DOI: 10.1002/isd2.12060

RESEARCH ARTICLE

WILEY

ICTs and development in developing countries: A systematic review of reviews

Edda Tandi Lwoga[1] | Raphael Zozimus Sangeda[2]

[1] Department of Mathematics and ICT, College of Business Education (CBE), Dar es Salaam, Tanzania

[2] Department of Pharmaceutical Microbiology, Muhimbili University of Health and Allied Sciences (MUHAS), Dar es Salaam, Tanzania

Correspondence
Edda Tandi Lwoga, Department of Mathematics and ICT, College of Business Education (CBE), Dar es Salaam, Tanzania.
Email: tlwoga@gmail.com

Abstract

This systematic review of reviews aimed to explore the contribution of information and communication technologies (ICTs) for development in developing countries. This systematic review of reviews determines and summarizes ICTD research trends, and methodologies and conceptual frameworks used in ICTD research discuss the findings and evidence and then suggest approaches for further research. We reviewed existing systematic reviews published on ICT and development between January 1990 and July 2017. The review of reviews shows that a growing number of ICTD research works have used qualitative research approaches for data collection and analysis. We note several attempts to develop and apply models/frameworks over explanatory and predictive theories, most notably in the area of social, sociotechnical, and technical. Nevertheless, there is limited evidence on the long-term contribution of ICT use on livelihoods, patterns of economic inequality, human freedom, and well-being in developing countries. This review of reviews synthesizes existing systematic reviews on the contribution of ICT for development than was previously available for developing countries. This review has the potential for several stakeholders, including the public and private sector, intermediaries, and nonprofit organizations, to utilize the accumulated evidence from selected systematic reviews to enable/improve the appropriate and sustainable use of ICTs for development.

KEYWORDS

Africa, Asia, developing countries, development, ICTD, South America

1 | INTRODUCTION

There is a growing body of evidence regarding the role of information and communication technologies (ICTs) for development (ICTD) in developing countries (Avgerou, 2010; Heeks, 2010b, 2014; Walsham, 2017). ICT is defined as the manipulation and communication of information by using electronic resources and tools, such as computers, Internet, and broadcasting technologies (Kaware & Sain, 2015). ICTD is rooted in different disciplines, including information systems (IS), human-computer interaction (HCI), communication studies, and development studies. Although most of the ICTD researchers focus on the contribution of ICT to the socioeconomic growth, "there are significant epistemological differences regarding the nature of the process of technology construction and use that permeate disciplinary boundaries" (Avgerou, 2010, p. 2). For example, IS researcher would be interested in the process of technology development and the changes it brings to the organization, while researchers in HCI would be focusing on technology design (Avgerou, 2010). Hence, the contribution ICT for development may vary among disciplines according to the interest they intend to address (Avgerou, 2010; Thapa & Sæbø, 2014; Zewge, Dittrich, & Bekele, 2017).

Development is a contested concept in ICTD research (Avgerou, 2010; Thapa & Hatakka, 2017; Walsham, 2017). Avgerou (2010) observes that most ICTD scholars avoid discussing what development constitutes and which development dimensions the ICT interventions intend to support. To theorize development in ICTD research, a number of approaches have been proposed. For instance, Avgerou (2010) argues that ICTD

 © 2018 John Wiley & Sons Ltd

scholars may enhance the contribution of ICT to development by grounding their theories from progressive transformation perspective (ICT as a tool for economic and social gains) and ongoing view of disruptive transformation to challenge the development process at different levels of context. Another scholar raised a concern regarding the development policies that ICT interventions are intending to address (Thompson, 2003). Several studies also recommended the use of capability approach (CA) to map the contribution of ICT for development (Gallivan & Tao, 2013; Hatakka & De, 2011; Kleine, 2010; Thapa & Sæbø, 2014). The CA focuses on a broader view by including social dimensions of development (Sen, 1999). Therefore, this study views development as a process of expanding the freedom that people value, which depends on social and economic arrangements, political and civil rights, and other determinants (Sen, 1999). It is imperative to conduct a systematic review of reviews to understand what development dimensions do ICT initiatives tend to support in developing countries.

There is a wide range of published systematic reviews regarding the contribution of ICTs for development in developing countries (Duncombe, 2016; Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017; Thapa & Sæbø, 2014; Zaremohzzabich, Samah, & Omar, 2014). As the evidence from reviews keeps on accumulating, new knowledge is regularly needed to identify trends, gaps, and areas for future research. Extended systematic review of these reviews will provide an adequate understanding of the linkage between ICT and development in developing countries.

A systematic review is an efficient method that provides "precise, synthesized and up to date information to identify well-written and most relevant studies and to understand and utilize strategies which diminish bias and maximize accuracy" (Zaremohzzabich et al., 2014, p. 387). The systematic review of reviews determines and appraises all published systematic reviews to identify their quality and summarize, compare, and contrast the strength of conclusions, thereby providing decision makers with the best evidence (Smith, Devane, Begley, & Clarke, 2011). In this vein, this paper attempts to synthesize existing systematic reviews to assess the contribution of ICT to human development in developing countries. In particular, this systematic review of published reviews has the following aims:

a. summarizes the methods used in the reviews and individual studies, discusses the findings and evidence, and suggests methodological approaches for further research;
b. analyzes conceptual approaches used for understanding ICTD in the reviews and individual studies; and
c. determines research trends of ICTD in the current systematic reviews and provides suggestions for future research.

This study contributes to the knowledge base by providing adequate understanding of the significance of ICTs for development in developing countries. These findings are essential for several stakeholders, such as the public sector, private sector, intermediaries, and nonprofit organizations, to enable/improve the use of ICTs for development in developing countries.

2 | RESEARCH METHODS

2.1 | Data sources and search strategy

This study reviewed existing systematic reviews that were peer-reviewed and published in academic journals, conference papers, books, book chapters, and working papers, between January 1990 and July 2017. Data sources involved the following databases: Wiley Online Library, ScienceDirect, Taylor and Francis Online, Sage Publishing, Emerald, the Association for Computing Machinery (ACM) Digital Library, Google Scholar, and Pubmed. We retrieved data from the top three journals in the field of ICTD as developed by Heeks (2010), which include the Information Technology and Development (ITD), Electronic Journals of Information System in Developing Countries (EJISDC), and Information Technology and International Development (ITID). We retrieved data from relevant references in the reference lists of significant papers. The study performed the main search between July and August 2017.

Search criteria involved multiple combinations of search terms and Boolean operators among keywords linked to (1) ICT (for example: ICT, telecenter, mobile phone, information technology (IT), internet café, radio, and television), (2) those linked to systematic reviews (for example, review, reviews, literature review, meta-analysis, and systematic reviews), (3) those related to human development, and (4) those linked with the developing country as a general concept or mainly focus on nations classified by the World Bank as low-income economies and lower middle-income economies (World Bank, 2016). Since South Africa is classified in the "upper-middle-income" category, it was supposed to be excluded in this review. However, there is an extensive body of literature on ICTD in South Africa, and further, the context of rural areas of South Africa is almost similar to other African countries. Therefore, an exception was made to include ICTD reviews from South Africa. The search terms for developing countries included developing countries, underserved area, Africa, Africa South of the Sahara, Asia, South America, Latin America, Central America, third world, underdeveloped, middle income, low income, and LMIC (low and middle-income countries).

Before searching, two librarians verified the search strategy for each of the databases. Two researchers searched and exported data to Rayyan online software for selection of excluded/included citations.

2.2 | Screening

After merging the duplicates in Rayyan software, the relevant research articles were screened based on titles and abstracts. We used the following inclusion and exclusion criteria that were adopted from Kgoroeadira (2010):

- Relevance for the review question
- Date of publication 1990-2017
- Geographic location: developing countries
- Types of publications: Peer-reviewed journals, books, book chapters, and working papers
- Nature of research: systematic reviews, narrative reviews, and meta-analytical reviews
- Method: qualitative and quantitative
- Language: English

After the title and abstract screening, the selected papers were examined based on the full text by using several criteria. The population/participants should comprise systematic reviews of people from developing countries. Interventions should include ICT initiatives for development such as mobile technologies, Internet-based interventions, public access ICTs such as telecenters, radio/television, etc. Articles that focused on software development and pure technical/engineering were excluded. Only reviews reporting on human development were included. If the same author had published several articles of the same review, the most current review was selected.

2.3 | Study quality assessment

Only articles that passed through the full-text screening were subjected for study quality assessment by using the Overview Quality Assessment Questionnaire (OQAQ) (Greaves et al., 2011; Oxman & Guyatt, 1991) (see Appendix A). All reviews were coded by using OQAQ, and they were included for further analysis if their OQAQ score was 14 or more than 14 (range 0–18) (Greaves et al., 2011; Oxman & Guyatt, 1991).

