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RESEARCH ARTICLE

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Novice researchers' perspectives on affordances in ICT4D research collaboration

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Abstract

Collaboration is fundamental to progress in the field of information and communication technologies for development (ICT4D) research where interdisciplinary teams are involved in the requirements elicitation, design, implementation and evaluation of context-sensitive digital solutions. Research collaboration harbors the potential for knowledge exchange, improving research impact and human development; it is often a requirement in grant applications for funding. Despite the known benefits and incentives, there is evidence that research collaborations between African countries are lacking compared to those with and between other geographic regions. Furthermore, *research collaboration* has been studied as a variable but theorisation of the concept is lacking. Therefore, the purpose of this paper is to theorize research collaboration as an object with affordances based on the perspective of novice researchers (master's, doctoral and postdoctoral students) in South Africa. The data capturing from a survey and focus groups with ICT4D novice researchers from different universities in South Africa produced 39 responses to be captured, transcribed and analyzed with Atlas.ti 8 using thematic analysis. The main contribution is the theorisation of research collaboration as an object with properties and then an investigation of the affordances offered to novice researchers together with the facilitating conditions and conversion factors influencing the actualisation of those affordances. The practical contribution is the insight gained into the perspectives of novice researchers as representatives of the future generation of research collaborators.

KEYWORDS
affordances, facilitating conditions in research, ICT4D, novice researchers, prerequisite conditions, research collaboration

1 | INTRODUCTION

Research collaboration in academia can be defined as a two-way process in which individuals and/or organizations share learning, ideas and experiences to produce joint scientific outcomes (Cataldi et al., 2016) through well-defined, mutually beneficial relationships (Sooryamoorthy, 2013). Research collaboration underlies the formation of multidisciplinary teams to conduct collaborative research on complex problems to achieve objectives not feasible for independent entities (Anandarajan & Anandarajan, 2010). Therefore, collaboration is essential in multi-, inter- and transdisciplinary fields such as information and communication technologies for development (ICT4D) (Walsham, 2017). National and international research collaboration is advocated for improving impact, which is measured by several criteria, including the quality of the research outputs, funding associated with research outputs and the related citations (Von Solms & Von Solms, 2010).

The United Nations Development Programme (UNDP, 2019) describes collaboration in terms of South–South cooperation and triangular cooperation. The key principles listed include a common endeavor, respect for national sovereignty, partnership among equals, mutual accountability and transparency and a multi-stakeholder approach. Walsham (2020) questions the feasibility of achieving the UNDP principles in practice and advocates the position that all information system (IS) and ICT4D researchers should be explicit about how they are contributing to the world with their engagement. We argue that this, being explicit on how researchers contribute to the world, motivates theorizing research collaboration as an object with properties that can be evaluated.

In ICT4D, the discussion on human development focuses on how humans can achieve their goals through technologies (Hatakka et al., 2019; Thapa & Zheng, 2019). This development entails progress, achieving goals and attaining outcomes that were previously seen as either challenging or even impossible. We argue for a similarity in the use of technology as an object in achieving goals and research collaboration as an object in achieving goals. Research collaboration can have different goals, including publications (Turpin, 2018), network building and knowledge acquisition (Freshwater et al., 2006). Based on journal analyzes (presented in Section 2.2), we maintain that there is a lack of theorisation on the construct of research collaboration in the field of ICT4D. Despite research collaboration's proven potential for increasing research output (Eduan, 2019), we could not find research on the collaboration of novice researchers in the ICT4D domain.

The term *novice researcher* is used to define an individual who is starting their career in research, such as teaching or research assistants, early career researchers and postgraduate students (Atkins et al., 2016; Austin & Baldwin, 1991; Maluleka et al., 2016). A novice researcher is not only new to the field but also assumed to require help in writing a research proposal, acquiring approval from the research ethics committee, collecting and analyzing data, writing a report (including a thesis or dissertation), applying for research funds from various organizations and mentoring (Atkins et al., 2016; Singh, 2011). Atkins et al. (2016) contend that many of the goals a novice researcher needs to achieve can be met by collaborating with senior researchers and colleagues, who are the potential main actors in their research collaboration. Research that has studied the distribution of researchers has found there are more novice researchers than senior researchers in sub-Saharan African countries such as Uganda (Eduan, 2019). Despite the efforts to increase publication in Africa, the scientific output has been small compared to other continents (Atkins et al., 2016). Focusing on South Africa, the same is observed in the field of information science (Maluleka et al., 2016), which is a research field included in the field of ICT4D research (Gomez et al., 2012; Turpin, 2018).

The lack of theorisation on the construct of research collaboration, coupled with the absence of research on novice researchers' collaboration, provided the rationale for this study. We consider the concept of *research collaboration* as an object and identify some properties of the object. As a theoretical premise, we propose affordance theory for guiding the theorizing of research collaboration whereby we consider the perceived affordances of research collaboration as well as the facilitating conditions and conversion factors that support the actualisation of the perceived affordances. Facilitating conditions and conversion factors are not core concepts of affordance theory. The framework combining affordances and capabilities to explain the relationship between ICT and development (Hatakka et al., 2019) does not mention the term *facilitating conditions*, but it does refer to the individual's characteristics, preconditions and the context as factors to be considered. Thapa and Sein (2018) argue that it is not affordances per se, but rather the interrelations between a variety of affordances and the actions of a group of actors who leveraged their capabilities to actualise the affordances. Thus, we found the concepts of facilitating conditions and conversion factors useful in describing the affordance actualisation process and draw on the work of Hatakka et al. (2020) in terms of incorporating both facilitating conditions and conversion factors when discussing affordances.

The research question the study addressed is: what are the affordances that research collaboration offers novice researchers in South Africa? Student supervision and co-supervision is mostly a mandatory part of the international funding application and therefore we argue that the selection of novice researchers as actors in a case study on research collaboration is justified. The discussion of other categories of researchers was beyond the scope of this study.

The main contribution of the paper is to theorize research collaboration as an object and then identify specific affordances based on the perspective of novice researchers. The theorisation of research collaboration as an object of study is relatively novel, and the insight acquired into the facilitating conditions and conversion factors that influence research collaboration should be useful in informing the design of sustainable research collaboration initiatives for novice researchers. The research contributes to the body of knowledge on research collaboration from a developing country point of view.

The next section deals with the relationship between research collaboration and affordances and is followed by an explanation of the research methodology. Affordance theory is applied in the results and findings section to the empirical evidence to structure the findings. The paper concludes with a discussion and conclusion, including direction for future research.

2 | BACKGROUND AND RATIONALE

We begin the literature review by engaging with the definition and categories of research collaboration. In Section 2.1, we interrogate the concept of research collaboration and highlight the aspects most relevant to the current study. The relevance of the application context, namely ICT4D for

investigating research collaboration, is justified in Section 2.2. In Section 2.3, we discuss affordances and why they are considered an appropriate theoretical lens.

2.1 | Research collaboration

Defining research collaboration is not a straightforward exercise as it involves several concepts and their connections (Lewis et al., 2012). Austin and Baldwin (1991, p. 5) define faculty collaboration as "a cooperative endeavour that involves common goals, coordinated efforts and outcomes or products for which the collaborators share responsibility and credit." For Maluleka et al. (2016, p. 338), research collaboration is "a process where two or more individuals or organizations deal collectively with issues that they cannot solve individually". Sonnenwald (2007, p. 645) defines a scientific (research) collaboration as an "interaction taking place within a social context among two or more scientists that facilitates the sharing of meaning and completion of tasks with respect to a mutually shared, superordinate goal". In essence, collaboration involves a project based on the interaction between a university researcher and another partner where the latter would be either another university researcher, a company representative as in the case of university-industry collaborations or an organization in the case of university collaboration with provincial and federal government agencies, local governments or other organized interest groups (Persson, 2018).

There are different approaches to categorizing a research collaboration: collaborations can be considered as theoretical (rendering advice, ideas, or criticism) or technical (providing tangible assistance in a research endeavor) (Heffner, 1981). In other cases, collaboration is categorized according to the collaborators (actors), for example, supervisors' collaboration with students (Austin & Baldwin, 1991; Subramanyam, 1983) and intra-institutional, inter-institutional or international collaboration (He et al., 2009; Naudé, 2016; Subramanyam, 1983). This introduces the actors in research collaboration as an individual, group, organization or government. Another perspective of research collaboration is based on the origin, which could be a formal agreement or it could be based on friendships (Austin & Baldwin, 1991; Lewis et al., 2012).

Globally, research collaborations are evaluated according to the respective government policies using different measures and factors to assess the use of research funding and meeting the set goals (Lewis et al., 2012). Research funding is among the motivations for researchers to engage in a research collaboration. Muriithi et al. (2018) summarize motivations for research collaboration into knowledge and resource-based factors, goal-oriented factors and social-cultural factors. Critical to all these factors is how an individual views a research collaboration and its expected outcomes.

Research collaboration with a focus on output is referred to as collaboration (upper case c) (Lewis et al., 2012). Lewis et al. (2012, p. 696) argue for the existence of another type of collaboration (lower case c) that they define as "discussion of research and ideas, feedback and commentary on research work and draft papers". The authors argue that (lower case c) collaboration is not given much attention compared to (upper case c) Collaboration when output is the focus. For this paper, we define a research collaboration as an interaction taking place between two or more individuals (or institutions) intending to share ideas, feedback and commentary to address an issue that may lead to an outcome based on one or more common goals requiring the individuals to share responsibility and credit. Should the research collaboration be among institutions, one of the institutions must be an academic institution. In the next section, we will discuss the application context, namely the field of ICT4D research.

