co-funding, Alumni networks, Doctoral outcomes

Paper type Research paper

Introduction

Over the course of centuries, the most important outcome of doctoral education in its traditional form was “the perpetuation of professional academic bodies” (Ruano-Borbalan, 2022, p. 368). Doctoral candidates were socialized into a community of peers through a long, ritualized master-apprenticeship preparation centered on forward-looking knowledge production (Frick *et al.*, 2017). The doctoral degree was narrowly seen as an academic degree that expresses ability to conduct research conforming to academic standards and served as a license to teach in a university (Baptista *et al.*, 2015). Over the past three decades, doctoral education has gone through tremendous changes due to public policies designed to encourage knowledge transfers from academia to society at large (Taylor and Wisker, 2023). Unprecedented importance is currently attached to better train doctoral graduates to fit both within and beyond academia (Nature Editorial, 2023). This is triggered by countries’ ambitions to sustainably establish themselves as knowledge societies or gain a competitive advantage globally (Bao *et al.*, 2018; Nerad, 2020; Sooryamoorthy and Christine, 2022). Initiatives to strategically integrate doctoral education into the national research and innovation system are being undertaken globally (OECD, 2023).

Increased numbers of doctoral students are pursuing non-academic careers due to increasing precarity of academic jobs (Bao *et al.*, 2018; Ortega and Kent, 2018). Non-academic destinations are no longer “simply a preference but a necessity for the PhD holder” (Germain-Alamartine *et al.*, 2021, p. 2689). However, employment mismatches such as knowledge and skills mismatches, field of study mismatches and over education or qualification mismatches confront doctoral graduates as they shift to non-academic careers (Corcoran and Faggian, 2017). Consequently, calls for a redefinition of the purpose and modes of doctoral education are overt in both policy and scholarly discourse (OECD, 2023; Ruano-Borbalan, 2022; Taylor and Wisker, 2023).

In Uganda, policy formulation for doctoral education is embedded in generic frameworks and guidelines for higher education. Institutions interpret and operationalize such frameworks in a varied manner. There is no specific framework, and defined numerical targets for doctoral education (Asiimwe, 2019; Etomaru *et al.*, 2023). Doctoral education capacity in both public and private institutions in Uganda is very low. Only about 1,197 PhDs have been awarded in Ugandan institutions between 1970 and 2020, of these, 1,025 were awarded by public institutions with 90.2% (923) awarded by Makerere University alone. Private universities awarded only 172 (9.8%) of the nation’s PhDs between 2001 and 2020. All of these were traditional academic-discipline based PhDs (Etomaru *et al.*, 2023). This translates into deficit in the number of researchers per million inhabitants in Uganda. Latest year available data in UNESCO-UIS data base shows that Uganda had only 37 researchers per million inhabitants (full-time equivalent-FTE), 83 researchers per million inhabitants (head count) by April 2015, significantly below the world average. Yet, globally the average number of researchers per million inhabitants increased from 1022 in 2010 and 1160 in 2015 to 1342 in 2020, annual growth rate of 3.9% in 10 years (UNESCO, 2021).

Currently, scholarly discourse on doctoral education in Uganda is narrow and fragmented. Focus has been on factors that attribute to doctoral completion or success and productivity of doctoral graduates. Notable are studies by [Bakkabulindi \(2014\)](#) and [Lunyolo *et al.* \(2019\)](#) who found supervision constraints to be a major factor slacking completion of doctoral studies in Makerere University; [Nakanjo *et al.* \(2014\)](#) who studied mentoring best practices at the Makerere University College of Health Sciences; [Muriisa \(2015\)](#) who studied the challenges and experiences of social science students in completing PhD programs in Mbarara University of Science and Technology. A survey of the careers and productivity of doctorates by the Uganda National Council for Science and Technology (UNCST) ([UNCST, 2012](#)) shows low productivity of doctorates and concentration of PhD holders in Uganda in academia. [Mamdani \(2012\)](#) and [Wamala and Ssembatya \(2013\)](#) found low scholarly productivity of doctoral holders in terms of (co)-authored journal articles, books, book chapters and monographs; [Mamdani \(2017\)](#) highlighted the need to foster inter-disciplinarity in doctoral education in Uganda; [Kasozi \(2019\)](#) pointed to the need to improve the quality of the doctorates and [Etomaru *et al.* \(2023\)](#) called for a paradigm shift toward generation of co-creation spaces for doctoral research training and socialization of doctorates which they found to be very weak. Extant scholarly work on doctoral education in Uganda does not directly address the important discourse on dynamics of linking doctoral programs to other sectors in society, a gap this study sought to address.