2.4 | Data extraction

Once the screening and study quality assessment phases were completed, all selected articles were exported to Nvivo qualitative software for data extraction and analysis. We used the data extraction form to extract data in two steps. The first matrix extracted the following data: detail of publication (author(s); year; title; source name; volume/issue/page number; origin: database; cross reference), objective of the review, geographical coverage of review, type of review, total number of included studies, underlying theories/frameworks/models, time frame of collecting data, and review results and conclusion.

The second matrix included data from all primary studies within each review. The individual studies that appeared in multiple reviews were included in the summary Appendix B and C only once. The second matrix included the following data:

- Developmental objective of the ICT initiative
- ICT intervention being studied
- Underlying theories/frameworks/models
- Study designs: the methodologies were first classified as "empirical" and "conceptual." Then, the empirical studies were further divided into the following: quantitative, qualitative, participatory/action oriented research, and mixed research and design research that focuses on design and development of ICT applications. Articles were classified as descriptive if they did not have any defined methodologically approach.
- Data-gathering methods
- Timeframe of the study, either a snapshot or longitudinal
- Level of analysis: either macrolevel, mesolevel, or microlevel

The study assessed the level of analysis at which the research is carried out, by adapting from Duncombe and Boateng (2009), who analyzed their results in three levels:

- microlevel, which focuses on the users or owners of ICTs including individual households, microenterprises, or communities;
- mesolevel, which involves intermediaries who deliver ICT services, such as telecenters, mobile phone operators, or other informal intermediaries; and
- macrolevel, which assesses the role of organizations that provide the infrastructure and formulates and regulates policies and regulations in ICT.

2.5 | Data analysis

The extracted data were synthesized and reported according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist (Liberati et al., 2009) and in accordance to the systematic reviews of reviews of mobile text messaging for health (Hall, Cole-Lewis, & Bernhardt, 2015).

3 | RESULTS

3.1 | Search results

The search retrieved 5044 records, and 1281 non-English and duplicated records were excluded (see Figure 1). About 3763 were selected for further screening, and 3663 were excluded following title screening. About 100 potentially relevant articles were selected, and 76 articles were excluded following abstract screening. Twenty-four relevant articles were selected and retrieved, and 11 papers were excluded based on the prespecified inclusion and exclusion criteria. About 13 papers were subjected for quality assessment, and five papers were excluded because their OQAQ score was below 14. The qualitative synthesis below relates to eight included articles as shown in Figure 1.

3.1.1 | Study quality, the risk of bias, and quality of evidence

The study assessed 13 papers and excluded five papers (Donner, 2009a; Donner & Tellez, 2008; Duncombe, 2011; Walsham, 2010; Walsham & Sahay, 2006) because their OQAQ score was below 14. Most of the excluded reviews did not assess the risk of bias in the included studies. We included eight papers for further analysis. Only one study by Mbuyisa and Leonard (2017) had used predetermined criteria for assessing methodological quality and risk of bias of included articles, namely, quality appraisal protocol. Assessment of quality of individual studies is important to demonstrate how the review minimizes bias, maximizes internal validity, and ensures generalizability and applicability of the results (Kitchenham, 2004). The findings of quality, bias, and OQAQ are presented in Appendix C.

3.2 | Conceptual approaches

Conceptual approaches are significant in looking at the processes that link with the use of ICTs to measures of outputs, outcomes, or impacts (Duncombe, 2011). In this study, we analyzed the conceptual approaches of the reviews and their individual studies based on conceptual classification proposed by several scholars (Gregor, 2006; Heeks, 2007), which include

- explanatory—theories used for explaining how, when, where, and why ICTs contributed to the development;
- predictive—theories used for predicting how ICTs bring development; and

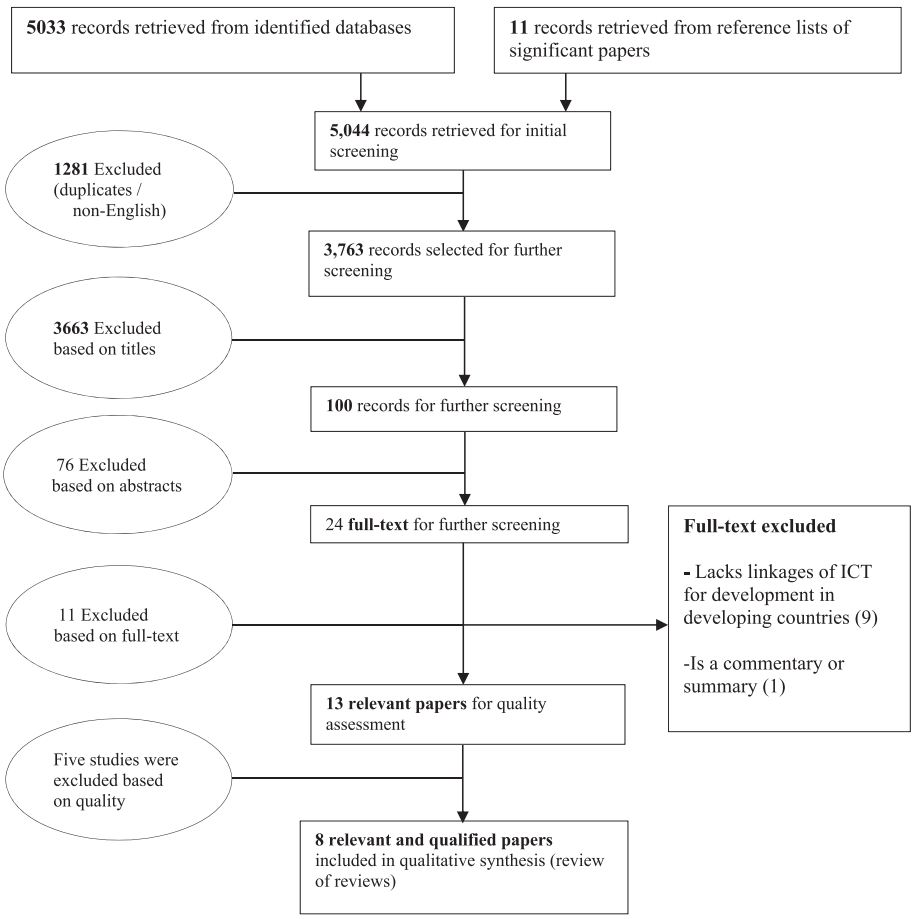


FIGURE 1 Review of reviews study flow diagram. ICT, information and communication technology

- approaches that applies a model, or framework or basic concepts or categorization that are less theoretically grounded.

Of eight reviews that were included in this study, only one review by Thapa and Sæbø (2014) was guided by the explanatory theory, namely, CA. About four reviews were guided by frameworks and models (see Table 1).

A similar trend emerged when assessing the primary studies in the reviews. Most of the primary studies in the reviews were guided by shallow theories, which take the form of framework, or models- or concept-based approaches (see Appendix B).

3.2.1 | Frameworks and models

Individual studies deployed frameworks to explore how ICTs can enable the livelihood of people in developing countries. The most prevalent framework in this category was the Sustainable Livelihood Framework (SLF). For instance, Zaremohzzabich et al. (2014) found that most studies (10 out of 15) were guided by a SLF. Mbuyisa and Leonard (2017) reported that four studies out of 21 empirical studies had used SLF. A few individual studies deployed SLF in other reviews (Duncombe & Boateng, 2009; Johnston et al., 2015; Thapa & Sæbø, 2014; Zewge et al., 2017).

Other primary studies focused on assessing the contribution of technology in diverse development dimensions. This group includes ICT—Rural Poverty linkages framework; the framework of the impact of ICTs on growth/poverty reduction among micro and small enterprises (MSEs); and growth model, as indicated by Mbuyisa and Leonard (2017). Other models include the mobile telephones impact model, as reported by Donner and Escobar (2010); Constructive Technology Assessment Approach, as reviewed by Zewge et al. (2017); and the concept of technology appropriation, as indicated in other reviews (Zaremohzzabich et al., 2014; Zewge et al., 2017). Some of the concept-based approaches were deployed to assess the transformational impact of ICTs, which include the ripple effect of technologies as reported by Duncombe and Boateng (2009).

The technology adoption models in a given time and space were prominent models applied to primary studies. These models included technology adoption model (TAM), as indicated by four reviews (Duncombe, 2016; Duncombe & Boateng, 2009; Johnston et al., 2015; Zewge et al., 2017). Other related models include ICT adoption model for socially excluded groups; model of e-government portal use, global IT adoption model, evaluation model of the digital business environment, and model of adoption of technology in the home as indicated by Johnston et al. (2015). Scholars argue that the technology adoption models were relevant when ICTD research began (Zewge et al., 2017). Further, they lack an understanding of the linkages between ICT and development (Zewge et al., 2017).

Other models focus on the social network, such as causal networks framework, as indicated in several reviews (Donner & Escobar, 2010; Johnston et al., 2015; Mbuyisa & Leonard, 2017), and a network of action framework (Johnston et al., 2015). Other models addressed issues related to the information needs of ICT initiatives. This includes the information needs modeling, as indicated by Duncombe (2016); information chain model, as mentioned in Thapa and Sæbø (2014) review; and information poverty, as reported by Duncombe and Boateng (2009).