2.2 | Research collaboration in information and communication technologies for development

The academic field of ICT4D is concerned with the use of ICTs for international development (Walsham, 2017). In the ICT4D research context, the world is geographically divided into the northern polar (also known as the Global North) and the southern polar (Global South) (Diga & May, 2016; Färnman et al., 2016; Van den Hoven & Connell, 2016). The term *Global North* represents developed countries found in the continents of North America, Europe and Australia. The Global South represents developing countries in South America, Africa and Asia.

ICT4D is diverse in terms of the disciplines from which the scholars originate and the sectors involved in the field, namely academia, industry, the public sector, civil society and others (Jonker, 2016). Historically, ICT4D emanated from the attempts of researchers and organizations in the Global North to use emerging computing technologies to improve conditions in the Global South (Heeks, 2009). The attempt was formalized through a series of reports, conferences and funding initiatives that acted as key policy-making avenues. Research collaboration has therefore been fundamental to ICT4D research and knowledge production.

A study of the representation of the scholars from the Global South in three top-level journals in the area of ICT4D found that such scholars were underrepresented in ICT4D scholarship (Bai, 2018). The findings support those of other researchers such as Naudé (2016) who investigated country productivity, collaboration behavior and citation impact of ICT4D researchers by examining articles published in the *Electronic Journal of Information Systems in Developing Countries* (*EJISDC*) over 14 years. These studies provide evidence that the contribution of southern researchers is lagging in terms of the scope and impact of their publications. A more recent study considered papers published on human-computer interaction for development (HCI4D) and confirmed the previous finding of underrepresentation, concluding that the number of first and second authors

from certain southern countries are disproportionately low compared to the number of studies (i.e., fieldwork) conducted (Van Biljon & Renaud, 2019).

The dominance of northern researchers has consequences for ICT4D research and knowledge production. Gitau et al. (2010) are of the opinion that the low output of African authors in the ICT4D field suggests that theories around the appropriate design, mechanisms of adoption and impact of ICTs in developing countries are being formed without significant influence by African scholars. Research collaborations can mitigate the negative impact on research quality and knowledge production by involving researchers from the application context. Furthermore, foreign researchers can bring much-needed resources and expertise, which could improve the local authors' research impact (Van Biljon & Renaud, 2019). Walsham (2020) supports efforts to bring together different countries and organizations to work on collaborative projects, but expresses concern that the driving force behind a particular project is not always discussed and an explicit analysis of who gains from the project and who loses is not always presented.

Considering research on the sub-Saharan African continent, Toivanen and Ponomariov (2011) investigated the structure of African research collaboration by retrieving research papers with an African address that were published between 2005 and 2009; they concluded that South Africa and Nigeria were the strongest research countries and integrative hubs in their regions (West Africa and Southern Africa). Adams et al. (2014) focused on the collaboration patterns of 50 African countries for the period 2000–2012 and found that South Africa was the research hub of Africa. A study by Naudé (2016) on the collaboration patterns in a prominent ICT4D journal, the *EJISDC*, revealed that most of the African authors were from (or working in) South Africa (37%).

A review of the prominent ICT4D journals (*EJISDC*, *ITD* and *ITID*) from 2009 to February 2020 using the English language and the word *collaboration* as the search term in the title, keywords and abstract produced 45 journal articles out of the 1133 papers considered. Having excluded manuscripts that were editorial notes and reports, we found only three articles, one from *EJISDC* and two from *ITD*, where research collaboration was considered the object of study (Muriithi et al., 2016; Van Biljon et al., 2017; Walsham, 2020). In 18 articles, collaboration was used as a variable and 24 articles viewed collaboration as a connector. We conclude that very few papers in the field of ICT4D (4%) discuss research collaboration, and even fewer (0.3%) consider collaboration as an object of investigation. The details of the review process and the outcome can be accessed in Appendix B.

Van Biljon and Naude (2018) investigated research collaboration from the perspective of South African ICT4D researchers and found the drivers to collaboration to be access to funding and resources, knowledge gains and building an international profile. The main barriers were reported to be funding, limited time and lack of administrative support in managing grants. Notably, their study involved only established researchers, a factor that could influence the responses. A study was done in South Africa by Maluleka et al. (2016) and presents evidence that the number of novice researchers in information science is higher than that of senior researchers and there is a demand for the development of their research knowledge and skills. Using Uganda as the case study, Eduan (2019) concludes that the number of novice researchers in sub-Saharan Africa is higher than that of senior researchers and measures should be taken to empower them and enhance their research development.

In summary, research collaboration as an object of investigation has not received much research attention in the ICT4D domain. South Africa has been identified as a research hub in Africa, and research collaborations from the perspective of established South African researchers have been investigated. However, the perspective of novice researchers is lacking despite their large presence in sub-Saharan African countries. These facts, together with the potential of research collaboration for human development, establish the rationale for this investigation into the perspectives of novice ICT4D researchers in South African universities regarding research collaboration.

2.3 | Affordance theory

In the context of information systems, affordances have been defined as the potential for behaviors associated with achieving an immediate concrete outcome arising from the relationship between the properties of an object and the characteristics of the goal-oriented actors (Volkoff & Strong, 2013). The concept of affordance has also been defined from two opposing viewpoints, namely the realist view (Pozzi et al., 2014) and the relational view (Volkoff & Strong, 2017).

The realist view (or material view) of affordance focuses on the presence of an affordance, irrespective of the actor realizing them, that is, without concern for who the actor is and what the actor wants to achieve with the object—actualisation (Volkoff & Strong, 2017). Pozzi et al. (2014) refer to the presence of affordances without concern for their actualisation as affordance existence and affordance perception. Thapa and Zheng (2019) contend that the realist view implies a linear causality in the sequence of existence-perception-actualisation. Burton-Jones and Grange (2013) present the realist view of affordance theory in terms of consecutive enabling mechanisms as depicted in Figure 1. Relating Figure 1 to the types of affordances, Pozzi et al. (2014) propose that the physical and sensory affordances relate to the affordance existence, the cognitive and functional affordances connect with affordance perception and the actions of the goal-oriented actor assist in affordance actualisation.

The relational view of affordances focuses on linking the object and the actor. It assumes that the object does not exist in isolation but primarily concerns the actor (Pozzi et al., 2014; Volkoff & Strong, 2017). The relational definition is premised on the presence of both the actor and

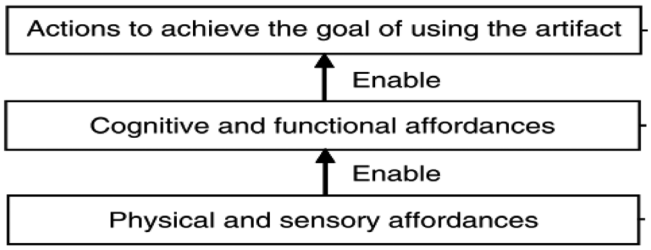

FIGURE 1 Representation of affordance theory (Burton-Jones & Grange, 2013, p. 639)

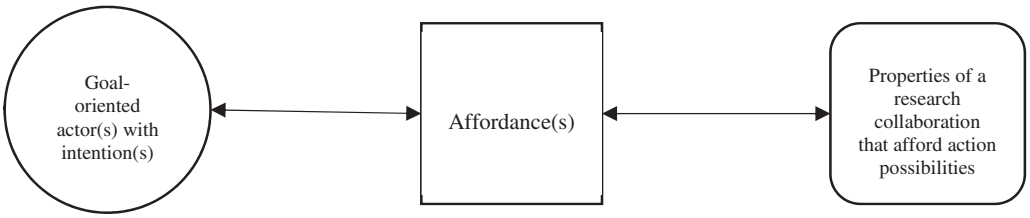

FIGURE 2 The relational view of affordance

object in a given environment, with neither able to exist in the absence of the other. Further, while the relationship is between the object and the actor, there is an acceptance that it is the actor's view of the object that may affect the affordance of the object (Pozzi et al., 2014).

The challenge we have with the linear causality is that it does not conform to the social-embedded demand as argued by Ramadani et al. (2018) which is important in ICT4D. Social-embeddedness requires comprehension "of the social situation where the technology takes place" (Ramadani et al., 2018, p. 2425). Therefore, we subscribe to the relational view of affordance as we engage with the research as relativists, focusing on the presence of novice researchers and understanding how their interactions with the technology and systems may affect the research collaborations. The relational view of affordances of research collaboration is presented in Figure 2 with novice researchers as the actors.

Affordance theory has been used in evaluating electronic medical records systems as they engage with the actualisation of technology affordances (Anderson & Robey, 2017). The theory has also been used to present an account of the telemedicine project in Nepal, leading to the extension of the theory by introducing the concept of the trajectory of affordance and allowing clustering of affordances and even development of new affordances (Thapa & Sein, 2018). Shin (2017) used (motivational) affordance theory to understand how education virtual reality systems affect users as they traverse to achieve their goals. Hatakka et al. (2020) provide an account of the role that ICT plays in study circles by using an educational project conducted in rural areas of Kenya. Volkoff and Strong (2013) used the theory to theorize IT artifacts from a critical realism philosophy, thereby providing an account of how to use a realist ontology and relativist epistemology in understanding affordances.

Affordance theory has some limitations, including the pull between realist and relativist ontologies (Oliver, 2005; Pozzi et al., 2014) and on how an affordance progresses from perception to actualisation. Thapa and Sein (2018) addressed the challenge by introducing the trajectory of affordances. Another solution has been the merger of the capabilities approach and affordance theory by Hatakka et al. (2020) to allow for the introduction of conversion factors and facilitating conditions. When considering the affordances of ICT, Hatakka et al. (2020) argue that those are not directly perceptible; they need facilitating conditions (e.g., training, appropriate information, awareness and skill development) to make them perceptible and available. The same applies to research collaboration where appropriate information and awareness (among other conditions) are required. Their argument for the need to consider limiting conversion factors when unpacking the affordances of ICT similarly applies when describing the affordances of research collaboration. We will now unpack these constructs for facilitating conditions and conversion factors.