Theoretical framework

At a broader theoretical level, doctoral education is informed by and nested within the broader societal realm. Theoretical frameworks such as Mode 2 knowledge production ([Nowotny *et al.*, 2003](#)), Mode 3 knowledge production ([Barnnet 2004](#); [Carayannis and Campbell, 2012](#)), the triple helix model ([Etzkowitz and Leydesdorff, 2000](#)) and the quadruple helix ([Carayannis and Campbell, 2012](#)) among others, all point to the importance of and the different aspects of linkages between higher education and other sectors. However, these frameworks tend to focus narrowly on the role of individual actors and are therefore not potent for this study's aims.

The theoretical lens for this paper is derived from the knowledge triangle framework ([Markkula, 2013](#)). The knowledge triangle framework is a functional model of interaction, emphasizing an integrated systemic approach. The knowledge triangle framework postulates an activity-oriented approach to linking higher education to other sectors demonstrating the importance of systemic and continuous interaction in the three activities of education, research and innovation. In short, linkage between education and research lays the foundation for improving skills-matching between the labor market and graduates; linkage between research and innovation supports and intensifies the transfer of knowledge through public-private partnership (PPP) models and links between education and innovation support the development of an entrepreneurial spirit and the formation of appropriate competencies in academic training programs ([Markkula, 2013](#); [Unger and Polt, 2017](#)). The knowledge triangle framework ties the development of new ideas to systemic interactions between education, research and innovation, by implication, effort devoted to strengthening linkages between academia and other sectors. In this study the knowledge triangle framework is articulated in terms of window of opportunities for enhancing the relevance of doctoral outcomes through linkages between doctoral programs and other sectors.

Stressing the importance of doctoral education for the Europe of knowledge, the European Commission (EC) pronounced Principles of Innovative Doctoral Education ([EC, 2011](#)). The fourth principle stipulates that an innovative doctoral program should expose students to relevant industry contexts. EC uses the term "industry" in the widest sense to

include all fields of future workplaces and public engagement, from industry to business, government, NGOs, charities and cultural institutions. Exposure to the relevant industry setting according to the EC entails placements during research training; shared funding; involvement of non-academics from relevant industry in informing/delivering teaching and supervision; promoting financial contribution of the relevant industry to doctoral programs; fostering alumni networks that can support the candidate (for example mentoring schemes) and the program, and a wide array of people/technology/knowledge transfer activities. Deriving the analytical lens and constructs from the knowledge triangle framework and the fourth principle of innovative doctoral training (EC, 2011; Markkula, 2013), this study sought to answer the broad question:

Q1. How and to what extent is doctoral education in Uganda linked to other sectors?

Literature review

The recognition that the global economy of the 21st century is going to be driven by knowledge has led to unprecedented importance attached to the way researchers are trained (Nature Editorial, 2023). Worldwide, debates about how best to structure doctoral training are taking center stage, growing importance is attached to the production of doctorates for scientific and economic advancement of nations (Sooryamoorthy and Christine, 2022; Nerad, 2020). For instance, in Europe, the role of doctoral education in enhancing European competitiveness and innovation capacity is widely acknowledged (Kallioniemi-Chambers and Nikander, 2021). Several large projects and studies are being undertaken resulting into remarkable reforms and new trends in the organization of doctoral education and training.

In the USA, doctoral programs are increasingly becoming market-driven in the context of the knowledge economy (Grant *et al.*, 2022). The Survey of Earned Doctorates (SED) shows that the number of research doctoral degrees awarded in the US increased from 52,194 in 2021 to 57,596 in 2022 (National Center for Science and Engineering Statistics, 2023). In Asia, China exhibits unprecedented expansion in doctoral education with numbers of doctoral graduates rising from approximately 7,300 degrees in 1997 to approximately 60,000 at beginning of the 2020s (Ruano-Borbalan, 2022), to 75,200 in 2023 (Yan, 2023). The government of India has made investments to attain a target of graduating up to 20,000 PhDs each year by 2020. In Singapore, PhD enrolments have grown by 60% in all disciplines in recent decades. Doctoral education in Malaysia and Thailand increased by 400 and 300%, respectively, in recent decades (Woldegivorgis *et al.*, 2020; Jansen and Walters, 2022).