Few reviews found the use of a model that focused on design and development of systems. This includes the user-centered design framework, Normative Information Model-based Systems Analysis and Design (NIMSAD) framework, and rural IS implementation process as reviewed by Zewge et al. (2017). Another reviewer found the use of the deployment of CAM design framework: an architecture of the mobiles for rural developing world approach for the development of mobile applications (Duncombe & Boateng, 2009).

Few models in primary studies focused on socioeconomic perspective. These models focused on the banking and finance research, such as banking market model: banking ladder as reported by Duncombe and Boateng (2009). Other primary studies in the reviews assessed the adoption of mobile finance, and they focused on additive-transformational m-payment model as indicated in one review (Duncombe & Boateng, 2009). Besides, few primary studies in the reviews looked at the value chain/supply analysis models that explore the information search and other transaction costs during the phase of any development activities, such as agricultural or business related activity, as indicated by Duncombe (2016). Other models include capital endowments; incentives as reported by Duncombe and Boateng (2009); the access, capacity, and environment (ACE) framework as indicated by Mbuyisa and Leonard (2017); and the resource movement framework, an integrated sensitizing framework as observed by Thapa and Sæbø (2014).

TABLE 1 Conceptual approaches used in the systematic reviews

Conceptual Approach	Name of the Conceptual Approach	Reviews
Explanatory	Capability approach	(Thapa & Sæbø, 2014)
Framework/models/concepts	Sustainable Livelihood Frameworks Temporal lifecycle model Value chain model and value system A framework for analysis of ICT-based development initiatives	(Zaremohzzabich et al., 2014) (Duncombe & Boateng, 2009) (Donner & Escobar, 2010) (Johnston, Jali, Kundaeli, & Adeniran, 2015)
No explicitly theory or undermined		(Duncombe, 2016; Mbuyisa & Leonard, 2017; Zewge et al., 2017).

Abbreviation: ICT, information and communication technology.

3.2.2 | Explanatory theories

Individual studies in the reviews that draw on explanatory theory tend to focus on various aspects, such as social capital, socioeconomic network analysis, technology adoption, and development. The theories in social capital and socioeconomic network analysis seek to gain insight of the complex causal associations between constructs and resultants outcomes and impacts for development (Duncombe & Boateng, 2009). Such theories include actor-network theory (ANT) as indicated in three reviews (Johnston et al., 2015; Thapa & Sæbø, 2014; Zewge et al., 2017). Other theories include theory of communicative action (TCA) as reported by Thapa and Sæbø (2014), a theory of networks and social ties and institutional theory indicated in two reviews (Johnston et al., 2015; Zewge et al., 2017), consensus theory and uses and gratification theory reported by one reviewer (Johnston et al., 2015), stakeholder theory specified in one review (Zewge et al., 2017), and structuration theory indicated by Thapa and Sæbø (2014).

Primary studies in six reviews were driven by theories related to adoption of technology through time and space, which include diffusion of innovation theories and theory of reasoned action as reported in several reviews (Duncombe, 2016; Duncombe & Boateng, 2009; Johnston et al., 2015; Mbuyisa & Leonard, 2017; Thapa & Sæbø, 2014; Zaremohzzabich et al., 2014; Zewge, Dittrich, & Bekele, 2015).

Other theories focused on institutional economics, asymmetrical information, and trust in economic relationships. Such theories include the theory of asymmetrical information and cultural perspectives on collective action as indicated in two reviews (Donner & Escobar, 2010; Duncombe & Boateng, 2009). Other theories explored the linkage between ICT and development, such as development theory and capability approach as reported by Zewge et al. (2017). One reviewer also found that primary studies deployed theories that focused on system development, which included sociotechnical theory, and soft system theory (Zewge et al., 2017).

3.2.3 | Predictive theories

Predictive theories tended to be based on microeconomic analysis, and they were deployed by primary studies in five reviews (Donner & Escobar, 2010; Duncombe, 2016; Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017; Thapa & Sæbø, 2011). For instance, primary research in these five reviews demonstrated greater use of theories in microeconomic modeling, measuring changes in prices and spatial arbitrage/market integration. Other theories include microeconomic modeling, measuring transaction costs, information search costs, and awareness/knowledge assimilation as indicated in four reviews (Donner & Escobar, 2010; Duncombe, 2016; Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017). Such theories include bottom of the pyramid economics: theory of marginal customer, financial deepening, connectivity, and economic growth as reported by Duncombe and Boateng (2009). Other theories focus on awareness or knowledge assimilation, which includes theory of information added values as reported by two reviewers (Duncombe, 2016; Duncombe & Boateng, 2009).

3.3 | Methodological issues

All reviewed research studies had used qualitative thematic synthesis to analyze their results. The studies covered countries from Africa, South and East Asia, and Latin America. In South East Asia, some reviewers indicated that most studies were conducted in India. For instance, Zewge et al. (2017) found that almost half (43% of 57 studies) of the publications were from India. In addition, only three reviews covered studies from developed countries in order to understand what makes them succeed (Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017; Zaremohzzabich et al., 2014).

The primary studies covered by the reviews ranged between 10 and 57 studies. Half of the reviews included empirical studies only (Duncombe, 2016; Thapa & Sæbø, 2014; Zaremohzzabich et al., 2014; Zewge et al., 2017), while others included both empirical and theoretical studies (Donner & Escobar, 2010; Duncombe & Boateng, 2009; Johnston et al., 2015; Mbuyisa & Leonard, 2017) (See Table 2).

This level of analysis in the primary studies of the reviews was primarily micro—carried out among users or communities, rather than providers of ICT services as indicated by all reviews (see Appendix C). One reviewer noted that most studies that rely on primary data tend to base at the microlevel, while studies that depend on secondary data tend to focus on mesolevel or macrolevel (Duncombe & Boateng, 2009).

TABLE 2 The methodological approached applied by primary studies in the reviews

Reviews	Qualitative	Quantitative	Mixed Method	Participatory	Design Research	Descriptive	Total
Zaremohzzabich et al. (2014)	9	0	6	0	0	0	15
Thapa and Sæbø (2014)	6	0	1	0	0	0	7
Duncombe and Boateng (2009)	8	5	6	0	0	24	43
Duncombe (2016)	15	18	10	3	0	0	46
Mbuyisa and Leonard (2017)	1	2	10	1	0	11	25
Johnston et al. (2015)	6	4	5	4	0	10	29
Donner and Escobar (2010)	5	5	3	0	0	1	14
Zewge et al. (2017)	5	26	0	20	4	0	55
Total	55	60	41	28	4	46	

Of these eight reviews, five had included a large number of primary studies using qualitative approaches (see Appendix C). This finding is similar to the results of a content analysis of 948 papers published between 2000 and 2010, which revealed that the qualitative (37%) was the most frequently applied method followed by mixed methods (29%) and quantitative methods (16%) (Gomez, 2013). The authors of two reviews noted that most of these qualitative studies are either exploratory work or work in progress, and there is lack of in-depth qualitative case studies that could inform further theorizing (Duncombe, 2016; Duncombe & Boateng, 2009). The authors of two reviews found that longitudinal designs were popular in qualitative research approaches. For instance, Johnston et al. (2015) reported that out of the reviewed six longitudinal designs, three studies had deployed participatory- or action-oriented research, while two studies had applied qualitative research design, and one study had used quantitative research approach.

Quantitative research approaches were popular among ICTD studies (see Appendix C). This approach was the predominant design of primary studies in two reviews (Duncombe, 2016; Zewge et al., 2017). Two reviewers noted that quantitative studies tend to identify key indicators that are narrowly defined, draw data from small sample sizes, with exception to studies that rely on secondary data (Duncombe, 2016; Duncombe & Boateng, 2009). These studies indicate different levels of transparency regarding methodological challenges in quantitative studies, although the authors acknowledge most of these limitations in their researches (Duncombe, 2016).

There were mixed findings regarding duration of data collection. On one hand, one reviewer reported that longitudinal studies tended to deploy quantitative research design, measuring control and treatment group, or had measured changes before and after the intervention concerning adoption or contribution of ICTs as indicated in two reviews (Duncombe, 2016). On the other hand, Zewge et al. (2017) found that nearly half of the studies (n = 26) had used a quantitative survey with a short duration of data collection. Indications are that there are varying levels of deploying longitudinal designs in the reviewed studies. Therefore, more long-term studies are needed to demonstrate the required contribution of ICT for development.

Mixed methods approaches were predominantly used by the primary studies in one review (Mbuyisa & Leonard, 2017). However, most of these mixed method studies were snapshots that tend to use varying degrees of cross-sectional designs to draw data from a small sample and lack stratification and coverage (Duncombe, 2016; Duncombe & Boateng, 2009). Mixed methods tended not to deploy triangulation of data sources to ensure validity (Duncombe, 2016). Therefore, the representativeness and validity of the results of mixed methods are open for questions.