Yidana and Maazurre (2012) investigated integrating ICTs into the teacher education curriculum and using faculty perception. They maintain that prerequisites "are the conditions that a learner (novice researcher) must satisfy before being allowed to proceed with the learning process" (p. 141). Based on our definition of research collaboration, a novice researcher can be involved in an effective research collaboration if the following facilitating conditions are met: application to undertake studies in a higher education institution is accepted, they can pay fees (as universities in Southern Africa do not have many scholarship opportunities and novice researchers depend on private finance, bursaries and loans [Nyahende, 2013; Scala, 2015]) and the university having studying and ICT facilities to assist in achieving the academic goal.

Robeyns (2005) identifies three groups of conversion factors concerning the capabilities approach, where those factors influence the relationship between a good and the functionings to achieve certain beings and doings. These groups are personal factors such as metabolism, physical condition, sex, reading skills and intelligence; social factors such as public policies, social norms, gender roles, societal hierarchies and power

relations; and environmental factors such as climate and geographical location. In terms of affordances, the concept of conversion factors applies when considering the factors that influence the actors' ability to actualise an affordance. For example, when considering research collaboration, the affordances are affected by conversion factors in the process of moving from a perception of collaboration to actualisation. The personal conversion factors include the individual abilities, knowledge and skills which affect research collaboration (Austin & Baldwin, 1991). The social conversion factors which impact the perception and actualisation of the research collaboration include the policies, social norms and research approaches compatible with the needs of the local and international communities (Atkins et al., 2016). Finally, there are environmental factors which include the geographical location of the research institution and the climate. Given the context of novice researchers in ICT4D in South Africa where resources are often limited, we aimed to identify the affordances and the related facilitating conditions and conversion factors that could support research collaboration even within resource-constrained contexts. The methodology guiding the research is now presented.

3 | RESEARCH METHODOLOGY

The philosophical assumptions that guided the study are described, the research design, data capturing and analysis strategies are justified and explained and the scope and limitations of this study are highlighted.

3.1 | Philosophical assumptions

Interpretive research holds the premise that our knowledge of reality is a social construction by human actors (Walsham, 2006). Our research focuses on understanding the research collaboration from novice researchers as participants who come from a society that can be investigated and understood as a social setting that holds sensitivity in terms of values and norms.

In the process of collecting data on research collaboration, we engaged with participants through a focus group discussion by defining different concepts put forth in explaining research collaboration, its types and operation(s) which might have affected their understanding of the concepts and their responses. The use of our preconception in data collection is centered on the principle of prejudice (Klein & Myers, 1999), which accepts that an interpretive researcher holds bias in conducting their research. The interaction between the researchers and participants is in line with the principles of interpretivism which supports "changing the perceptions of both parties" (Walsham, 1995, p. 376).

3.2 | Research design

Case study research advocates the understanding of a real-world phenomenon that involves important contextual conditions pertinent to the case (Walsham, 2006). A case study applies to this study. A case study enquiry is recommended for coping with the technically distinctive situation where there are many more variables of interest than data points; a case study relies on multiple sources of evidence, with data needing to converge in a triangulating fashion, and benefits from the prior development of theoretical propositions to guide data collection and analysis (Walsham, 2006).

As discussed, there are different approaches to research collaboration premised on different goals, but most research collaboration projects include the focus of sharing knowledge and other resources toward improving impact. In the case of novice researchers, human capacity development is always involved and then Sen's capability approach (1999) comes into play. That, however, is beyond the scope of this paper where we focus only on research collaboration as an object and the related affordances.

In the study, the objects were the set of research collaboration affordances in the evaluative space, and the sources of data included a survey and focus group discussions with novice researchers. The study benefitted from the prior development of theoretical propositions in terms of affordance theory to guide the data collection and analysis. The novice researchers undertaking master's, PhD and postdoctoral fellowships were the units of analysis. The researchers, who were selected from five different universities across South Africa, originated from different countries in Africa, including South Africa, Uganda, Kenya, Nigeria, Tanzania, Zimbabwe and Namibia.

3.3 | Data capturing and analysis

The unit of analysis was novice researchers in ICT4D where novice researcher includes teaching or research assistants, postgraduate students and early career researchers. Novice researchers have different goals when collaborating, aimed at their development as academics which includes human capacity development to various degrees. These goals include sharing and acquiring knowledge, increasing research output [documented reports, conference proceedings and journal papers], obtaining a [academic] qualification, acquiring fresh perspectives on different subjects,

support for individual growth and connecting to research networks [including those of senior researchers] (Atkins et al., 2016; Maluleka et al., 2016; Sonnenwald, 2007). Novice researchers collaborating with senior researchers provides a meaningful learning environment for both (Pyhältö et al., 2009).

Data was collected at five different sessions held between July 2019 and November 2019 with a total of 39 participants (novice researchers) comprising master's, PhD and postdoctoral fellows. The first session was a chapter launch held at the University of South Africa (Unisa), South Africa, in July 2019, which consisted of 20 novice researchers and five senior researchers. The event attracted individuals from six universities and other organizations across South Africa who were interested in ICT4D and attended presentations by a guest speaker and a director from the network sponsor.

The second session held at the beginning of September 2019 was a master's and doctoral fellows workshop at Unisa, with seven novice researchers in attendance. Likewise, the third session involved seven novice researchers from Unisa and was conducted at the end of September 2019. The fourth session was conducted in October 2019 at the Council for Scientific and Industrial Research (CSIR), with three novice researchers. While these four sessions were held in Johannesburg and Pretoria (Gauteng) and entailed physical presence in closed meeting rooms, the fifth meeting was held via Skype with two novice researchers who resided in Stellenbosch and Cape Town (Western Cape). For the fourth and fifth sessions, more than four individuals had been invited for each but only three and two individuals, respectively, were in attendance during the data collection session.

We developed an open-ended questionnaire with seven questions (see Appendix A) that elicited individual researchers' expectations of research collaboration, its challenges and the tools used in research collaboration. Notably, the questionnaire was not structured according to Figure 2, but the researchers were conscious of affordance theory and the constructs of the theory that informed the analysis. Furthermore, the researchers were aware of the presence of facilitating conditions that play a significant role in viewing research collaboration as an object. Ethical clearance was obtained from the Unisa College of Science, Engineering and Technology's (CSET) Research and Ethics Committee and the Research Permission Sub-Committee (RPSC) of the Senate Research, Innovation, Postgraduate Degrees and Commercialisation Committee (SRIPCC). Each novice researcher was requested to read and sign the ethics consent form before the questionnaire was distributed. The open-ended questionnaire was printed and handed to 37 novice researchers. The two novice researchers in the Western Cape received the questionnaire by email. All the researchers had 35 min to complete the questionnaire. The questionnaire aimed to acquire individual views and perceptions of the phenomenon of interest before the focus group discussions.

Once the researchers had completed the questionnaire, we asked them to form groups of five or more individuals so that each group included master's, doctoral and postdoctoral fellows. The first session was divided into two focus groups and the remaining sessions involved a single focus group. For 30–60 min, each focus group discussed the seven questions in the questionnaire. Each group had a coordinator who facilitated the discussion and audio recorded the interviews using a smartphone. The focus group discussions allowed novice researchers to engage with colleagues and address the questions they had answered interactively and flexibly, enabling interaction among the participants as advocated by Chen and Katz (2009).

We used thematic analysis as recommended by Braun and Clarke (2006) to analyze the focus group discussions and the completed open-ended questionnaires following an abductive approach, that is, a combination of the inductive and deductive approaches (Ahmed & Parsons, 2013). The deductive approach provided an awareness of the constructs and categories of interest, especially those resonating with Figure 2. The inductive approach used empirical data to describe the facilitating conditions. A thematic analysis consisting of six phases that allowed the researcher the flexibility to navigate back and forth among them was applied to the data (Braun & Clarke, 2006). The phases that were executed are as follows:

- The first phase entailed familiarization with the data, which began with the edited transcription of the recorded focus group discussions. The completed questionnaires were coded and scanned. A research team member transcribed the interview recordings of each focus group into Microsoft Word for 2 weeks after each session. All the transcripts (from the focus group interviews and the open-ended questionnaires) were loaded on Atlas.ti version 8, and the researchers read and actively reread the transcripts to understand the breadth and depth of each participant's contributions. Data from the focus groups are identified in Section 4 by FG and a number for each focus group (i.e., FG1, FG2, FG3, FG4, FG5 and FG6). Questionnaire data is noted as Q (for the first session), M&D (for the second session), U (for the third session), C (for the fourth session) and W (for the fifth session), followed by the number for each analyzed questionnaire given during coding.
- The second phase involved generating initial codes on the transcripts concerning a sentence or paragraph to address the research questions. The researchers studied the theory (Figure 2) before looking at the data and were thus sensitized to those concepts. Initial codes included 'challenges of research collaboration,' 'conditions for research collaboration,' 'intention to collaborate,' 'benefits of collaborations,' 'resources, policy' and 'supervisor or senior researcher.' The researchers also took notice of tension (contradictions) in the transcripts as participants engaged with the questions.
- The third phase involved searching for themes and engaging with the initial codes by collating all related and relevant data extracts. Related codes were connected using networks on Atlas.ti, and a code group was created to link them. A few initial codes were grouped as miscellaneous because they did not fit into any of the related codes. At this stage, the code groups were referred to as themes.