In these jurisdictions, intentional university-other sector linkages are increasingly being pursued. Among others, in the UK, collaborating with industry is seen as essential for enhancing the impact of doctoral research on society and the economy (Hughes and Martin, 2020). In China, there is growing policy focus on fostering industry-academia partnerships to improve doctoral training outcomes (Zhou and Zha, 2022). The French government has implemented initiatives to foster PPP through the Innovation and Research Program (Frayssé, 2018). Germany has implemented industry-on-campus programs in the context of the knowledge triangle where universities cooperate with other sectors in strategic basic research, and doctoral candidates are placed in innovation clusters within national policy frameworks (OECD, 2023).

In Africa, notable upsurge of interest in doctoral education occurred from the 1990s (Jowi, 2021; Harle, 2013). Notably, South Africa released plans to increase the number of PhD graduates nationally fivefold by 2030 (Jansen and Walters, 2022; Herman, 2015;

National Planning Commission, 2012, p. 319). Current discourse on doctoral education in Africa affirms the need for increased volumes of PhD output (quantity imperative), transformation in doctoral education (relevance, efficiency and quality imperative) and internationalization of doctoral education (competitiveness imperative) (Atickem *et al.*, 2019; Sooryamoorthy and Christine, 2022).

African countries seek to foster collaborations that enhance the relevance of doctoral research to other sectors, improve the employability of PhD graduates and encourage innovation and commercialization of research outputs (Abdullahi, 2021; Adeyemi and Olayemi, 2020). In South Africa, the National Research Foundation (NRF) promotes the Technology and Human Resource for Industry Programme to link doctoral candidates with industry through the establishment of research centers and innovation hubs in collaboration with other sectors (Badu, 2020; Chisasa, 2019). Similarly, in Kenya universities are increasingly offering PhD candidates opportunities to undertake industrial attachments as part of their doctoral training (Eze, 2022; Odera, 2021). In Nigeria, according to Adeyemi and Olayemi, efforts to establish doctoral programs that focus on developing skills for innovation and entrepreneurship through linkage to other sectors have been initiated under the National University Commission (NUC).

Existing literature points to exponential expansion in doctoral education globally, and at the same time inadequate preparation of doctoral graduates for the cross-disciplinary environments within and outside academia that absorb them (Germain-Alamartine *et al.*, 2021; Nature Editorial, 2023). Aligning academic goals with other sector needs, and limited financial support for collaborative projects remain a challenge (Thomson and Rousset, 2020). Intentional linkages to other sectors are increasingly being pursued to enhance the relevance of doctoral graduates and their research outputs. However, this trend is quite small and the dynamics involved are not yet fully understood.

Methods

This study used qualitative multiple case study research design. Data was collected through interviewing. Face-to-face interviews were conducted with a total of 45 participants selected across 12 institutions: five public universities (Gulu University, Kyambogo University, Makerere University, Makerere University Business School and Mbarara University of Science and Technology), one public degree awarding institute (Uganda Management Institute) and six private universities (Bishop Stuart University, Islamic University in Uganda, Kampala International University, Nkumba University, Ndejje University and Uganda Martyrs University). The voice of priority was Coordinators of doctoral programs, in case a doctoral program did not have a Coordinator, the Head of Department or the Dean of the Unit/School/Faculty was selected. To get information on all doctoral programs in a given institution, Directors of Research and Graduate Schools or their equivalent or Directors of Quality Assurance were selected. The summary of interview participants is given in Table 1.

To uphold research ethics and integrity, letters of introduction, support and authorization were obtained from the National Council for Higher Education and Makerere University Research and Innovation Fund (Mak-RIF) Secretariat. These letters were used to seek entry into the institutions providing doctoral education in Uganda. The purpose of the study was explained to the interview participants, and their informed consent was sought by inviting them to fill in an informed consent form. All participants were assured of anonymity and participation in the study was voluntary.