Participatory or action-oriented research approaches were less popular as indicated in all reviews. Even when participatory approaches are applied, the user participation is incomplete in the ICT development cycle in the primary studies of the reviewed reviews. Zewge et al. (2017) found that nearly half of the reviewed articles (20 out of 57) had used participatory- or action-oriented approaches. However, there was partial involvement of local communities in the ICT design and development process. In many cases, the core design concepts were identified before engaging end users (Zewge et al., 2017). A content analysis study by Gomez (2013) share similar findings that few studies had applied participatory approaches (11%). Nonetheless, participatory research is a significant method for exploring new concepts/phenomena and development of particular initiatives (Duncombe, 2016). Action-oriented research extends ethnographic research-based approaches by understanding the social context, propose the solutions, and evaluate their effects (Zewge et al., 2017).

Further, the use of design research was very low in the reviewed ICTD research, as only two primary studies deployed this approach in one review (Zewge et al. (2017). The design research focuses on designing and developing a solution to solve a given problem for a specific group of stakeholders (Zewge et al., 2017).

3.4 | Mapping linkages between ICT and development: Key issues and evidence

This study mapped the contribution of ICT to development, by assessing the developmental objectives used in the reviews and primary studies, themes that emerged in the reviews, ICT interventions used, and the major findings regarding the contribution of ICT for development by the reviews. Appendix C shows the results of the linkage between ICT and development through reviews' primary findings.

All reviews had the objective of assessing the contribution of ICT for development in diverse perspectives such as poverty reduction, sustainable livelihood, economic growth, and the view of development as freedom. Similarly, the ICTD initiatives in the primary studies of the reviews had the developmental objectives in different dimensions. For instance, Thapa and Sæbø (2014) found that ICTD projects were established with the goals of contributing to social, cultural, economic, human, and political problems. In a systematic review of contribution of ICT for agricultural development, Zewge et al. (2017) found that some ICTD studies focused on economic growth, while others concentrated either on the Millennium Development Goals, or people's livelihoods, or the concept of development as freedom of opportunity. In the same manner, Mbuyisa and Leonard (2017) found that scholars investigated the contribution of mobile phones on SMEs based on the economic dimension, while none of the primary studies evaluated the social impact.

On the themes utilized by the reviews, the findings indicate that reviewers assessed the following: diffusion of ICTs (Duncombe, 2016; Duncombe & Boateng, 2009); use of ICT by SMEs (Donner & Escobar, 2010; Duncombe, 2016; Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017), assessment of financial needs (Duncombe & Boateng, 2009); design and development of ICT applications (Duncombe & Boateng, 2009; Zewge et al., 2017); and understanding the context including best practices, field experiences, assessment and evaluation, benefits, barriers, and success factors of ICT initiatives (Zewge et al., 2017). The findings indicate that these reviews fall mainly into two areas, as suggested by Avgerou (2010), which include technology adoption and transfer and social embeddedness. Reviewers who assessed the adoption of ICT noted that this theme is well conceptualized and studied as compared with research on the contribution of ICT for development (Duncombe, 2016;

Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017). Another reviewer noted that there is inadequate research on design and development of ICT applications especially for illiterate people and community involvement in the development process (Zewge et al., 2017). Duncombe and Boateng (2009) also found that there is limited research on the assessment of financial needs in mobile finance research. Indications are that research on the context in which ICTs are applied, and adoption of ICTs are extensively studied and conceptualized, while research on financial needs, design, and development of ICT applications and contribution of ICT for development are comparatively neglected in the reviewed studies.

Three reviewers focused on reviewing the contribution of mobile phones for development (Donner & Escobar, 2010; Duncombe, 2016; Duncombe & Boateng, 2009). Two reviews found a high use of mobile phones as the means used by communities to build their capabilities. For instance, Mbuyisa and Leonard (2017) found a high prevalence of mobile phones as the main tools used by SMEs as compared with computers. Consistently, Zewge et al. (2017) found that more than half of the reviewed papers studied mobile phones, followed by telecenter, general ICTs, and desktop computers. Other types of ICTs assessed by the systematic reviews range from general ICTs (Thapa & Sæbø, 2014; Zaremohzzabich et al., 2014), to specific ICTs, such as the desktop computers (Zewge et al., 2017); telecenters (Thapa & Sæbø, 2014; Zaremohzzabich et al., 2014; Zewge et al., 2017); rural radio (Zaremohzzabich et al., 2014); and several types of IS, for example, free text user interface (Thapa & Sæbø, 2014), Geographical Information System (GIS), health IS, e-government (Johnston et al., 2015; Thapa & Sæbø, 2014), and e-commerce (Johnston et al., 2015; Mbuyisa & Leonard, 2017).

We found mixed results regarding the contribution of ICT to development in the surveyed systematic reviews. On one hand, two reviews reported that ICTs are a key contributor to development. For instance, Zaremohzzabich et al. (2014) concluded that ICTs contributed to sustainable livelihood of communities in various aspects, including human, social, financial, physical, and natural assets. Another review found that the principal achieved functioning was access to information and communication services, which can play a key role in developing social and human capital in remote communities (Thapa & Sæbø, 2014).

On the other hand, six reviewers reported that ICTs were a key contributor to some dimensions of development during the time of their reviews (Donner & Escobari, 2010; Duncombe, 2016; Duncombe & Boateng, 2009; Johnston et al., 2015; Mbuyisa & Leonard, 2017; Zewge et al., 2017). Mbuyisa and Leonard (2017) reported that ICTs could be used as a tool for SMEs to drive socioeconomic development in areas such as information sharing, enhancement of business operations, and improved use of assets and structures, resulting in poverty reduction. However, Mbuyisa and Leonard (2017) noted that the positive association between ICT and poverty reduction is still questioned from the reviewed theoretical and empirical studies. Another review from South Africa reported that ICT played a key role to some development dimensions (such as agricultural supply chains, the provision of health care for the poor, and development of policies for improving lives of the poor). However, ICTs did not benefit the poor on other aspects, such as e-government direct services and telecenters (Johnston et al., 2015). Donner and Escobari (2010) also found that mobile phones increased information flow in the value chain, which translated into reduced price variability and higher profits per actor. However, few studies reported evidence on the contribution of mobile phones in the creation of new business or ability of producers to bypass middlemen (Donner & Escobar, 2010).

Further, Duncombe (2016) found that most benefits derived from the usage of mobile phones seem to be generated from market diffusion (adoption and use) (Duncombe, 2016). There was less evidence on the extent and distribution of benefits regarding the use of mobile phones for the agricultural and rural development (Duncombe, 2016). Consistently, Duncombe and Boateng (2009) concluded that research on needs and impact of mobile finance is scarce, while research on application design and adoption has been well conceptualized. Similarly, Zewge et al. (2017) found that most researches tend to center around understanding the context in which ICT operates including best practices and experiences, while research on linking ICT initiative with development and design and development of applications for illiterate people is understudied. It is argued that research studies need to address the whole lifecycle of ICT applications development, ranging from user requirements to design, implementation, and evaluation of ICT initiatives, instead of addressing usability issues by end users (Zewge et al., 2017).

What emerges from the reviews outlined above is that the positive linkage between ICTs and development remains contested in the surveyed reviews as already observed in the literature (Avgerou, 2010; Heeks, 2010; Thapa & Hatakka, 2017). While some scholars argue that ICTs have provided tangible benefits to the poor, others argue that the poor cannot benefit from ICTs for a number of reasons. First, the ICT projects have not attained the required scale, they are either localized or at a pilot stage (Donner, 2009b). Second, they tend to be a practitioner and not academic oriented, and thus, their results are disseminated through publications and not to inform policy (Duncombe, 2016). Third, most of these projects are funded by donors or the public, and therefore, their results of impact assessment, monitoring, and evaluation are not made public (Duncombe, 2016). Fourth, each of the ICT projects has a different view of development that affect their project development, implementation, use, and outcomes (Thapa & Sæbø, 2014). Fifth, there is an overemphasis on the supply side of ICTs when evaluating the role of ICT for development (Duncombe, 2016; Duncombe & Boateng, 2009; Mbuyisa & Leonard, 2017). This means that most of the assessed ICT reviews focused on analyzing the supply side (eg, benefits of investment in ICT infrastructure), without comparing with the outcomes of the investment for development issues such as education, health, roads, etc (Mbuyisa & Leonard, 2017).

4 | KEY ISSUES

This section discusses key issues regarding ICTD research trends and theoretical and methodological approaches and provides recommendations for further research.

4.1 | ICTD research trends

A key concern is to explore how the concept of development is addressed in ICTD research. Five of eight reviews demonstrated that there is limited evidence regarding the contribution of ICT for development. One of the important finding reported in the two reviews was that each ICT project or initiative may have a different view regarding development that affects project design, implementation, and contribution (Thapa & Sæbø, 2014; Zewge et al., 2017). Further, some of the primary studies focusing on ICTD did not indicate development outcomes emanating from surveyed ICT interventions (Zewge et al., 2017). Sein, Hatakka, Thapa, and Sæbø (2016) argue that the existing ICTD research has put more attention on gaining broad insight of "what ICTs" and "how ICTs" lead to development, while the explanation of "why" is missing. These ICTD initiatives need to identify the sort of technology to be used, identify development goal, and why and how two can be fitted together (Islam & Grönlund, 2012). This calls for a need to assess how different views of development affect project outcomes from the ICT projects or initiatives and stakeholders' perspectives. Stakeholders can include donors, governments, project owners, designers, implementers, and users.