- The fourth phase focused on refining the code groups. Each code group was assessed for internal homogeneity and external heterogeneity. In the process, the researchers coded more data extracts based on new ideas that emerged during the reviewing of themes.
- The fifth phase involved defining and naming the themes from phase four. We used the collated data to identify their interesting characteristics and understand why they were important as a theme. Most of the existing categories were confirmed as relevant, and the theme of personal resources was added to represent the broader perspective of research collaboration.
- The sixth phase entailed producing the research report, that is, the complete data-based story that allows the reader to understand the merit and rigor of the analysis.

3.4 | Scope and limitations

Data capturing was limited to novice researchers (master's, doctoral and postdoctoral students) in the field of ICT4D who were studying at South African universities. This research considered novice researchers' perceptions of research collaboration, which concerned perceived or actualised affordances. Since the study focused on the perceived outcomes, it suffers from the limitations of self-reporting.

4 | RESULTS AND FINDINGS

All participants agreed that research collaboration depends on the perspective of the researcher, but that research collaboration affords access to new communities that could be crucial when considering publication or skills transfer. Therefore, we consider research collaboration as occurring through a combination of relational affordances composed of an object, goal-oriented actors, facilitating conditions and conversion factors. The properties listed in Section 4.1 resonate with those mentioned in the generic structure of an affordance suggested by Thapa and Sein (2018). Continuing with that generic structure, we present our empirical findings relating to affordances in Section 4.2, facilitating conditions in Section 4.3, conversion factors in Section 4.4 and a summary relating the conditions and factors to the affordances in 2.5.

4.1 | Research collaboration properties

Returning to our earlier definition of research collaboration as an interaction taking place between two or more individuals (or institutions) intending to share ideas, feedback and commentary to address an issue that may lead to an outcome based on one or more common goals requiring the individuals to share responsibility and credit, we identify goal orientation, committed actors, constructive communication and mutually acceptable sharing as fundamental properties of research collaboration. Each of those is now discussed in more detail and supported by evidence from our findings.

- Goal orientation can be perceived as an engagement with a specific end goal, or rather something more loosely defined such as the feedback and commentary on research work. The goal of research collaboration is also a fundamental part as confirmed by the quotation from the Focus Group 4 session:

> I think it depends on which perspectives you are looking at. Is it on the final product or what? Like right now, I feel like what is the reason why [we] are collaborating? Is it because [of] getting the publication output, the issue of skill transfer or getting more knowledge, creating or maintaining the relationships, or to improve your visibility? For already established people, you know that they prepare for the higher-ranking journal community, and changing the focus (e.g., from conferences) then learn how to publish in a journal. FG4

- Committed actors are two or more individuals with a common interest or representatives of institutions with one or more common goals. The collaboration network includes actors such as supervisors, mentors or peer researchers who support novice researchers in attaining their goals. Working in a university establishment allows novice researchers to interact with colleagues, supervisors, practitioners and librarians and to access other departments through which they can attend workshops, seminars and symposiums, assist during conferences and connect with the industry. Through these interactions, the communities provide novice researchers with an opportunity for a general view of their field of study. This was confirmed by our findings as represented by RC02, M&D3 and FG6:

> … a great idea and a new experience since it [research collaboration] involve both, experienced and naïve [novice] researchers. RC02

> Collaborating amongst all parties help to identify problem areas earlier and the different areas of focus (supervisor, mentees and students) often highlight the problem areas before it is put down on paper (chapters). M&D3

> … be the subject matter experts involved in the collaboration, not necessarily a professor of computer science but someone from the industry who is [has] been involved in whatever field that we are trying to research on so that some kind of guidance from industry is provided so that the research that we are doing is on track and is relevant. FG6

- Constructive communication is the multi-layered mechanism that facilitates the exchange of different types of information in different formats and protocols. Communication includes the different technologies used to relay messages among actors in research collaboration, such as instant messaging applications, emails, cloud storage facilities and referencing tools. Furthermore, communication is inclusive of activities such as workshops where actors participate and engage in discussions to ensure that the collaboration goals are attained. This is also a fundamental part of research collaboration as confirmed by C3, RC03 and M&D4. The need to have a clear and honest conversation was emphasized by Focus Group 4 as a requirement for communication:

> Everyone should be able to communicate their expectation from each other. Roles and responsibilities should be clearly defined and shared with all people involved. C3

> From an idea generation point of view, we shall make use of WhatsApp and Skype more frequently as they become the repositories of the ideas and Mendeley becomes the execution platform of ideas generated. The ideas have more substance than the execution which is usually confined to academic writing. RC03

> More frequent interaction and collaboration increase participant trust in the process thus allowing for a more honest interaction. Occasional face-to-face meetings ensure that participants are more comfortable. M&D4

> The time or synchronizing time. If you work into yours [section of the manuscript] is okay. You know you can do yours then the person can add this [respective section of the manuscript] tomorrow but even then you got to wait for them. You don't get the conversation running. FG4

- Mutually acceptable sharing of responsibility and credit is a basic mechanism of all research collaboration. Research collaboration is expected to offer access to material and intellectual resources toward improving the impact of the research. The main interest for novice researchers, as for senior researchers, is producing research that is of high quality as part of their development. This argument was supported by C3, RC03 and RC15:

> Roles and responsibilities should be clearly defined and shared with all people involved. C3

> The alignment of true intentions, the furtherance of research work in the field with expected outcomes from the collaboration. Transparency from the onset is critical in the production of quality work that tackles the real socio-economic problems in developing countries. RC03

> The ability to share challenges that need to be addressed particularly looking at ICT innovation to support township and rural economies. RC15

4.2 | Affordances of research collaboration

Research collaboration can provide affordances to improve researchers' progress with their studies, output and impact. As discussed in Sections 4.3 and 4.4, there are facilitating conditions and conversion factors that influence the conversion of a perceived affordance to actualisation. For example, a person needs to be registered for a master's degree (at minimum) to be considered a novice researcher, so the master's registration is a prerequisite and the individual's competencies will be the facilitating condition. In practice, this means that research collaboration can only provide the affordance (perceived) if the facilitating conditions are met, while the conversion factors influence the actualisation of the affordance. Based on our findings we identified four affordances of research collaboration and now present those together with their goal-oriented actors. Because we are focusing on novice researchers, it should be noted that facilitating conditions (as discussed in Section 4.3) apply to all affordances, but the conversion factors (as discussed in Section 4.4) are more specific. Table 1 (at the end of Section 4.4) provides a summary of the facilitating conditions and the conversion. How the conversion factors related to specific affordances are discussed in Section 4.5.

4.2.1 | Perceived affordance: Postgraduate qualification

The goal-oriented actors are the novice researcher (student), supervisor(s) and collaborator(s). The completion of a qualification helps a novice researcher to actualise the affordance through graduation.

4.2.2 | Perceived affordance: Writing manuscripts

The goal-oriented actors are the novice researcher (student), supervisor(s), reviewers and collaborator(s). The actualised affordance from research output is a publication in the form of either a journal paper or conference proceeding.

4.2.3 | Perceived affordance: Social networking

The goal-oriented actors are the novice researcher (student) and the collaborator(s) who form the social network. The actualised affordance from networking is the novice researcher's career advancement.

4.2.4 | Perceived affordance: Advancement of skills

The goal-oriented actors are the novice researcher (student), supervisor(s) and collaborator(s). The actualised affordance of the advancement of skills is capacity development.

4.3 | Facilitating conditions

There are several conditions without which research collaboration and the actualisation of an affordance are not possible. These include the provision of educational (academic), financial and material resources as detailed in the following three sections.

4.3.1 | Educational resources

Educational resources encompass the academic material provided by the academic institution for novice researchers. The resources include the library, study material, educational content and administration. For academic institutions in which the administration assists novice researchers in registering quickly and gaining access to different study material, the novice researchers surveyed spoke about research collaboration as an idea in which they were engaging and were willing to engage in the future. However, for academic institutions in which the administration takes considerable time to register students and delays their access to study material, the library and other educational content, the novice researchers surveyed were reserved. RC03 provides an account of educational institutions that limit the success of novice researchers due to bureaucracy:

> There can be impediments in the process of discoveries as institutional bureaucracy will dictate the shape and form of the research work resulting in many lost opportunities. RC03

The entry requirements for a master's degree that focuses on ICT4D are almost the same among higher education institutions in South Africa. The application for a master's degree in ICT is accompanied by the expectation that the student has completed an honors degree (four-year degree) in the field with an academic average of at least 65% or has completed a bachelor's degree and acquired experience in the ICT industry or academia. For a PhD application, the expectations are that the applicant has completed a master's degree in ICT (or a related field) with an academic average of at least 60% and acquired considerable experience in the industry or academia.

4.3.2 | Financial resources

The novice researchers had an extensive discussion on the issue of funding and viewed funding as an essential component of most collaborative research projects. Funding for novice researchers begins with paying study fees. In Southern African universities, few postgraduate students are

awarded bursaries, scholarships or fellowships that assist in paying tuition fees (or study fees). Payment of study fees provides a novice researcher with not only the registration rights but also access to databases and other academic material that would be expensive if paid for by the researcher. However, some academic institutions struggle to collate sufficient study fees to pay for access to journals and databases, as explained in Focus Group 2:

> It is difficult to have fundamental access to resources, journals, journals' database, etc. Students cannot access because institutions cannot afford into the journals. All they do is doing profit. But we can't read our colleagues work. FG2

4.3.3 | Material resources

Material resources include the physical institutional facilities that will assist a novice researcher in achieving the aims of research collaboration, such as rooms for meetings and events and ICT infrastructure.