Predetermined themes to guide construction of the interview guide and data analysis were derived from the EC principle of “exposure to the relevant industry.” The EC Principles for

Table 1. Data sources by category

Category	Interview participants		Total
	Public institutions	Private institutions	
Coordinator of Doctoral Program	9	2	11
Head of Department	6	1	7
Dean of Faculty	6	2	8
Dean of School	1	0	1
Director of Research	2	0	2
Coordinator of Graduate Studies	0	1	1
Coordinator of Research and Innovation	0	2	2
Director of Quality Assurance	2	4	6
Director/Head of Graduate School	3	3	6
Deputy Principal	0	1	1
Total	29	16	45
Source(s): Authors' own work			

Innovative Doctoral Training (EC, 2011) has some degree of universal appeal, and therefore, contextualized application as a guiding framework, but not as a checklist, offers insight into analyzing local conditions for guiding reforms in doctoral education and training. The predetermined analytical constructs we derived from the EC principle of innovative doctoral training are: other sector placements during research, co-funding with other sectors, co-teaching with other sector partners, co-supervision with other sector partners, fostering Alumni/Alumnae networks and knowledge sharing with other sectors.

Thematic framework analysis was used to analyze the data. Deriving from Gale et al. (2013), the steps we followed in data analysis are summarized in *Steps in Thematic Framework Analysis*.

Steps in Thematic Framework Analysis

- (1) Step 1: Transcription of Data
 - Data from interviews was transcribed. The textual data was organized according to the predetermined constructs derived from the EC principle of “exposure to the relevant industry”, these are: other sector placements during research, co-funding with other sectors, co-teaching with other sector partners, co-supervision with other sector partners, fostering Alumni/Alumnae networks and knowledge sharing with other sectors. The process of data transcription gave us the opportunity to deeply immerse in the data.
- (2) Step 2: Coding of Data
 - Descriptive deductive coding was done. This process involved reading through the textual data line by line, applying a paraphrase or label (a code) that described important phrases. Deductive coding was done because a priori categories corresponding to the constructs derived from the principle of exposure to the relevant industry were used. However, keen attention was given to identification of emerging codes and categories from the data.
- (3) Step 3: Developing the Working Analytical Framework
 - Emerging codes were merged with the pre-defined codes, categories, sub-themes and themes to develop a comprehensive working analytical framework.

(4) Step 4: Applying the Working Analytical Framework

- The working analytical framework was applied by indexing the interview transcripts using the existing categories and codes (the constructs in the analytical framework derived from the principle of exposure to the relevant industry).

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(5) Step 5: Charting Data into the Framework Matrix

- Spread sheet was used to generate matrices into which the data was charted. Data from each document or interview transcript was summarized by category. This necessitated striking a balance between reducing the data and retaining the original meanings. The resulting chart included references to illustrative quotations.

(6) Step 6: Interpreting the Data

- At this stage, characteristics of the data were identified, for example, similarities, differences and repeated patterns of meaning. Thus, typologies were generated, theoretical concepts were interrogated and connections between categories were mapped. This enabled descriptions of particular cases and the emergence of particular themes. Sufficient time was devoted to conduct the interpretation and writing up of findings.

Source: Adapted from [Gale et al. \(2013\)](#)

Findings

This study explored the mechanisms through which doctoral programs offered in Ugandan institutions expose students to other sectors using the knowledge triangle framework and EC's principle of exposure to the relevant industry as a conceptual lens. Other sector placements during research, co-funding with other sectors, co-teaching with other sector partners, co-supervision with other sector partners, fostering Alumni/Alumnae networks and knowledge sharing with other sectors were taken to be innovative mechanisms for linking doctoral programs to the other sectors as add-ons to enhance doctoral training, but not as avenues for developing totally a new unique mode of doctoral training *per se*. The findings reveal that mechanisms to link doctoral programs to the other sectors were not institutionalized. Linkages to other sectors were largely personal and informal as illustrated under the pre-determined themes in the subsequent segments.

Other sector placements during research training

The most common response from the participants in regard to other sector placements during research was that most doctoral students were already exposed to other sectors in so far as they are employed. This finding was illustrated by these representative extracts: "PhD students are already employed, so field placements are not our problem" (Program Coordinator, Public University²), equally, a Head of Department in Public University⁴ stated that "the doctoral students that are by research already work and are upgrading in their areas", therefore, are already linked to the other sector. Such a perception is complex given the fact that not all doctoral students are pursuing doctoral studies in fields relevant to their current employment; the employment status of students does not automatically translate into formal linkage of doctoral programs to other sectors. For example, some of the students actually enroll for doctoral studies without the official knowledge of their employers. Thus, field placement during doctoral research training was not institutionalized. Students mainly had personal, informal attachments by virtue of being employed. In instances where students pursued doctoral studies out-side of their current field of employment; there were no

institutionalized mechanisms to link them to other sectors for research training placements, particularly in non-STEM disciplines.