Another significant concern is to understand the linkages between ICT and development. Despite the notable theoretical conceptualization of ICTs in relation to technology adoption and development context, the assessed reviews revealed that the contribution of ICT for development is still contested. The success of any ICT intervention demands that the ICT design and development are aligned with local communities to ensure governance and sustain development outcomes from economic and sociopolitical perspectives (Heeks, 2010). Participative approaches can play a clear role in understanding such a context. Further, there is a need to develop theories that address the conceptual relationships of ICT innovation together with communities/other stakeholders, technical reasoning/institutional dynamics, and sociopolitical context (Avgerou, 2010). It is argued that ICTD research should "allow different ideologies of development, but make them more explicit" (Walsham, 2017). A good illustration of this approach is the work of Sein et al. (2016). These authors proposed a need to combine three groups of theories to investigate the link between ICT and development, which includes development theories (eg, capability approach), theories that conceptualizing ICT (eg, theory of affordance), and theories that link ICT and development (eg, social capital theory and ANT) (Sein et al., 2016).

There is a need to enhance the accessibility of data regarding the contribution of ICT in the decision-making processes at all levels. A number of reasons were raised in the assessed reviews that most ICT projects are either at the pilot level, or most research is not published or disseminated to inform policy (Duncombe, 2016). This necessitates a need to conduct more research to enhance the management and accessibility of the broad base of knowledge and data regarding ICTD to influence policy and support decision making at all levels.

Another concern relates to the limited geographical coverage. The reviews indicated that most of the ICTD research tend to be conducted in sub-Saharan Africa, Latin America, and South and East Asia especially India. Despite the fact that more research is still needed in these countries, other developing countries need to be covered, such as the developing Arabic countries and other countries in Asia. Further research is also required for the underresearched mountainous regions, which hosts one third of the world population (Heeks & Kanashiro, 2009). Otherwise, the common concepts, barriers, capabilities, and development outcomes will only base in a few areas. It is significant to understand the contextual variations between these countries, including capabilities and development outcomes that emanate from the use of ICT.

There is inadequate evidence of the contribution of ICTs in major societal issues, such as improved civil society (Johnston et al., 2015). It is important to conduct more studies on the contribution of ICTs to other categories of freedom as proposed by Sen (1999), including political freedoms, transparency guarantees, and protective security. Other major societal issues as raised by Walsham (2017) also require further investigation, which include economic well-being, systemic poverty, monitoring, managing and forecasting environment issues and climate change impacts, humanitarian crisis caused by natural disaster, wars and terrorism (ie, activism for social justice), internet security and protection (ie, cybercrime, identity theft), global health, social media, and big data. Substantial work on ICT and health was assessed by some reviewers (Johnston et al., 2015), while issues related to ICT and wasteland management was reviewed by (Thapa & Sæbø, 2014). However, there was inadequate research on these issues in the reviewed studies, and therefore, these issues require further research. In addition, other key ICTD research areas as identified by (Heeks, 2014) using the post-2015 development agenda also require further investigation. These research areas include development management, food and agriculture, development finance, inclusive development, rights and justice, data revolution development 2.0, growth and jobs, security and violence, cross-border flows, resilience, governance, and urban development. ICTD research needs to have a particular theme or issue as their development agenda as an effective way to engage users, practitioners, and policy makers and achieve the desired outcome (Walsham, 2017).

4.2 | Key issues in methodologies/theories

The findings indicated that some of the surveyed reviews had deployed weak methodological approaches when conducting the systematic reviews. It is therefore important to use rigorous methodological approaches when conducting systematic reviews in ICTD. This study excluded some reviews due to weak methodological approaches. Some reviews either lacked details on search strategy and inclusion/exclusion criteria, while others did not have details on assessment of methodological quality of primary studies and data analysis. Further, most of reviews assessed lacked the details on assessment of methodological quality of individual studies. It is important that systematic reviews have a clear focused research question; protocol with inclusion and exclusion criteria and systematic literature search of published and unpublished data; systematic data screening and extraction by more than one assessor; quality assessment and risk of bias; and data synthesis (meta-analysis if relevant) (Liberati et al., 2009). This will enhance the quality and reproducibility of the systematic reviews to inform policies and practices and identify key gaps for future studies.

The reviews revealed that the qualitative approach was the predominant method deployed in the primary ICTD research. However, the findings from the assessed reviews showed that there was limited use of in-depth qualitative case studies in the reviewed primary studies. It is therefore important to conduct extensive qualitative studies, such as ethnographic field studies, and triangulate with quantitative surveys (ie, mixed methods) to gain more insight into the local context. Further studies need to provide detailed statements on the research approach and conduct long-term studies to demonstrate the desired development outcome, especially for the rural communities.

The findings indicated that some primary studies in the reviews had used quantitative approaches whose indicators were narrowly defined, drew on a small sample, did not provide detailed data on methodologies, and some of them collected data within a short duration of time. Quantitative studies are useful for policy makers to identify issues for action regarding ICTD. Therefore, it is important to enhance the replication of results of these studies by researching with a large sample, repeated studies, with the inclusion of detailed methodology statement.

The reviews indicated that there is an inadequate application of participatory methods or action research, or experimental research designs, which are essential in understanding the context in which ICTs are deployed and the interplay of social, organizational, cultural, political, and economic factors. ICTD research has received a considerable attention from practitioners. However, their results have not been "translated into definable and publishable approaches to research involving participatory methods" (Duncombe, 2016, p. 18). There is a need to conduct qualitative research using participatory methods or action research or experimental research designs to gain more insight into the conceptualization of ICTD research.

Based on observations, there is limited use of design research in the assessed reviews that focus on developing ICT applications relevant for illiterate people. Therefore, there is a need to shift from developing technologies for users to designing and developing applications with users to enhance collective problem definition and gain more insight of the context that can significantly affect the outcome of the intervention (Zewge et al., 2017).

The assessed reviews indicated that the ICTD research is being conducted at the microlevel. A good ICT4D research "identifies, focuses on and targets its particular audience" (Heeks, 2014). The level of analysis in ICTD research can be individual, community, organization, country, region, or world, and different indicators can be deployed to analyze the role of ICTs (Sein et al., 2016). The typology by Qureshi (2015) can assist to determine indicators for analysis based on the development perspective and level of analysis.

It was evident that there was a prevalence of framework and model-based approaches as compared with theories in the primary studies included in the reviews. These frameworks and models focused on several areas, such as livelihood, technology adoption, social capital, and banking and finance research. These findings explain why there is limited evidence of the contribution of ICT to development research. According to several scholars (Duncombe & Boateng, 2009; Walsham, 2017), it is difficult to assess ICTD impact within a single model-based approach. Impact research tends to be conceptual and do not follow a predetermined research approach. A good ICTD research needs to be grounded on a conceptual framework or theory (Heeks, 2014). Andersson and Hatakka (2013) identified 11 dimensions of ICTD research and related theories based on a literature review of ICTD research between 2005 and 2012. Sein et al. (2016) proposed a need to combine social theories together with development and affordance theories to understand the interaction processes of various stakeholders with technologies in both urban and rural setting. It is also important to combine both predictive and explanatory theories to enhance the conceptualization of associations that exist across a range of contexts (Duncombe, 2016).

5 | CONCLUSION

This systematic review of reviews revealed that there was a rapid growth of research concerning ICT for development in the developing countries in the assessed studies. A growing number of ICTD research have used qualitative research approaches for data collection and analysis in the surveyed reviews. We note several attempts to develop and apply models/frameworks over explanatory and predictive theories, most notably in the area of social, sociotechnical, and technical in the investigated reviews. However, there is limited evidence on the long-term contribution of ICT use on livelihoods, patterns of economic inequality, and broader well-being in developing countries, as reported in the reviews. The key insights from this review include

- ICTD research are initiated with the objective of contributing to development in diverse dimensions, which affects their design, implementation, and outcomes in developing countries;
- despite the notable theoretical conceptualization of ICTs in relation to development context, there is limited evidence on the broader contribution of ICTs for development;
- limited geographical coverage, as ICTD research tend to be conducted in sub-Saharan Africa, Latin America, and South and East Asia especially India;
- there is limited evidence on how ICTD research is addressing major societal issues, including improved civil society, environment and climate change, humanitarian crisis, wars and terrorism (ie, activism for social justice), internet security and protection (ie, cybercrime, identity theft), and global health;
- limited use of rigorous methodological approaches in conducting ICTD systematic reviews;

- inadequate understanding of the local context due to inadequate in-depth qualitative case studies, participatory methods or action research, and experimental research designs;
- there is limited use of design research that focuses on developing ICT applications relevant for illiterate people; and
- most of the reviewed ICTD research is being conducted at the micro level.