> Endnote is a great referencing system although requires licensing. C1

Among the material resources identified in C1 was the need for licensing. As part of the tools given by the academic institutions, novice researchers require software that will assist them in conducting research, and this software must be licensed to experience its full potential.

4.4 | Conversion factors

Conversion factors are premised on the fact that the basic resources are available to ensure the facilitating conditions, for example, the student is registered for the postgraduate degree and has a supervisor. The discussion is about the factors that support the actualisation of the affordances, the most important of which is to obtain the degree (see Section 4.4 for the identification of the affordances). Following Robeyns (2005), the conversion factors are categorized under personal, social and institutional.

4.4.1 | Personal factors

Based on our findings, some personal resources were confirmed, and they relate to the properties conducive to collaboration. The research environment in South Africa requires one to be mindful of the different cultures, norms and wisdom during a research collaboration. As expressed by Focus Groups 1, 2 and 4, culture sensitivity includes issues related to colleague interaction, attention to detail, arrival times for meetings, gender sensitivity when considering publication and race accommodation.

> I think we have different cultures in general. I think it's good because it neutralises the bias. If I publish and not mention you, then you would be neutralised. But if you are from my culture, you will understand that women don't do partnership. FG1

> Culture, practice and the way you do things. For example, when there are meetings, people come late, and it is a disrespecting to others. FG2

> There was another supervisor in our school who was working with a Chinese student. The supervisor was surprised when a student was saying 'Okay' repeatedly to every explanation. Up until the supervisor is asking that I am asking but you are not contributing. Then the student answered by saying, 'I grew up in a culture where you are not supposed to respond to elders. If an elder is saying something, I must take it even if I am not accepting whether I agree or disagree. I am not allowed to challenge the elders. So the way I respond to you, it is the way I grew up.' FG4

Commitment was an issue raised by novice researchers as important when involved in research collaborations. As part of the commitment, novice researchers expect colleagues to understand their roles and responsibilities and be active in the collaboration, as evidenced in Q11:

> I would generally expect the collaborators to be active in providing input and to assume responsibility for their roles. Q11

Expertise is necessary when engaging in research collaboration because different parties with extensive knowledge contribute toward achieving the goal of the research collaboration, as narrated in Q06.

> Each party should represent an aspect of knowledge that they are familiar with or have expertise. Q06

Perceived benefits in a research collaboration that the novice researchers discussed include knowledge sharing, intellectual benefits and financial benefits that enable conference attendance and connection to other researchers and communities. Q09 captures a novice researcher's perceived benefit of research collaboration:

> I believe that should I do a collaboration with [my] supervisor, for example, I would gain from their expertise and I would contribute in sharing knowledge. Q09

Ethics is fundamental to novice researchers. In every research collaboration, researchers must be transparent and account for their roles. The research collaboration is thus space not only to share knowledge and build networks but also to ensure that ethical requirements are met, as expressed in Focus Groups 4 and 6. Also, the novice researchers recognized that ethics application is time-consuming and requires extra effort for approval to be awarded.

> Ethical sustainability is people collaborating have pure benefits. For me, that is ethical collaboration and both people are learning from each other, and you have an agreement that if I do more, then I will be the main authors. You know that type of situations. FG4

> For institutional requirements and practices, the main requirement is the ethical clearance and is standardised in many research institutions in South Africa; the way you obtain should be correct. FG6

The degree of criticality is based on the fact that novice researchers expect colleagues in the research collaboration space to understand that each member may come from a different field, and this may affect the understanding of concepts and the collaboration process. Among the issues raised was understanding that collaborators from computer science departments may not be equipped to write a research paper, as evidenced in the discussion by the M&D group. C2 argues that collaborators should understand that language and comprehension of theories might not be clear to other colleagues.

> We all come from different backgrounds with a variety of languages. English on its own poses challenges to many of the researchers in terms of how you receive the message as well as the actual interpretation of the message. C2

> Research in itself is a challenge. Most of us are from computing [Computer Science] background. The mind shifting from technical writing to research writing is big. M&D

The personal resources that the novice researchers considered when discussing research collaborations include cultural sensitivity, commitment, experience, perceived benefits, ethics and the degree of criticality. These assist in understanding individuals' ability to collaborate and the issues that may affect their effort in the collaborative space.

Time

The novice researchers indicated that a research collaboration requires time to attend meetings, engage with the writing and deal with the data. Some of the novice researchers worked full time and had families, and time constraints due to these responsibilities hampered their availability to attend collaboration meetings, as noted in the M&D group.

> I expect to know what my responsibilities are as well as any due dates for work done. Communication between me and my supervisor should be regular and timeous. C3

> It is a challenge to take time to attend collaboration sessions as it implies lost income if working based on hourly remuneration. M&D

Thus, the novice researchers viewed on-time feedback as relevant to achieve a workable research collaboration. On-time feedback could include the feedback from a supervisor as documented in C3 or the sharing of resources as agreed upon in a meeting.

Expectations

A novice researcher expects a research collaboration to assist in addressing the objective of the research and learning and sharing their views voluntarily and flexibly, as expressed by Focus Group 4:

> Back to the objectives of the research, I think when you are in an in-volunteering situation, I feel like there is no room for the discussion of the objectives. It is different when it is a volunteering situation. With volunteering space, you have a system that allows you to do things. That creates flexibility. FG4

The novice researchers noted that they were flexible when engaged in a voluntary research collaboration.

Institutional requirements

Institutional requirements relate to the research policies guiding the credits and rewards for joint publications, external supervision and collaboration programmes such as visiting researchers. One of the novice researchers in Focus Group 2 explained that novice researchers would prefer knowing the expected standards and qualities in marking research papers, that is, theses or dissertations.

> So if I get an external Wits [the University of Witwatersrand] perspective and maybe my paper is going to be marked by a Wits lecturer, I mean it is quite beneficial for me to sort of understand how do Wits perceive writing styles or expectations out of your research paper. Unless if there is a standard in research on how you should research terms of what is expected. FG2

> Like the issue you pointing out of students not getting informed about certain things, I find that a lot of time maybe we tend not to read through the websites, etc. because a lot of information is there but we tend to mostly rely on what did the person next to me say. FG2

The novice researchers reminded each other to read the official university documents and visit the websites to obtain important information about financing, research quality and standards, as explained by Focus Group 2.

Knowledge resources

The novice researchers noted that perceived capability influences the roles assigned to individuals in collaborative projects. A novice researcher that lacks experience and publications, has limited research networks and is ill-equipped to operate in a multi-disciplinary collaborative team was cited as a barrier to possible research collaboration, as explained in Focus Group 2:

> The challenge that I think we are experiencing as emerging researchers—you will find that the people who are already well established do not want to collaborate with us because the information is only going in one direction; they don't gain anything. FG2

Knowledge sharing was proposed as a morale booster for novice researchers by Focus Group 2 because it can test new ideas, concepts or arguments and to acquire feedback that will assist them in understanding their area of specialization.

4.4.2 | Social factors

The enabling structure depends on the social structure provided by the institution with which a novice researcher is registered and to which they are exposed. Thus the social structure includes the influence of policies, supervision practices and access to collaborators.

Policies or programmes

The presence of some policies and procedures was identified as a hindrance to collaboration by Focus Group 5. However, novice researchers from Focus Groups 1 and 2 counteracted the hindrance by stating that there was a need for supervisors to explain to the novice researchers what was expected of them.

> I think it depends on which institution you went for and what type of relationship you have with your supervisor. Like you may sit down with your supervisor discuss what is it that you are expecting to do. Then the supervisor explains what is it that he is expecting and what he is not expecting. After that, a student is supposed to attend a policy session to familiarise himself with the policies for the institution as a student. FG1

> Sometimes, different institutions have different requirements on how things are done and how the research will be managed. For example, at UCT [the University of Cape Town], there is a policy where everything you have done, interviews etc., all belongs to the university. When you are working with the communities or maybe you are collaborating with a different organisation[s], everything is confidential and you are not allowed to share with anyone else. FG2

> Policies and procedures hinder a lot of progress through collaborations. FG5

When novice researchers enroll in an academic institution in South Africa, among the documents they are given as educational resources are the university policies in either hard or soft copy. The procedures are also explained in educational resources.

Research collaboration programmes are fostered in universities through the development of programmes or partnering with institutions and organizations that create special programmes. The culture of universities partnering with other institutions and organizations promotes the offering of funds to novice researchers as stipends, fellowships or scholarships. Furthermore, some organizations such as IPID offer opportunities for novice researchers to travel and attend conferences where they develop social networks.

> For example, how can I put together a solution without understanding the background? If we are implementing [an] immunisation programme in Kenya, I need someone with an understanding of that actual cultural background for me to put a research project together. FG6

One of the participants in Focus Group 6 provided an example of a research collaboration programme. In this case, the novice researchers insisted that for the research collaboration to work, they needed to embrace not only cultural sensitivity (from enabling resources) but also another researcher who knew the context.

Mentor/supervisor

The novice researchers surveyed knew that their mentors or supervisors would provide expertise in shaping the research collaboration and, in turn, they expected to contribute the knowledge they had. Novice researchers, especially those interested in new research areas, assist their supervisors and mentors in learning about new research fields through the research they conduct.

> There was another supervisor in our school who was working with a Chinese student. The supervisor was surprised when a student was saying 'Okay' repeatedly to every explanation. Up until the supervisor is asking that I am asking but you are not contributing. Then the student answered by saying, 'I grew up in a culture where you are not supposed to respond to elders. If an elder is saying something, I must take it even if I am not accepting whether I agree or disagree. I am not allowed to challenge the elders. So the way I respond to you it is the way I grew up.' FG2

Research collaborators (such as supervisors) are urged to be sensitive to different cultures, as noted by Focus Group 2.

