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Human-Computer Interaction for Development: A knowledge mobilisation framework

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ABSTRACT

Human-computer interaction for development (HCI4D) is an interdisciplinary field aimed at understanding and designing technologies for under-served, under-resourced, and under-represented populations around the world. The interdisciplinary nature complicates knowledge transfer and articulation between the disciplines contributing to the HCI4D domain with the consequence that researchers in one sub-domain do not always build on the extant theoretical and methodological progress in other sub-domains. The purpose of this paper is to propose a framework for HCI4D that could facilitate a better understanding of this domain, for knowledge mobilisation and articulation between researchers in HCI4D and the related field of information and communication technology for development (ICT4D). Previous studies have presented an overview of the HCI4D field in terms of the geographies it covers, technologies it targets, and its varied epistemological and methodological underpinnings. This paper builds on those methodologies and findings to conduct a systematic literature review which revisits the domain questions, thus, the core issues and topics (why), the phenomenon of interest (what) and the research methods (how). A comparison of the findings from three seminal HCI4D papers led to the identification of three core issues (motor themes) namely, *context*, *design* and *development.* Based on Ward's idea of a *knowledge mobilisation framework*, the findings from the systematic literature review are then synthesised and presented as a framework which comprises the core issues, recurring themes and the salient elements for each of the domain questions. The contribution is a knowledge mobilisation framework to enrich discussions on positioning HCI4D as research field.

Keywords: HCI4D, human-computer interaction for development, cooperation, capacity building

INTRODUCTION

HCI4D is a research domain aimed at understanding and designing technologies for under-served, under-resourced, and under-represented populations around the world (Dell & Kumar, 2016). It caters for the needs and aspirations of people in developing regions, or for specific social, cultural, and/or infrastructural challenges of developing regions (Ho, Smyth, Kam & Dearden, 2009). HCI4D inherits the *international development* focus from information and communication for development (ICT4D) while human-computer interaction (HCI) research and literature provide conceptual and methodological tools to understand the human dimension of ICT4D (Abdelnour-Nocera & Densmore, 2017).

Matching and aligning goals, expectations and practices across the HCI4D domain are complicated by the interdisciplinary nature of both ICT4D (Toyama, 2010; Walsham, 2017) and HCI4D (Dell & Kumar, 2016; Toyama, 2010). There are different philosophical and methodological streams to contend with and researchers may be unable to appreciate the value of other disciplinary streams (Best, 2010). This can cause isolated streams of progress which are disconnected from other discourses in the field, hence the maturation of the field and the real-world impact suffers. For example, Van Biljon and Renaud (2016) raised questions about the usefulness and validity of guidelines abstracted from literature and refined through heuristic evaluations without practical evaluation by implementation in the intended context of use. This was based on their finding that some usability guidelines for using mobile phones in developing countries were iteratively refined and published without any evidence of implementation (Van Biljon & Renaud, 2016).

One of the reasons for the lack of implementation could be found in the different methodological approaches, which broadly include (1) qualitative methods and user studies, (2) design and iterative prototyping, and (3) evaluation (Toyama, 2010). If, for example, the guidelines were created from an interpretive position where researchers used qualitative methods and user studies, then they would need to change to a design focus for implementation which could require a pragmatic philosophy and a different set of skills. Likewise, considering ICT4D projects, Qureshi & Xiong (2017) maintain that many well-intended projects fail, due to

unrealistic expectations set by development agencies responding to their political objectives, while information systems research is ripe with well-studied concepts that do little to achieve a better world. Sein, Thapa, Hatakka and & Sæbø (2018) identify four research agendas for ICT4D research, namely theorising ICT4D; the philosophical bases of ICT4D; expanding ICT4D research to the developed world; and *moving from understanding to intervention studies*. The latter highlights the need for more action research and action design research studies to create knowledge while solving development problems (Sein et al, 2018). Furthermore, it provides evidence that Best's recommendation to develop a set of fundamental shared problems and an appreciation for mixed (and when appropriate, shared) methods while ensuring robust evaluation and assessment (Best, 2010), is still relevant. However, as mentioned earlier, to progress from *understanding* to *intervention* researchers need to be able to articulate across sub-domains and that requires knowledge mobilisation.