There is a need to address these weaknesses by focusing on the following issues:

- Have a focused development objective and investigate perspective of development from several stakeholders in ICTD initiatives
- Explore processes and interactions among different stakeholders and ICTD initiative using participative approaches
- Enhance accessibility of data regarding the contribution of ICT for development for decision making at all levels. A need to develop theories that address the ICT innovation context and ICT enabled development perspectives
- A need to expand the geographical coverage to cover other developing countries, such as the developing Arabic countries, other countries in Asia, and mountainous region
- Conduct more studies on how to enhance both means of revenue generation and alternative funding models
- Conduct systematic reviews using rigorous methods to maximize validity and reliability and reproducibility of study findings
- Conduct extensive qualitative studies, such as ethnographic field studies, and triangulate with quantitative surveys (ie, mixed methods) to gain more insight into the local context
- Enhance the replication, generalization, and reproducibility of quantitative results by conducting research with a large sample, longitudinal studies, and with the inclusion of detailed methodology statement
- Need to shift from developing technologies for users to designing and developing applications with users to enhance collective problem definition and gain more insight into the context that can greatly affect the outcome of the intervention (Zewge et al., 2017)
- Combine explanatory (ie, measure social contribution) and predictive theories in order to understand the complex interaction of different stakeholders, processes, and context within which the ICTs are used and the resultant outcomes to the urban and rural communities
- A need to conduct multiple levels of analysis with specific indicators for analysis based on the development perspective and level of analysis

This review has several limitations. The coverage of the reviews is limited to publications in the English language, with a bias towards developing countries. This systematic review draws its findings from the data provided in the reviews and did not conduct a more deep investigation into the primary studies. The strength of the study findings and conclusions is thus limited to the data and quality of included reviews. This review only used qualitative narrative synthesis, and therefore, future reviews should combine narrative synthesis with other approaches, such as meta-analysis. Future studies should also assess any variations observed based on the periods of the reviews selected.

REFERENCES

Andersson, A., & Hatakka, M. (2013). What are we doing? Theories used in ICT4D research. In N. Hayes, & R. La Rovere (Eds.), *12th International Conference on Social Implications of Computers in Developing Countries* (pp. 282–300). Mona: University of the West Indies.

Avgerou, C. (2010). Discourses on ICT and development. *Information Technologies & International Development*, *6*(3), 1–18. Retrieved from http://www.itidjournal.org/index.php/itid/article/view/560

Donner, J. (2009a). Mobile-based livelihood services for individuals, small farms and micro & small enterprises in Africa: pilots and early deployments abstract: In *Conference on Development and Information Technologies. Mobile Phones and Internet in Latin America and Africa: What benefits for the most disadvantaged?* (pp. 23–24).

Donner, J. (2009b). Mobile-based livelihood services in Africa: pilots and early deployments. *Communication Technologies in Latin America and Africa: A Multidisciplinary Perspective*, 37–58. Retrieved from http://citeseerx.ist.psu.edu/viewdoc/download?rep=rep1&type=pdf&doi=10.1.1.205.2894

Donner, J., & Escobar, M. X. (2010). A review of evidence on mobile use by micro and small enterprises in developing countries. *Journal of International Development*, *22*(5), 641–658. https://doi.org/10.1002/jid.1717

Donner, J., & Escobari, M. (2010). A review of the research on mobile use by micro and small enterprises (MSEs). *Journal of International Development*, *22*, 641–658. https://doi.org/10.1002/jid.1717

Donner, J., & Tellez, C. A. (2008). Mobile banking and economic development: linking adoption, impact, and use. *Asian Journal of Communication*, *18*(4), 318–332. https://doi.org/10.1080/01292980802344190

Duncombe, R. (2011). Researching impact of mobile phones for development: concepts, methods and lessons for practice. *Information Technology for Development*, *17*(4), 268–288. https://doi.org/10.1080/02681102.2011.561279

Duncombe, R. (2016). Mobile phones for agricultural and rural development: A literature review and suggestions for future research. *The European Journal of Development Research*, *28*(2), 213–235. https://doi.org/10.1057/ejdr.2014.60

Duncombe, R., & Boateng, R. (2009). Mobile phones and financial services in developing countries: a review of concepts, methods, issues, evidence and future research directions. *Third World Quarterly*, *30*(7), 1237–1258. https://doi.org/10.1080/01436590903134882

Gallivan, M., & Tao, Y. Y. (2013). A longitudinal scientometric analysis of research published in IFIP 9.4 (2002-2013). GlobDev *2013*, *4*. Retrieved from http://aisel.aisnet.org/globdev2013/12

Gomez, R. (2013). The changing field of ICTD: growth and maturation of the field, 2000–2010. *Of Information Systems in Developing Countries*.

Greaves, C. J., Sheppard, K. E., Abraham, C., Hardeman, W., Roden, M., Evans, P. H., & Schwarz, P. (2011). Systematic review of reviews of intervention components associated with increased effectiveness in dietary and physical activity interventions. *BMC Public Health*, *11*(119). https://doi.org/10.1186/1471-2458-11-119

Gregor, S. (2006). The nature of theory in information systems. *MIS Quarterly: Management Information Systems*, *30*(3), 611, 10.2307/25148742–642.

Hall, A. K., Cole-Lewis, H., & Bernhardt, J. M. (2015). Mobile text messaging for health: a systematic review of reviews. *Annual Review of Public Health*, *36*, 393–415. https://doi.org/10.1146/annurev-publhealth-031914-122855

Hatakka, M., & De, R. (2011). Development, capabilities and technology—an evaluative framework. In *Proceedings of the 11th International Conference on Social Implications of Computers in Developing Countries, Kathmandu, Nepal, May 2011*.

Heeks, R. (2007). Theorizing ICT4D research. *Information Technologies & international development*, *3*(3), 1–4.

Heeks, R. (2010). An ICT4D journal ranking table. *Information Technologies & international development*, *6*(4), 71–75.

Heeks, R. (2010b). Do information and communication technologies (ICTs) contribute to development? *Journal of International Development*, *22*(5), 625–640. https://doi.org/10.1002/jid.1716/abstract

Heeks, R. (2014). Future priorities for development informatics research from the post-2015 development agenda. *Manchester Centre for Development Informatics Working Paper 57 Future* (Vol. 57). https://doi.org/10.1016/0736-5853(84)90003-0

Heeks, R., & Kanashiro, L. (2009). Telecentres in mountain regions—a Peruvian case study of the impact of information and communication technologies on remoteness and exclusion. *Journal of Mountain Science*, *6*(4), 320–330. https://doi.org/10.1007/s11629-009-1070-y

Islam, M. S., & Grönlund, Å. (2012). Applying design science approach in ICT4D research: mobile phone based Agriculture Market Information Service (AMIS) in Bangladesh. In M. Helfert, & B. Donnellan (Eds.), *Communications in Computer and Information Science* (pp. 132–143). Berlin: Springer.

Johnston, K., Jali, N., Kundaeli, F., & Adeniran, T. (2015). ICT for the broader development of South Africa: an analysis of literature. *Electronic Journal of Information Systems in Developing Countries*, *70*(3), 1–22.

Kaware, S. S., & Sain, S. (2015). ICT application in education: an overview Sudhir. *International Journal of Multidisciplinary Approach and Studies*, *2*(1), 25–32.

Kgoroeadira, R. (2010). Promoting entrepreneurship as a means to foster economic development: a review of market failure and public policy. Cranfield University. Retrieved from https://dspace.lib.cranfield.ac.uk/bitstream/1826/6901/1/Kgoroeadira_Reabetswe_Thesis_2010.pdf

Kitchenham, B. (2004). Procedures for performing systematic reviews. Keele, UK, Keele University, 33(TR/SE-0401), 28. 10.1.1.122.3308

Kleine, D. (2010). The capability approach and the "medium of choice": steps towards conceptualising information and communication technologies for development. *Journal of International Development*, *13*(2), 108–117. https://doi.org/10.1007/s10676-010-9251-5

Liberati, A., Altman, D. G., Tetzlaff, J., Mulrow, C., Gøtzsche, P. C., Ioannidis, J. P. A., … Moher, D. (2009). The PRISMA statement for reporting systematic reviews and meta-analyses of studies that evaluate health care interventions: explanation and elaboration. *Journal of clinical epidemiology*, *62*, e1–e34. https://doi.org/10.1016/j.jclinepi.2009.06.006

Mbuyisa, B., & Leonard, A. (2017). The role of ICT use in SMEs towards poverty reduction: a systematic literature review. *Journal of International Development*, *29*(2), 159–197. https://doi.org/10.1002/jid.3258

Oxman, A. D., & Guyatt, G. H. (1991). Validation of an index of the quality of review articles. *Journal of Clinical Epidemiology*, *44*(11), 1271–1278. https://doi.org/10.1016/0895-4356(91)90160-B

Qureshi, S. (2015). Are we making a better world with information and communication technology for development (ICT4D) research ? Findings from the field and theory building. *Information Systems and Quantitative Analysis Faculty Publications*, 46.