Collaborator

A research collaboration requires participants who are committed to meeting objectives through some form of volunteering. Through this voluntary approach, each collaborator is expected to be vested in the research collaboration, as explained by Focus Group 1:

> Because when you talk about collaboration is not something to foster; there is some level of volunteering to be a collaborator. FG1

The common ground between collaborators was identified as an important aspect to consider in a research collaboration. The common ground among collaborators begins by having participants who are committed and willing to achieve the perceived benefits of a research collaboration through teamwork, as expressed in Q02.

> It will be more successful as long as we work towards a common goal. It will give an advantage since it is a teamwork. Q02

Complementarity is important in a research collaboration. Focus Group 4 considered publication as one of the outputs of research collaboration in which researchers complement each other in producing an output:

> For instance, if I am expected to produce points alone and I can't. But if I collaborate, the other collaborator will show greediness, but we divide the points. FG4

4.4.3 | Environmental factors

The novice researchers expected the academic institution to create an environment for them to achieve their expectations, which included sound institutional support from departmental level to university level. They regarded having in-house editing for students' manuscripts as an enabling resource as not only did this allow an independent person to read their work and have a general discussion on it, but also provided them with an opportunity to expand their writing abilities. Together with the material resources, novice researchers explained that the institutional support assisted them in conducting scientific research, publishing and graduating. Being in a department that promotes publication in A-rated journals and attendance of high-ranked conferences helps novice researchers to increase their publication count and they view it as an additional motive for their engagement in a research collaboration.

4.5 | Summary

4.5.1 | Perceived affordance: Postgraduate qualification

Obtaining a postgraduate qualification seemed to be the primary objective of the novice researchers in our sample and for some participants, their idea of collaboration was limited to their interaction with their supervisors. Throughout their studies, novice researchers either meet the supervisor(s) face-to-face or through the use of technology and innovations which afford them a communication platform. Besides communication, novice researchers use technology and innovation to access document creation and editing tools, data analysis tools and referencing tools. The learning management systems (LMS) are crucial as each submitted thesis or dissertation has to be checked for plagiarism through Turnitin, a tool that academic institutions have integrated with LMS.

Novice researchers registering for a postgraduate qualification are committed to engaging in all activities that will assist in completing their studies. The researchers perceive that they will benefit in their interaction with supervisors, who also assist them in meeting ethical standards. The degree of criticality is attained when novice researchers engage with other disciplines through attending events that aid in learning and acquiring skills they would not have access to in their department. The department plays a vital role by inviting renowned senior researchers to conduct workshops or seminars. The senior researchers also play the mentor role by giving initial feedback on questions raised by novice researchers and in some cases reading their research work. Apart from the departments, the institutional requirements are important as they set standards that novice researchers have to meet in ensuring that their research work is worth examination when submitted to the higher degrees body. The higher degrees body and examiners were other actors that the novice researchers surveyed discussed.

On-time feedback will assist novice researchers in progressing quicker and completing their studies. Meanwhile, some novice researchers want to get to know the field and thus they might take longer to complete the qualification. The completion of a qualification helps a novice researcher to actualise the affordance through graduation.

4.5.2 | Perceived affordance: Writing manuscripts

The process of writing manuscripts is important for novice researchers because not only is their morale boosted once they publish, but the outputs also provide the opportunity to engage in a research collaboration following scientific and verified approaches. Novice researchers understand that graduating is among the research outputs required and in the process, they will build social networks with which they may collaborate

TABLE 1 Facilitating conditions and conversion factors in research collaboration

Facilitating conditions	Conversion factors	
Educational resources • Entry requirements (master's/PhD) • Study material • Library • Administration • Educational content Financial resources • Study fees Material resources • Institutional facilities (space for meetings and events) • ICT infrastructure (license) • Computing devices and internet access	Personal • Cultural sensitivity • Commitment • Experience • Perceived benefits (intellectual, financial, connectedness) • Ethics (accountability and transparency) • Degree of criticality • Knowledge resources • Time • Expectations Institutional requirements Environmental factors	Policies/programmes • A institutional or inter-institutional research collaboration programme (e.g., IPID) Mentor/supervisor • Encourages research collaboration Collaborator • Common ground • Complementary role

in future. To publish, novice researchers need to understand the role of university policies, ethical requirements and the degree of criticality expected. Furthermore, many novice researchers believe that financial resources are required to produce quality research outputs. The additional finances assist novice researchers in traveling to conferences that will publish their manuscripts in reputable conference proceedings or request extension and publish in journals. The department and supervisor play a crucial role in helping novice researchers to identify publication avenues that are within the department and institutional requirements.

The perceived benefit of research outputs for novice researchers is to get exposure on how to publish their research work. The publications in some cases might be in different fields and thus the degree of criticality is expected. Through publications, novice researchers receive on-time feedback from reviewers (as actors) on their research, which affects the approach to the dissertation or thesis. The networking opportunities and increased feedback received by the novice researchers who published are examples of how the actualisation of affordances leads to the emergence of new affordances. To complete the manuscripts, novice researchers use different technology tools such as those for document creation and editing, data analysis, communication tools and referencing tools. The actualised affordance from research output is a publication in the form of either a journal paper or a paper in conference proceedings.

4.5.3 | Perceived affordance: Social networking

In the process of engaging with the postgraduate registration and research outputs, novice researchers socialize and build networks. Engaging with collaborators' demographics, practices and cultures is rewarding but challenging and requires personal, financial, environmental and knowledge resources. Our thematic analysis identified personal properties that the specific group found important such as cultural sensitivity, commitment, experience, being sensitive to one another and the degree of criticality.

Environmental factors, such as the department inviting senior researchers and journal editors (actors), help novice researchers to understand the required standards in a specific journal and how to organize the time for submission, including the time it takes to get feedback. Novice researchers gaining access to editors and senior researchers is part of building their network and realizing expectations.

Novice researchers meet editors and reviewers in conferences where they discuss their research and this could lead to joining a working group or in some cases being asked to be a reviewer for a conference or journal. The results of a research collaboration extend to providing novice researchers with opportunities that include career advancement. Much of the novice researcher's publications during a qualification are done with input from the supervisor, with technology assisting in communication. The actualised affordance from networking is the novice researcher's career advancement through obtaining a better position or simply having a rich, diverse and supportive social network.

4.5.4 | Perceived affordance: Advancement of skills

The research skills that novice researchers acquire and share in a research collaboration depend on several resources. Among the resources are finances, time, technologies and the need to manage expectations. Thus, well-structured policies are considered a tool that assists novice researchers in engaging in research collaborations. Supervisors also assist in the acquisition of research skills because they provide experience and a degree of criticality.

The interaction with editors, senior researchers, mentors and collaborators allows novice researchers to acquire knowledge that would have been difficult to acquire if they only collaborated with their supervisors. The environmental factors and institutional requirements help novice researchers to share their knowledge in a safe and research-friendly environment where feedback and constructing ideas are critical. The perceived affordance of the advancement of skills is capacity development.

5 | DISCUSSION

We found affordance theory appropriate for theorizing research collaboration as an object and the insights gathered from the novice researchers assisted in understanding what facilitating conditions are required in the actualisation of the perceived affordances and what the limiting conversion factors are. The need for facilitating conditions in research when dealing with affordances is also discussed by Dunleavy et al. (2009) and Thapa and Sein (2018). Dunleavy et al. (2009) focus on the application of augmented reality simulations for teaching and learning and employ affordance theory to explain the actor and object interaction. To ensure that the affordances of research collaboration are successful in achieving their goals, close attention must be paid to the facilitating conditions in research, and the limiting factors must be addressed.

The actualised affordance of graduation can be considered as evidence of human capacity development. Novice researchers view the actualised affordance of publication as central to research collaboration and strive to achieve it by submitting manuscripts to conferences and

journals. Sooryamoorthy (2013), having investigated research on scientific collaboration in South Africa, argues that the country has made it their mission for researchers to collaborate and one of the incentives is publication.

Novice researchers develop social networks with other researchers through colleagues of their supervisors, mentors and collaborators, or events such as conferences, workshops, seminars and symposiums. These networks assist novice researchers in graduating and publishing by providing feedback and sharing knowledge. Furthermore, the networks assist novice researchers in realizing the actualised affordance of career advancement, as explained by Bozeman and Corley (2004) when investigating scientific collaboration strategies.

The affordance of knowledge generation shows that participants' interactions with other novice researchers often involved knowledge sharing and academic and technical support normally associated with research collaboration, and aimed at assisting one another in finishing their studies but without clear publication expectations, that is, the collaboration referred to by Lewis et al. (2012). This could be attributed to the *ubuntu* culture (Lutz, 2009; Nussbaum, 2003) found in parts of Africa in which people share resources without an immediate, direct expectation of reciprocity. Even though the actors may not express a clear outcome or quid pro quo, their involvement and interest in supporting other researchers lead to the actualisation of capacity development.

Hatakka et al. (2019) maintain that affordances center around the action possibilities of the object and goal-oriented actors, whereas the theory pays less attention to the outcome of actualisation on the socio-cultural and individualized factors that can enable or inhibit the affordance from being perceived and actualised. Therefore, more research is needed to investigate the socio-cultural and individualized impacts of research collaboration. On a sampling level, the fact that the participants were all from universities situated in the Gauteng and Western Cape provinces (two of the nine South African provinces) is a limitation. In mitigation, at least some of the participants were citizens of other African countries. Postgraduate students in the field of ICT4D are assumed to have had exposure to ICTs and knowledge and skills on a level that may have influenced the reporting.