Co-funding with other sectors

Doctoral students in Uganda are largely self-financed. In few instances, mainly in science-based disciplines, particularly the applied sciences, funding came through external scholarship schemes or programs funded by donors and development partners. A typical response from the participants was, “there is no co-funding from industry”. Majority of the participants expressed that they had not explored the possibilities of getting funding from other sectors as demonstrated by this representative quote:

We have not yet explored possibilities of co-funding with other sectors [...]. Maybe we shall learn from your study how people in social sciences are getting funders from the other sectors [...] with natural sciences its quite different [...]. (Program Coordinator in a Public University3).

Participants expressed that funding from other sectors was not possible in the current political and economic setting where neither government nor other sectors are ready to fund doctoral research. Participants held the view that doctoral education is a more personal initiative and therefore there is no logic in linking with other sectors for funding:

At PhD? [...], somebody comes to do a PhD with his goals, that is why it has not been an area where there is a conversation between the other sector and our graduate of PhD [...] it's really personal. So, I don't think it has been done because there is no logic, other sectors cannot sponsor them [...]. (Program Coordinator Public University4)

This illustrates that doctoral education is understood in the narrow sense of the traditional, academically-oriented PhD. Furthermore, the participant positions, the PhD as of high individual value but limited in terms of its potential contribution or value to society. Thus, links between other sectors and doctoral programs were undefined. Other sectors were largely detached, save for very few instances in STEM fields, for instance, in the health and agricultural sciences, which were largely by default but not by deliberate design as illustrated in this excerpt:

[...] they make arrangements, [...] for example, that of Agro-ecology, sometimes they need to do the researches in NARO research center, use their equipment [...] although we have to pay for them [...] but the fund is given by World Bank (Director of Graduate School Private University F).

This is further illuminated by Program Coordinator Public University 5 who said, “there is no direct scheme for a deliberate other sector mobility program. So, quite often the students themselves try to find their way out.” Thus, direct funding from other sectors for doctoral program was, according to participants’ accounts, non-existent.

Co-teaching and co-supervision with other sector partners

Mechanisms to co-teach and co-supervise with partners from other sectors were not institutionalized. Personal, informal connections between individual supervisors were being used in very few instances to attach students to other sector partners for supervision. Given that most PhD programs were by research only, co-teaching and co-supervision were rarely practiced. Therefore, opportunities for creating linkages between education, research and innovation as envisaged in the knowledge triangle framework risk being missed.

Alumni/alumnae networks

Mechanisms for fostering networks of alumni/alumnae were not institutionalized. Some of the PhD programs, particularly PhDs by course work and dissertation had been newly

launched, hence, the first cohorts had not yet completed the first cycle, thus alumni/alumnae networks were naturally non-existent. For example, Program Coordinator Public University1 said that “there are no PhD alumni networks since the cycle of five years has not been completed”. Most doctoral programs offered were PhDs by research only which tends to be highly individual and lonely; networks of doctoral alumni/alumnae were therefore non-existent.

Knowledge sharing with other sectors

By design, doctoral programs offered in Ugandan universities were lacking in the aspect of knowledge sharing with other sectors. Partners from the other sectors were occasionally invited for seminars and workshops as expressed by this participant:

We have had seminars [...] and during the seminars we have facilitators who come to talk about pertinent issues regarding research [...] and then we have those who have finished their doctorates especially young doctors coming in to share what is coming out of their researches [...]. (Program Coordinator Public University3)

Knowledge sharing with other sectors was more apparent in the STEM disciplines compared to non-STEM disciplines. Participants held the perception that knowledge sharing with other sectors was more natural and by default in the STEM disciplines, but very difficult to attain in the non-STEM disciplines. The expression made by this participant attests to this:

[...] one of the principles would be having a PhD training which has linkage to non-academia as a way of solving societal problems, but we don't see it coming up. It is not going to come. It is a few in sciences, I know the sciences have taken a leaf, you know they are never with us because by design science is really a living thing, science has no choice [...] maybe they have also ended there accidentally [...] in agriculture whether you are a joker or not you must be doing some practical on the farm and before you know it you have killed a germ. (Program Coordinator Public University4)

Participants acknowledged the need to deliberately embed mechanisms to foster knowledge sharing with other sectors in the design of doctoral programs as expressed in this excerpt:

[...] but you can see here it is haphazard [...] so, other sectors, forget about it if your design is not correct. But in developed countries this is the way to go because they design them correctly [...]. I attended one meeting in a place where I was doing some training, they sit with other sectors [...]. So, design, go back and design these things. (Program Coordinator Public University3)

Therefore, institutionalized mechanisms to link doctoral programs to the other sectors were not embedded in doctoral program design. In the STEM disciplines, linkages to the other sectors were largely by default, but not by design and institutionalization. A myriad of challenges repressed opportunities for exposing doctoral candidates to other sectors as illustrated in the following segments.