Therefore, the purpose of this paper is to propose a conceptual framework that aligns the core issues (motor themes) in the HCI4D field with the salient philosophies and methodologies, thereby relating HCI4D to ICT4D on a methodological level. Acknowledging the continued growth and diversification in the field, this framework is proposed as a non-prescriptive point of departure for verification and further research in the field of HCI4D. The research philosophy can best be described as pragmatism with mixed-methods as research design. The literature review section discusses approaches to positioning a research field and identifying the core issues (motor themes in terms of centrality and density). That is followed by a discussion of seminal HCI4D overview papers that informed the dimensions of the systematic literature analysis and led to the identification of the motor themes, namely *context*, *design* and *development.* The systematic literature review and analysis process is explained in the research design section. The findings from this literature analysis are then synthesised to present the conceptual framework for HCI4D knowledge mobilisation which presents the salient elements in each dimension and explains how those can be related to the motor themes. The paper concludes by considering the limitations and contributions of this research.

POSITIONING A RESEARCH FIELD

Bødker (2015) contends that the changing nature of the published papers can be used as an indicator of how a field is maturing and identifies the following waves in the development of a new human-related research field such as HCI:

- The first wave of papers generally present individual, small-scale studies where researchers report empirical results in order to lay down founding principles
- The second wave emerges, with reports on the use of the initial results in larger-scale studies, often in organisations where the focus on the individual no longer dominates
- The third wave is introduced when meaning-making papers start appearing – with researchers producing papers questioning unwritten assumptions and making recommendations about the way forward (Bødker, 2015).

Therefore, researchers need to build on existing research in the field in order for a field to mature. Besides the maturity of the field, Reeves and Stuart (2015) suggest that the core issues in a field can also be described in terms of centrality and density. As depicted in Figure , a theme can be tracked and plotted as the themes evolve through inception ("Quadrant III: Emerging or declining themes"); begin to stabilise ("Quadrant IV: Basic and transversal themes"); go mainstream ("Quadrant I: Motor themes"); and then terminate (back to Quadrant III) or perhaps decline ("Quadrant II: Developed but isolated themes"). The progression of a theme is not predictable; however, that discussion is beyond the scope of this study where we are interested in the usefulness of motor themes (based on their centrality and density) to describe the core issues for knowledge mobilisation in HCI4D.