A general observation from the focus groups is that the novice researchers found it difficult to conceive of independent research collaboration beyond their relationships with their supervisors. In research discussing joint doctoral supervision, Van den Hoven and Connell (2016) show that the student-supervisor research collaboration is common but recommend that proper structures be available to help novice researchers operate independently. These findings have implications for planning research collaborations; while it could be advisable to support student independence, our findings indicate that the supervisor needs to be considered and, where possible, accommodated in the collaboration strategy.

6 | CONCLUSION

This paper draws on affordance theory to improve our understanding of research collaboration by considering the perspectives of novice ICT4D researchers in South Africa. The main contribution of the study was to theorize research collaboration in terms of affordance theory. Research collaboration is presented as an object with affordances and novice researchers as goal-oriented actors striving toward the actualisation of perceived affordances. The empirical findings contribute to the identification of facilitating conditions and conversion factors that influence the actualisation of the perceived affordances. We identified the perceived affordances of *postgraduate qualification*, *research output*, *social networks* and *research skills* that we mapped to the actualised affordances of *graduation*, *publication*, *career development* and *capacity development*, respectively. The use of facilitating conditions and conversion factors originated from the capabilities approach. However, we found these constructs appropriate in theorizing research collaboration in terms of affordances and thereby build on recent work by Hatakka et al. (2020) on applying affordances. The practical contribution lies in the explanation of the novice researcher's approach to research collaboration in terms of the facilitating conditions and conversion factors that influence the actualisation of the perceived affordances. Lastly, the research contributes to expanding the limited body of knowledge on research collaboration from a developing country perspective.

More research is needed to verify the generalisability of the findings, especially the conditions beyond South African ICT4D novice researchers by also including other stakeholders such as senior researchers (supervisors) and university management. Technical colleges that have been converted to universities and universities outside Gauteng and Western Cape should be included to understand the challenges and opportunities of research collaboration in those spaces.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request from the corresponding author. The data are not publicly available due to privacy or ethical restrictions.

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REFERENCES

Adams, J., Gurney, K., Hook, D., & Leydesdorff, L. (2014). International collaboration clusters in Africa. *Scientometrics*, *98*(1), 547–556.

Ahmed, S., & Parsons, D. (2013). Abductive science inquiry using mobile devices in the classroom. *Computers & Education*, *63*, 62–72.

Anandarajan, A., & Anandarajan, M. (2010). An overview of e-research collaboration. In *E-Research collaboration* (pp. 3–13). Springer.

Anderson, C., & Robey, D. (2017). Affordance potency: Explaining the actualization of technology affordances. *Information and Organization*, *27*(2), 100–115.

Atkins, S., Marsden, S., Diwan, V., & Zwarenstein, M. (2016). North-south collaboration and capacity development in global health research in low- and middle-income countries - the ARCADE projects. *Global Health Action*, *9*(1), 30524. https://doi.org/10.3402/GHA.V9.30524

Austin, A. E., & Baldwin, R. G. (1991). *Faculty collaboration: Enhancing the quality of scholarship and teaching*. ERIC Clearinghouse on Higher Education.

Bai, Y. (2018). Has the global south become a playground for Western scholars in information and communication technologies. *Scientometrics*, *116*(3), 2139–2153.

Bozeman, B., & Corley, E. (2004). Scientists' collaboration strategies: Implications for scientific and technical human capital. *Research Policy*, *33*, 599–616.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101.

Burton-Jones, A., & Grange, C. (2013). From use to effective use: A representation theory perspective. *Information Systems Research*, *24*(3), 632–658.

Cataldi, M., Caro, L., & Schifanella, C. (2016). *Ranking researchers through collaboration pattern analysis*. Joint European Conference on Machine Learning and Knowledge Discovery in Databases. pp. 50–54.

Chen, Y., & Katz, J. E. (2009). Extending family to school life: College students' use of the mobile phone. *International Journal of Human-Computer Studies*, *67*(2), 179–191.

Diga, K., & May, J. (2016). The ICT ecosystem: The application, usefulness, and future of an evolving concept. *Information Technology for Development*, *22* (sup1), 1–6.

Dunleavy, M., Dede, C., & Mitchell, R. (2009). Affordances and limitations of immersive participatory augmented reality simulations for teaching and learning. *Journal of Science Education and Technology*, *18*(1), 7–22.

Eduan, W. (2019). Influence of study abroad factors on international research collaboration: Evidence from higher education academics in sub-Saharan Africa. *Studies in Higher Education*, *44*(4), 774–785.

Färnman, R., Diwan, V., Zwarenstein, M., & Atkins, S. (2016). Successes and challenges of north-south partnerships - key lessons from the African/Asian regional capacity development projects. *Global Health Action*, *9*(1), 1–10.

Freshwater, D., Sherwood, G., & Drury, V. (2006). International research collaboration: Issues, benefits and challenges of the global network. *Journal of Research in Nursing*, *11*(4), 295–303.

Gitau, S., Plantinga, P., & Diga, K. (2010). *ICTD research by Africans*: *Origins*, *interests and impact*. Fourth International Conference on Information and Communication Technologies and Development (ICTD 2010).

Gomez, R., Baron, L. F., & Fiore-Silfvast, B. (2012). *The changing field of ICTD*: *Content analysis of research published in selected journals and conference*, *2000-2010*. Proceedings of the fifth international conference on information and communication technologies and development. pp. 65–74.

Hatakka, M., Sæbø, O., & Thapa, D. (2019). A framework to explain the relation between ICT and development: Combining affordances and the capability approach. In P. Nielsen & H. C. Kimaro (Eds.), *Information and Communication Technologies for Development: 15th IFIP WG 9.4 International Conference* (pp. 60–71). Springer Nature.

Hatakka, M., Thapa, D., & Sæbø, Ø. (2020). Understanding the role of ICT and study circles in enabling economic opportunities: Lessons learned from an educational project in Kenya. *Information Systems Journal*, *30*(4), 664–698.

He, Z. L., Geng, X. S., & Campbell-Hunt, C. (2009). Research collaboration and research output: A longitudinal study of 65 biomedical scientists in a New Zealand university. *Research Policy*, *38*(2), 306–317.

Heeks, R. (2009). *The ICT4D 2.0 manifesto*: *Where next for ICTs and international development?* Development informatics, working paper series (Issue 42). https://doi.org/10.1016/0736-5853(84)90003-0

Heffner, A. G. (1981). Funded research, multiple authorship, and subauthorship collaboration in four disciplines. *Scientometrics*, *3*(1), 5–12.

Jonker, J. W. (2016). *A comparative analysis of development theories in ICTD research from developed and developing countries*. Stellenbosch University.

Klein, H. K., & Myers, M. D. (1999). A set of principles for conducting and evaluating interpretive field studies in information systems. *MIS Quarterly*, *23*(1), 67–93.

Lewis, J. M., Ross, S., & Holden, T. (2012). The how and why of academic collaboration: Disciplinary differences and policy implications. *Higher Education*, *64*(5), 693–708.

Lutz, D. W. (2009). African Ubuntu philosophy and global management. *Journal of Business Ethics*, *84*(3 SUPPL), 313–328.

Maluleka, J. R., Onyancha, O. B., & Ajiferuke, I. (2016). Factors influencing research collaboration in LIS schools in South Africa. *Scientometrics*, *107*(2), 337–355.

Muriithi, P., Horner, D., & Pemberton, L. (2016). Factors contributing to adoption and use of information and communication technologies within research collaborations in Kenya. *Information Technology for Development*, *22*(Sup1), 84–100.

Muriithi, P., Horner, D., Pemberton, L., & Wao, H. (2018). Factors influencing research collaborations in Kenyan universities. *Research Policy*, *47*(1), 88–97.

Naudé, F. (2016). Country trends and scholarly collaboration in the ICT4D research community 2000-2013: A single journal study. *Electronic Journal of Information Systems in Developing Countries*, *72*(1), 1–26.

Nussbaum, B. (2003). African culture and Ubuntu: Reflections of a south African in America. *World Business Academy*, *17*(1), 1–12.

Nyahende, V. R. (2013). The success of students' loans in financing higher education in Tanzania. *Higher Education Studies*, *3*(3), 47–61.

Oliver, M. (2005). The problem with affordance. *E-Learning and Digital Media*, *2*(4), 402–413.

Persson, J. (2018). *Talking collaboration*: *Conceptualizing collaborative research for sustainable development in theory and practice*. Uppsala.

Pozzi, G., Pigni, F., & Vitari, C. (2014). *Affordance theory in the IS discipline*: *A review and synthesis of the literature*. Twentieth Americas Conference on Information Systems 2014 Proceedings. pp. 1–12.

Pyhältö, K., Stubb, J., & Lonka, K. (2009). Developing scholarly communities as learning environments for doctoral students. *International Journal for Academic Development*, *14*(3), 221–232.

Ramadani, L., Kurnia, S., & Breidbach, C. F. (2018). *In search for holistic ICT4D research*: *A systematic literature review*. Proceedings of the 51st Hawaii international conference on system sciences. pp. 2424–2433.

Robeyns, I. (2005). The capability approach: A theoretical survey. *Journal of Human Development*, *6*(1), 93–117. https://doi.org/10.1080/14649880520003426 6

Scala, E. (2015). Tailoring tertiary education and ICTs for sustainable development in LDCs: Challenges and opportunities. *TIGOR*, *7*(1), 15–34.

Shin, D. (2017). The role of affordance in the experience of virtual reality learning: Technological and affective affordances in virtual reality. *Telematics and Informatics*, *34*(8), 1826–1836.

Singh, G. (2011). An online abstract mentoring programme for junior researchers and healthcare professionals. *Distance Education*, *32*(2), 229–242.