Challenges of linking doctoral programs in Uganda to other sectors

The traditional discipline-based academic culture

The traditional discipline-based academic culture militated against linkage to other sectors in doctoral research training. Participants expressed that cross-disciplinary PhD programs have been criticized during the examination process due to lack of anchor in a specific discipline as demonstrated in the following excerpt:

Actually, I could say that cross-disciplinarity is one of our areas of strength, but some other people say it is an area of weakness [...] much of our studies are actually inter disciplinary but examiners

always criticize that they are not anchored in a given discipline. (Head of Department Public University3)

Research training outside traditional academic discipline boundaries rested largely on personal, informal initiatives as expressed by this participant: “we don’t have internship, [...] but if somebody wants to do a study in collaboration with other sectors, there is nothing that prohibits it” (Program Coordinator Private University A). Participants’ understanding of exposure to industry was somewhat vague. Some participants claimed that in so far as their students are already employed, their doctoral programs are already linked to other sectors as illustrated by this excerpt: “most of our students are employed [...], so their experiences help to enrich the program [...] linking to other sectors” (Program Coordinator Private University F). Doctoral programs were largely offered within traditional discipline-based academic boundaries limiting opportunities for linking education, research and innovation.

Cultural mismatch and organizational secrecy

Participants expressed that linkage to other sectors was hard to effect because of organizational secrecy and differences in culture: “this is a challenge because other sectors have secrecy [...] but students want to publish their findings [...]. Industries are economic oriented while students are academic and learning oriented” (Program Coordinator Public University4). Therefore, organizational secrecy entrenched by cultural mismatch between academia and other sectors, and lack of trust were a major limitation to linkage to other sectors in doctoral research training. The relationship between industry and doctoral programs was therefore undefined.

Lack of institutionalization

Lack of formal institutionalized mechanisms to link doctoral programs to the other sectors was a major challenge. Linkage to other sectors was left at the discretion of individual students as shown by this illustrative extract:

For PhD, that is generally lacking [...], the students should attain this only at a personal level. It is done by students depending on the experience they have [...]. I also blame it on our country, there is minimum appreciation of the academia [...]. limited attention is given by government and other sectors to the academics. (Program Coordinator Public University3)

Some participants held the view that exposure to other sectors works better at lower levels of education than the PhD as illustrated by this excerpt:

[...] it has worked largely for under-graduate. Other sectors want interns because internship gives free labor, that is what they want from them. They also want to hire them because at that level they are cheaper. But when you come to PhD training, train you for my sector to give me what? (Program Coordinator Public University2)

Thus, failure to elaborate the relationship between other sectors and doctoral programs through memoranda of understanding (MoUs) and formal institutionalized mechanisms limited possibilities of linking doctoral education, research and innovation through exposure to other sectors.

Funding constraints

The government of Uganda had not integrated doctoral education and training into national development planning, and hence, there was no direct government funding for doctoral programs. Doctoral programs rely entirely on two major sources of funding: development partners and donors, and student tuition fees. Only in few instances, some institutions sponsored

staff for PhD studies under staff development programs. Therefore, doctoral research focus was entirely directed by individual interests of students and that of the donors and development partners. This translated into mono-disciplinary research focus, and consequently lack of exposure to the other sectors which the existing funding schemes did not support.

Overall, the participants acknowledged the need for and value of embedding linkages to other sectors in doctoral program design. However, due to the systemic barriers we have highlighted, doctoral programs were largely academic-discipline based. Opportunities for creating linkages between education, research and innovation to attain relevant doctoral outcomes for both students and the wider society were missed.

Discussion of findings

Doctoral education plays a central role in strengthening the knowledge ecosystem of any country as it's the apex for training researchers (OECD, 2023). Doctorates ought to be trained in open, high quality research environments. This requires collaboration with the other sectors that absorb doctorates (Grant *et al.*, 2022), as such, calls for revolutionizing the organization of doctoral research training are taking center stage globally (Nature Editorial, 2023). The need for generation of co-creation spaces to foster convergence of education, research and innovation activities as postulated in the knowledge triangle strategy has become apparent.