Sein, M. K., Hatakka, M., Thapa, D., & Sæbø, Ø. (2016). What theories do we need to know to conduct. *Proceedings of SIG GlobDev Ninth Annual Workshop*, (December).

Sen, A. (1999). *Development as freedom*. Oxford press (ed., Vol. 9) (p. 350). Oxford: Oxford University Press. 10.1215/0961754X-9-2-350.

Smith, V., Devane, D., Begley, C. M., & Clarke, M. (2011). Methodology in conducting a systematic review of systematic reviews of healthcare interventions. *BMC Medical Research Methodology*, *11*(1), 15. https://doi.org/10.1186/1471-2288-11-15

Thapa, D. (2011). The role of ICT actors and networks in development: the case study of a wireless project in Nepal. *Of Information Systems in Developing Countries*.

Thapa, D., & Hatakka, M. (2017). Introduction to "ICT4D: ICTs and sustainable development" minitrack. In *Proceedings of the 50th Hawaii International Conference on System Sciences* (p. 9981331). Retrieved from http://aisel.aisnet.org/cgi/viewcontent.cgi?article=1333&context=hicss-50

Thapa, D., & Sæbø, Ø. (2011). Exploring the link between ICT and development: a literature review. *Proceedings of the 11th International Conference on*.

Thapa, D., & Sæbø, Ø. (2014). Exploring the link between ICT and development in the context of developing countries: a literature review. *The Electronic Journal of Information Systems in Developing Countries*, *64*(4), 1–15. Retrieved from https://www.ejisdc.org/ojs2/index.php/ejisdc/article/view/1332

Thompson, M. (2003). ICT, power, and developmental discourse: a critical analysis. In *IFIP advances in information and communication technology* (ed., Vol. 110) (pp. 347–373). 10.1007/978-0-387-35634-1

Walsham, G. (2010). ICTs for the broader development of India: an analysis of the literature. *Electronic Journal of Information Systems in Developing Countries*, *41*(4), 1–20.

Walsham, G. (2017). ICT4D research: reflections on history and future agenda. *Information Technology for Development*, *23*(1), 18–41. https://doi.org/10.1080/02681102.2016.1246406

Walsham, G., & Sahay, S. (2006). Research on information systems in developing countries: current landscape and future prospects. *Information Technology for Development*, *12*(1), 7–24. https://doi.org/10.1002/itdj.20020

World Bank. (2016). World Bank list of economies. Retrieved from http://www.iphpc2017.com/wp-content/uploads/2016/07/World-Bank-list-of-economies-July-2016.pdf

Zaremohzzabich, Z., Samah, B., & Omar, S. (2014). A systematic review of qualitative research on the role of ICTs in sustainable livelihood. *The Social Sciences*, *9*(6), 386–401.

Zewge, A., Dittrich, Y., & Bekele, R. (2015). Systematic mapping study of information communication technology research for agriculture (in case of developing Countries) (IT University Technical Report Series). *Electronic Journal of Information Systems in Developing Countries*, *82*. Retrieved from http://www.is.cityu.edu.hk/staff/isrobert/ejisdc/82-2.pdf

Zewge, A., Dittrich, Y., & Bekele, R. (2017). Systematic mapping study of information communication technology research for agriculture: the case of developing countries. *Electronic Journal of Information Systems in Developing Countries*, *82*(2), 1–25. Retrieved from http://www.is.cityu.edu.hk/staff/isrobert/ejisdc/82-2.pdf

How to cite this article: Lwoga ET, Sangeda RZ. ICTs and development in developing countries: A systematic review of reviews. *E J Info Sys Dev Countries*. 2019;85:e12060. https://doi.org/10.1002/isd2.12060

APPENDIX A

OVERVIEW QUALITY ASSESSMENT QUESTIONNAIRE (GREAVES ET AL., 2011; OXMAN & GUYATT, 1991)

1. Were the search methods used to find evidence on the primary question(s) stated?
   (a) **Yes**, description of databases searched, search strategy, and years reviewed. **2 points**.
   (b) **Partially**, descriptions of methods not complete. **1 point**.
   (c) **No**, no description of search methods. **0 points**.
2. Was the search for evidence reasonably comprehensive?
   (a) **Yes**, at least one computerized database searched and also a search of unpublished or non-indexed literature. **2 points**.
   (b) **Can't tell**, search strategy partially comprehensive, at least one of the strategies performed. **1 point**.
   (c) **No**, search not comprehensive or not described well. **0 points**.
3. Were the criteria used for deciding which studies to include in the review reported?
   (a) **Yes**, inclusion and exclusion criteria clearly defined. **2 points**.
   (b) **Partially**, reference to inclusion and exclusion criteria can be found but are not defined clearly enough. **1 point**.
   (c) **No**, no criteria defined. **0 points**
4. Was bias in the selection of articles avoided?
   (a) **Yes**, issues influencing selection bias were covered. Both of the following bias-avoiding strategies were used: (1) two or more assessors independently judged study relevance, (2) assessors selected studies using predetermined criteria. **2 points**.
   (b) **Can't tell**, only one of the strategies used. **1 point**.
   (c) **No**, selection bias was not avoided or was not discussed. **0 points**.
5. Were the criteria used for assessing the methodological quality of studies reviewed reported?
   (a) **Yes**, criteria defined and used addressed the major factors influencing bias. **2 points**.
   (b) **Partially**, some discussion or reference to criteria. **1 point**.
   (c) **No**, validity or methodological quality criteria not used or not described. **0 points**.
6 Were study quality assessment criteria used to inform the review analysis?
   (a) **Yes**, criteria were used to inform the analysis, either by exclusion from the analysis if low quality or through sensitivity analysis. **2 points**.
   (b) **Partially**, some discussion but not clearly described application of criteria. **1 point**.
   (c) **No**, criteria not used or not described. **0 points**.
7 Were the methods used to combine the findings of the relevant studies (to reach a conclusion) reported?
   (a) **Yes**, qualitative and quantitative methods are acceptable. **2 points.**
   (b) **Partially**, partial description of methods to combine and tabulate; not sufficient to duplicate. **1 point**.
   (c) **No**, methods not stated or described. **0 points**.
8 Were findings of the relevant studies combined appropriately relative to the primary question of the overview?
   (a) **Yes**, combining of studies appears acceptable. **2 points**.
   (b) **Can't tell**, should be marked if in doubt. **1 point**.
   (c) **No**, no attempt was made to combine findings, and no statement was made regarding the inappropriateness of combining findings. **0 points**.
9 Were the conclusions made by the author(s) supported by the data and/or analysis reported in the overview?
   (a) **Yes**, data were reported that support the main conclusions regarding the primary question(s) that the overview addresses. **2 points**.
   (b) **Partially**. **1 point**.
   (c) **No**, conclusions not supported or unclear. **0 points**.