Sonnenwald, D. H. (2007). Scientific collaboration. *Annual Review of Information Science and Technology*, *41*(1), 643–681.

Sooryamoorthy, R. (2013). Scientific collaboration in South Africa. *South African Journal of Science*, *109*(5/6), 1–5.

Subramanyam, K. (1983). Bibliometric studies of research collaboration: A review. *Journal of Information Science*, *6*(1), 33–38.

Thapa, D., & Sein, M. K. (2018). Trajectory of affordances: Insights from a case of telemedicine in Nepal. *Information Systems Journal*, *28*(5), 796–817.

Thapa, D., & Zheng, Y. (2019). Capabilities and affordances in the ICT4D context: Similarities, differences, and complementarities. In P. Nielsen & H. C. Kimaro (Eds.), *Information and Communication Technologies for Development: 15th IFIP WG 9.4 International Conference* (pp. 49–59). Springer Nature.

Toivanen, H., & Ponomariov, B. (2011). African regional innovation systems: Bibliometric analysis of research collaboration patterns 2005–2009. *Scientometrics*, *88*(2), 471–493.

Turpin, M. (2018). Assessing south African ICT4D research outputs: A journal review. *South African Computer Journal*, *30*(1), 108–127.

UNDP. (2019). *South-south and triangular cooperation*. FAQ on South-South and Triangular Cooperation. Retrieved from https://www.undp.org/content/undp/en/home/search.html?q=South-South+and+triangular+cooperation

Van Biljon, J., Marais, M., & Platz, M. (2017). Digital platforms for research collaboration: Using design science in developing a south African open knowledge repository. *Information Technology for Development*, *23*(3), 463–485.

Van Biljon, J., & Naude, F. (2018). Collaboration towards a more inclusive society: The case of south African ICT4D researchers. *IFIP Advances in Information and Communication Technology*, *537*, 1–13.

Van Biljon, J., & Renaud, K. (2019). *Human-computer interaction for development* (*HCI4D*): *The southern African landscape*. IFIP 9.4 international conference on social implications of computers in developing countries. p. 1. https://doi.org/10.1007/978-3-030-19115-3

Van den Hoven, E., & Connell, J. (2016). Joint doctoral supervision across countries: Changes, challenges and considerations. *Emerging Directions in Doctoral Education*, *6*, 259–280.

Volkoff, O., & Strong, D. M. (2013). Critical realism and affordances: Theorizing IT-associated organizational change processes. *MIS Quarterly*, *37*(3), 819–834.

Volkoff, O., & Strong, D. M. (2017). Affordance theory and how to use it in IS research. In R. D. Galliers (Ed.), *The Routledge companion to management information systems* (1st ed., pp. 232–246). Routledge.

Von Solms, R., & Von Solms, B. (2010). Publish or perish…but where ? *South African Computer Journal*, *28*(section 1), 1–11.

Walsham, G. (1995). The emergence of interpretivism in IS research. *Information Systems Research*, *6*(4), 376–394.

Walsham, G. (2006). Doing interpretive research. *European Journal of Information Systems*, *15*(3), 320–330.

Walsham, G. (2017). ICT4D research: Reflections on history and future agenda. *Information Technology for Development*, *23*(1), 18–41.

Walsham, G. (2020). South-south and triangular cooperation in ICT4D. *Electronic Journal of Information Systems in Developing Countries*, *86*(4), 2–7. https://doi.org/10.1002/isd2.12130

Yidana, I., & Maazurre, C. (2012). Integrating ICT into teacher education curriculum: Faculty perceptions of their technology professional development needs in two Ghanian universities. *Journal of Continuing, Open and Distance Education*, *2*(1), 175–199.

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APPENDIX A.: RESEARCH COLLABORATION QUESTIONNAIRE

Dear Researchers,

Please respond to the following questions by writing your response next to or below the questions provided:

1. What do you think would be the general expectations from research collaboration with other ICT4D students, supervisors and mentors? .....

2. What are your specific expectations of the collaboration with other ICT4D students, supervisors and mentors? .....

3. Do you think that research collaborations are more successful if there are power imbalances, that is, large differences in the intellectual, financial or other capabilities of the participants? .....

4. What technologies do you see as essential to ensuring collaboration (type and platform if the latter is relevant) for example, Referencing systems preferably Mendeley since that is free and supports collaboration? .....

5. Research collaborations harbor challenges. Please provide more detail on what you see as the most important regarding the following aspects of collaboration.

a. Financial

.....

b. Differences in knowledge background

.....

c. Differences in institutional requirements and practices

.....

d. Differences in cultural background

.....

6. Initiatives that would be useful in establishing research collaborations .....

7. Any other information that you believe is important in establishing and maintaining sustainable research collaborations. .....

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THANK YOU FOR YOUR PARTICIPATION

APPENDIX B.: ANALYSIS OF THREE JOURNALS (EJISDC, ITD AND ITID) ON RESEARCH COLLABORATION AS AN OBJECT

We collected information from three prominent journals in ICT4D in developing countries, that is, the *Electronic Journal of Information Systems in Developing Countries* (EJISDC), the *Journal of Information Technology and Development* (ITD) and the *Journal of Information Technology and International Development* (ITID). Collectively, we found 45 (4%) articles with the search term from 1133 articles considered that were distributed as follows: EJISDC (378), ITD (349) and ITID (406). The journal information we used included the publication title, keywords and abstract from articles in English. We limited our search to journal articles that were published between 2009 and February 2020. Our search term was the word *collaboration*. During the review of articles, we excluded manuscripts that were editorial notes and general reports.

We decided to categories each abstract using three criteria, that is, object, variable or connector. Using the definition in Section 2.1, abstracts that were included as objects were based on manuscripts that focused on research collaboration with a university as one of the actors and the goal would have included knowledge sharing. Variable abstracts focused on collaboration in the industry, government, bibliometric results or community. The term connector was used in abstracts that mentioned collaboration as a common word but did not discuss any aspects of collaboration.

Using the three categories, we found a total of three journal articles that discussed collaboration as an object. These articles were in EJISDC (one) and ITD (two). We had 18 articles that discussed collaboration as a variable and these were distributed in EJISDC (six), ITD (seven) and ITID (five). The variables category appeared in the format of industry-industry (five), industry-citizens (two), government-government (one), government-industry (one), bibliometric (four) and community collaboration (five). The numbers in brackets represent articles in the category. Lastly, we had 24 articles whose abstract was categorized as a connector.

We conclude that very few papers in the field of ICT4D (4%) discuss research collaboration and even fewer (0.3%) as an object and therefore the concept is worthy of understanding. The focus of this study was on research collaboration and the object category speaks to our definition of research collaboration. The three abstracts that focused on research collaboration were further broken down to their view of information

technology application to facilitate knowledge production and Global North and Global South collaboration. The details of the articles that we classified as variable and connector can be found on this link.

Object category

No.	Author(s) and year	Title	Keywords	Abstract
1	Walsham (2020)	South–South and triangular cooperation in ICT4D	ICT4D; political perspectives; South–South collaboration; triangular collaboration	This paper addresses cooperation between countries in the Global South based on ICTs and also triangular cooperation including partners in the developed countries. It is argued that now is an important time for research and action in this space and in ICT4D more generally. Some opportunities are identified, selecting mainly from papers in the IFIP WG9.4 conference in Dar-es-Salaam, Tanzania, in May 2019. The paper has a strong critical dimension, asking questions such as who is driving ICT4D projects, who benefits from the work and are the less advantaged adequately included in the process. The paper ends with five broad principles on which further ICT4D research could build.
2	Van Biljon et al. (2017)	Digital platforms for research collaboration: using design science in developing a South African open knowledge repository	Collaboration; community; development informatics; knowledge management; knowledge repository; knowledge sharing	Research involving the use of ICT4D inhabits an interdisciplinary space characterized by various philosophies, aspirations, realities and priorities. This diversity in the ICT4D research area complicates knowledge sharing between stakeholders in the field, which may inhibit the dialog between researchers, policy-makers and practitioners and limit collaboration. The purpose of this research was to investigate IT-enabled collaboration through the design and development of a sustainable open knowledge repository (OKR) according to the design science research (DSR) paradigm. OKRs are tools used to support knowledge sharing and collaboration. The theoretical contribution of this paper lies in the sharing of insights gained into the user requirements, system features and principles for guiding the development process of an OKR for development informatics research in South Africa and the implications for knowledge management. The research builds on existing knowledge by applying the four-cycle DSR methodology as a systematic and reproducible method of investigating an OKR as an example of IT-enabled collaboration. The practical contribution is the artifact (OKR) developed to enable the sharing of research knowledge.
3	Muriithi et al. (2016)	Factors contributing to adoption and use of information and communication technologies within research collaborations in Kenya	Developing countries; ICT adoption; knowledge production; research collaborations; UTAUT	Use of ICTs to support research work is becoming increasingly common. This study set out to establish how ICTs are being used to support collaborative research in Kenya, and identify factors within the ICT ecosystem that contribute to their adoption and use. A mixed methods research design, involving 248 academic scientists in 4 disciplines across 4 major Kenyan universities, was employed. We found little diversity in forms of ICTs used to support collaborative research within the studied population. Several factors affect adoption and use practices, including availability and access to ICT resources, nature of the work, national and institutional ICT and

(Continues)

No.	Author(s) and year	Title	Keywords	Abstract
				research environments and the social-cultural practices of researchers. We explain our findings using Venkatesh et al.'s Unified Theory of Acceptance and Use of Technology model, which identifies four main constructs that affect the adoption of technology: performance expectancy, effort expectancy, facilitating conditions and social influence.