Our findings reveal that linkage of doctoral education to other sectors in Uganda remains obscure. It is thus tenable to deduce that there are no defined and deliberate mechanisms for linking doctoral training to other sectors, as such the extent of this linkage can best be described as weak or indeed informal. This means that there is weak linkage among the three spheres of education, research and innovation suggesting that knowledge from doctoral researches at best reach the public only through PhD defenses, otherwise they largely remain within the walls of academia. Yet, the National Research and Innovation Policy encourages collaboration between higher education institutions and industries to foster innovation and address socio-economic challenges (UNCST, 2014). This scenario can be attributed to limited funding and weak implementation of institutional frameworks as posited by Kutesa and Obua (2021).

Empirically, the findings resonate with Unger and Polt (2017) who note that many higher education policy instruments still do not use an integrated approach to research, education and training. Further corroborated is the fact that the Government of Uganda (GoU) recognizes the poor exposure to industry in higher education institutions (HEIs) in Uganda reflected by a mismatch between university admissions and national skills gap (Government of Uganda, 2020, p. 160). Theoretically, this is not surprising as the findings reveal that doctoral training in Uganda has remained traditional in nature, typified by mono-disciplinarity and thus confined in specific fields of study rooted in Mode 1 knowledge production.

Indeed, traditional knowledge production is averse to application, inter-disciplinarity, multiple layers of accountability and transparency to external stakeholders in other sectors. This mode of doctoral training also eludes the dictates of the knowledge triangle framework. Moreover, this stagnation in traditional Mode 1 knowledge production in doctoral training is passionately guarded by its proponents who interpret broadening the scope of doctoral programs as diluting of the traditional hallmarks of doctoral education enshrined in the conventional, traditional PhD (Frick *et al.*, 2017). Traditional doctoral education is increasingly being supplemented, superimposed or replaced by forms of structured doctoral education (Nerad, 2020). Promoting the knowledge triangle approach by creation of synergies between education, research and innovation through linkages to the other sectors

would enhance the attainment of relevant doctoral outcomes for students and the wider society.

Conclusion and recommendations

Our findings show that the knowledge triangle concept does not play an explicit role in the strategic development of doctoral programs in Uganda. The lack of institutionalized linkages to other sectors in doctoral programs translates into lack of systemic interaction in the three spheres of education, research and innovation. Thus, mechanisms to support integrated learning and research training in collaborative academia-other sector settings by applying the knowledge triangle strategy are needed to accentuate the worthwhileness of doctorates and doctoral research outputs beyond the academia. This entails deliberate actions at the national policy level and within the framework of institutional strategy.

We recommend that at the national level, policies and funded steering mechanisms should be developed to encourage interaction between universities, research institutes, businesses and public institutions in doctoral training to link education, research and innovation; for instance, national policy frameworks for PhD placements in innovation clusters. Structures and programs for education, research and development as well as innovation must relate to each other. As such, the National Council for Higher Education should incorporate linkage to other sectors in accreditation guidelines for all doctoral programs.

Within the framework of institutional strategy, partnerships with other relevant sectors should be embedded in doctoral program design. For instance, institutionalization of joint research agendas, other sector placements and industry-on-campus models, where higher education institutions cooperate with other sectors in strategic basic research through PPP, commissioned research and links to public sector research. Institutions will need to develop strategies to tackle lack of mobility of staff between academia and other sectors, particularly by regarding mobility between the three sides of the knowledge triangle as a merit in appointing doctoral supervisors and their career advancement. This will foster co-teaching and co-supervision with partners from other sectors in doctoral programs.

We further recommend strengthening of alumni/alumnae networks by establishing doctoral alumni/alumnae offices and incorporating alumni information in the academic information management systems. PhD candidates and alumni are an important link between education, research and innovation; their role can be harnessed through improved working conditions, and appropriate funding mechanisms.

This study is not without limitations. The research data is exclusively from higher education institutions, the possibility of not comprehensively reflecting the broader perspectives from other sectors cannot be overlooked. A more comprehensive study of the dynamics of innovating doctoral education in Uganda through coherent collaboration between higher education institutions and other sectors to ensure the success of linking education, research and innovation is recommended.

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Further reading

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Corresponding author

Irene Etomaru can be contacted at: irene.etomaru@mak.ac.ug