APPENDIX B

CONCEPTUAL APPROACHES APPLIED BY THE PRIMARY STUDIES INCLUDED IN THE REVIEWS

Conceptual approach	Name of the conceptual approach	Reviews	Total number of primary studies	Total number of primary studies after removing duplicates
Explanatory	Modeling social capital formation Social/economic network analysis	(Duncombe & Boateng, 2009; Duncombe, 2016; Thapa & Sæbø, 2014; Johnston et al., 2015; Donner & Escobar, 2010; Zewge et al., 2017)	22	17
	Diffusion of Innovation Theory	(Duncombe & Boateng, 2009; Duncombe, 2016; Thapa & Sæbø, 2014; Johnston et al., 2015; Mbuyisa & Leonard, 2017; Zaremohzzabich et al., 2014; Zewge, Dittrich, & Bekele, 2017)	11	11
	Institutional economics, asymmetrical information, trust in economic relationships	(Duncombe, 2016; Duncombe & Boateng, 2009; Donner & Escobar, 2010)	6	5
	Development and capability theories	(Zewge, Dittrich, & Bekele, 2017)	2	2
	System development theories	(Zewge, Dittrich, & Bekele, 2017)	2	2
Predictive	Microeconomic modeling—changes in prices, spatial arbitrage/market integration	(Duncombe, 2016; Duncombe & Boateng, 2009; Thapa & Sæbø, 2014; Mbuyisa & Leonard, 2017; Donner & Escobar, 2010)	17	14
	Microeconomic modeling—transaction costs and new institutionalism; information search costs	(Duncombe & Boateng, 2009; Duncombe, 2016; Mbuyisa & Leonard, 2017; Donner & Escobar, 2010)	6	5
	Awareness/knowledge assimilation	(Duncombe & Boateng, 2009; Duncombe, 2016)	2	2
Framework/models/concepts	Sustainable Livelihood Frameworks	(Duncombe & Boateng, 2009; Duncombe, 2016; Thapa & Sæbø, 2014; Johnston et al., 2015; Mbuyisa & Leonard, 2017; Zewge, Dittrich, & Bekele, 2017; Zaremohzzabich et al., 2014)	21	17
	Technology acceptance models	(Duncombe & Boateng, 2009; Duncombe, 2016; Johnston et al., 2015; Zewge, Dittrich, & Bekele, 2017)	14	11
	Modeling mobile finance—additive-transformational m-payments models	(Duncombe & Boateng, 2009)	11	11
	Modeling ICT, development, technology appropriation	(Duncombe & Boateng, 2009; Donner & Escobar, 2010; Johnston et al., 2015; Mbuyisa & Leonard, 2017; Zewge, Dittrich, & Bekele, 2017; Zaremohzzabich et al., 2014)	9	8
	Modeling social capital—causal networks	(Donner & Escobar, 2010; Johnston et al., 2015; Mbuyisa & Leonard, 2017)	8	6
	Value chain/supply analysis	(Duncombe, 2016)	6	6
	Information needs modeling	(Duncombe, 2016; Duncombe & Boateng, 2009; Thapa & Sæbø, 2014)	5	5
	Modeling system analysis and development	(Duncombe & Boateng, 2009; Zewge, Dittrich, & Bekele, 2017)	4	4
	Access, capacity, and environment (ACE) framework	(Johnston et al., 2015)	2	2
	Capital endowments; incentive	(Duncombe, 2016)	1	1
	Banking and finance research models	(Duncombe & Boateng, 2009)	1	1
	Ethnographic Decision Tree Model	(Zaremohzzabich et al., 2014)	1	1
	The resource movement framework	(Thapa & Sæbø, 2014)	1	1
	An integrated sensitizing framework	(Thapa & Sæbø, 2014)	1	1
	Pull and push mechanisms	(Duncombe & Boateng, 2009)	1	1
	Access frontier	(Duncombe & Boateng, 2009)	1	1
	Context and processes framework	(Johnston et al., 2015)	1	1
	Boundary objects—conceptual frameworks and participation processes	(Zewge, Dittrich, & Bekele, 2017)	1	1
No explicitly theory or undermined		(Donner & Escobar, 2010; Duncombe & Boateng, 2009; Duncombe, 2016; Thapa & Sæbø, 2014; Johnston et al., 2015; Mbuyisa & Leonard, 2017; Zaremohzzabich et al., 2014; Zewge, Dittrich, & Bekele, 2017)	98	96

Abbreviation: ICT, information and communication technology.

APPENDIX C

ICTD ISSUES, EVIDENCE, AND METHODOLOGICAL APPROACHES APPLIED BY THE SYSTEMATIC REVIEWS AND PRIMARY STUDIES

Reference	Countries Covered	Timeframe	Included Studies	Level of Analysis in Primary Studies	Timing in Primary Studies	Primary Review Results	Review Conclusions	Authors' Recommendations	OQAQ
Zaremohzzabich et al. (2014)	14 countries in underdeveloped and developing countries	January 2007 to April 2014	15 empirical studies	Micro (13 studies), meso (1 study), and meso-micro (1 study)	Snapshots (11 studies), two longitudinal studies, multiple time period (2 studies)	ICTs have a significant influence on sustainable livelihoods, which include human, social, financial, physical, and natural assets.	ICTD initiatives need to consider human factors indicated in sustainable livelihood approach.	Raise awareness to policy makers and development agencies to enable multiple support for ICT initiatives	14
Thapa and Sæbø (2014)	Four developing countries, while 60% were from India	Not indicated	10 empirical studies	Microlevel (7 studies), macro (2 studies), and meso (1 study)	Snapshots (6 studies), two longitudinal studies, and multiple times (2 studies)	The common achieved functioning was access to information and communication services, which can be helpful in creating social and human capital in remote communities.	Sen's capability approach (CA) emerged as a suitable framework with which to explore the link between ICT and D.	Recommends use of social capital to study the link between ICT and development; assess views on development from various stakeholders; more research on other developing countries including mountainous areas; explore issues on digital divide, gender, power structures and corruption; and deploy participatory methods	15
Duncombe and Boateng (2009)	77 developing countries and one developed country	2000 to August 31, 2008	43 studies (19 empirical; 24 theoretical)	Micro (12 studies), meso (10 studies), macro (10 studies), meso-micro (6 studies), and macro-meso (5 studies)	Snapshots (18 studies) and time series data (one study)	Mobile finance research related to design and adoption have received greater attention, while research on needs and measurement of impact have been comparatively neglected.	Mobile finance research is narrowly defined. Issues of assessing financial need and the measurement of impact have been comparatively neglected.	With adequate resources, research should use larger samples, longitudinal surveys, control groups, and carefully constructed research design. In absence of resources, research should use larger and more carefully constructed samples and repeat (panel) studies; use more detailed qualitative case studies and experimental research designs; and link mobile finance research with other disciplines	16

(Continued)

Reference	Countries Covered	Timeframe	Included Studies	Level of Analysis in Primary Studies	Timing in Primary Studies	Primary Review Results	Review Conclusions	Authors' Recommendations	OQAQ
Duncombe (2016)	17 developing countries	January 1, 2000 to December 31, 2013	46 empirical studies	Most studies were conducted at the microlevel	Snapshots (9 studies), longitudinal (7 studies), and multiple times period (6 studies). References were not available for 24 studies	The form, extent, and distribution of benefits (such as between producers and traders) is contested, and evidence highlights constraints on access and use. There is less evidence of significant benefits arising from active innovation in service.	There is a growing number of research studies that have developed rigorous methodologies for data collection and analysis, with welcome contribution from developing country institutions and researchers.	Need to provide agricultural data for effective planning; assess information and service needs that consider gender differences and the user's capacity to use ICTs; and investigate the potential for financial market integration, sustainable business models, and assessment of broader impacts at the community level	14
Mbuyisa and Leonard (2017)	20 developing countries and two developed countries	Not indicated	34 studies (21 empirical studies, 13 theoretical)	Micro (17 studies), meso (3 studies), and macro (1 study)	Snapshots (18 studies), longitudinal (2 studies), and multiple times period (1 study)	ICTs can contribute to poverty reduction, by small and medium enterprises (SMEs). However, SMEs face many challenges, which impede them from adopting ICTs in their business processes.	ICTs have a potential impact on improving the livelihoods of SMEs.	Proposes a conceptual framework to understand the relationship between the role of ICT use in SMEs and the resulting changes in poverty levels	17
Johnston et al. (2015)	South Africa	Past decade	36 studies (empirical, 24; theoretical, 12)	Micro (23 studies), meso (6 studies), and macro (5 studies)	Snapshots (18 studies), longitudinal (5 studies), and multiple times period (3 studies)	ICT has been a key contributor to agricultural supply chains, the provision of health care, and part of development policies. However, ICTs do not fully benefit the poor, eg, e-government direct services and telecenters.	The understanding of how ICTs contribute towards development provides a basis for further studies and how development can be achieved through the use of ICTs.	More research is needed on the role that ICTs on improving civil society and how government is using GIS to enhance service delivery	14
Donner and Escobar (2010)	22 countries in Africa, India, and Jamaica	Not indicated	14 studies (13 empirical; one theoretical)	Most studies were conducted at microlevel (11)	Snapshot (9 studies), longitudinal (2 studies), and multiple times period (1 study)	There is currently more evidence for the benefits of mobile use accruing mostly (but not exclusively) to existing micro and small enterprises (MSEs) rather than new MSEs, in ways that amplify existing material and	The review presents comparisons of the impact of mobile use across subsectors of MSEs and extensions beyond studies of existing enterprises.	Recommends a need for more research to generalize, segment, and further quantify the impacts by subsectors of MSEs and a need to investigate the use of new nonvoice advanced mobile services (such as	14

(Continued)

Reference	Countries Covered	Timeframe	Included Studies	Level of Analysis in Primary Studies	Timing in Primary Studies	Primary Review Results	Review Conclusions	Authors' Recommendations	OQAQ
						informational flows rather than transform them.		mobile banking and mobile marketplaces) by MSEs	
Zewge et al. (2017)	Five countries from Asia, eight countries from Africa, and two countries from South America	2006 to 2014	57 empirical studies	Nearly half of the studies (26) had used quantitative survey with a short duration of data collection.	Most studies (26) had used quantitative survey with a short duration of data collection (snapshot).	The ICT use in agricultural field is still in a consolidating phase despite great number of contributions. Theoretical concepts are sparse, so it is difficult to generalize and transfer the findings. Research on appropriate ICT design applications are still scarce.	The results show that sustainability and transferring ownership to the target community needs in depth understanding in ICT4A initiatives.	There is a need for a bottom-up process that involves the local community, rather than a technology-centric approach. Ensure information exchange between users, ICT developers, and researchers. More further research on how participatory design and development can be organized in ICT4D contexts.	14

Abbreviations: GIS, geographical information system; ICT, information and communication technology; ICTD, information and communication technology for development.