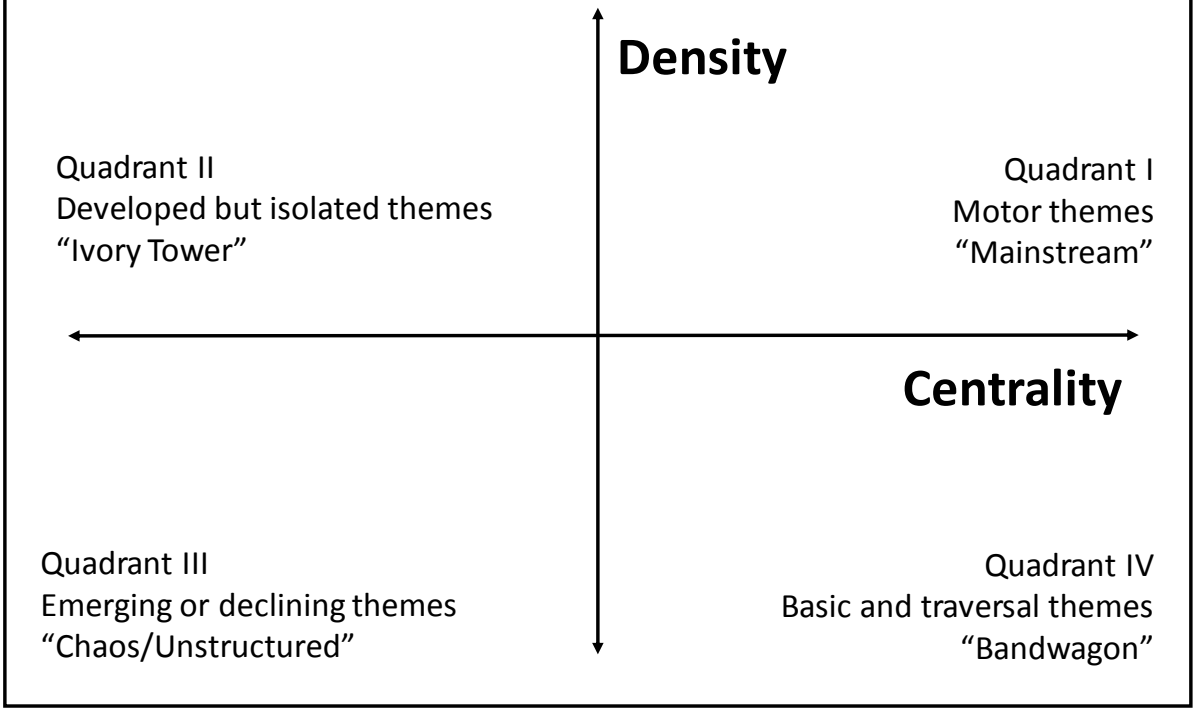


Figure 1: Mapping disciplinary knowledge production as quadrants (Reeves & Stuart, 2015)

To link the core themes to the related elements in a way that researchers can articulate between different philosophical and methodological entities, knowledge mobilisation is necessary. Ward (2016) proposes a framework to help knowledge mobilisers reflect on, communicate and evaluate their aims and objectives towards increasing clarity and understanding across the field. Their framework presents the results from a literature review in the field under investigation in terms of dimensions including the who, why, what, and how dimensions (Ward, 2016). The framework provides a point of departure for structuring the conceptual framework presented in this study. This section explained the thinking behind the positioning of a research field in terms of maturity, and the idea of identifying motor themes in terms of centrality and density. We conclude with the suggestion that the knowledge articulation between fields could be presented as a knowledge mobilisation framework.

POSITIONING HCI4D AS A RESEARCH FIELD

Information and communication technology for development (ICT4D) has been defined as the application of any entity that processes or communicates digital data in order to deliver some part of the international development agenda in a developing country (Heeks, 2018). The ICT4D discourse is guided by theories conceptualising development, theories conceptualising the use of ICT and theories on the transformative processes linking ICT to development (Sein et al, 2018).

Human-computer interaction for development (HCI4D) was originally focused on the adaptation of traditional HCI methods and techniques for designing and deploying solutions for developing nations (also referred to as the Global South) (Chetty & Grinter, 2007). More recently, Abdelnour-Nocera and Densmore (2017) maintained that HCI4D is a response to the fact that HCI as a discipline must alleviate tension created between local cultures and the assumptions, priorities and values embedded in the tools and concepts of this discipline. Toyama (2010) overviews the historical relationship between HCI and international development, and compares their disciplinary approaches. This is useful in terms of differentiating HCI4D from HCI while acknowledging that the HCI4D field is distinctly shaped by the inheritance from HCI and ICT4D as parent fields.

Rogers (2012) describes HCI as an interdiscipline that signifies the absence of a disciplinary core in HCI, which allows it to be a space for connecting disciplines rather than a way of ordering knowledge. Walsham (2017) describes ICT4D as interdisciplinary and hence HCI4D as a field at the intersection of HCI; and ICT4D would accommodate different epistemologies and methodologies. HCI4D can be considered as a research domain at the intersection of ICT4D and HCI, and thus interdisciplinarity lies as the core of HCI4D research. HCI4D through the connection with HCI deals with human factors while retaining the focus on designing, implementing and evaluating technologies for development. Abdelnour-Nocera & Densmore (2017) maintain that HCI research and literature provide conceptual and methodological tools which are useful in understanding the human dimension of ICT4D. They maintain that although the human element is pervasive in ICT design, implementation and evaluation, the focus is on the difference in the performance of technology in different geographies where HCI4D reports on local experiences, adapting and implementing conceptual and methodological HCI frameworks to make it locally accountable. The “4D” part in HCI4D has been contested, arguing

that HCI in developing regions is not always and not only "for development" (Toyama, 2010). In response some other terms have been used. Irani et al, 2010 proposed postcolonial computing as an analytical orientation to better understand the challenges of cultural contexts and how designs and methods engage new constituencies, where design and analytical practices face significant challenges.

While acknowledging those discourses, the term HCI4D will be used for the purpose of this paper, since that indicates the relationship to both HCI and ICT4D fields. Two studies in particular, also having conducted surveys of the HCI4D literature, informed the methodology of this study:

- The Ho et al (2009) study published the result of a literature survey towards presenting a conceptual map for making sense of the emerging HCI4D literature. Their specific aims were to articulate some of the histories that informed the particular community of researchers; to provide an overview of existing work in HCI4D; discuss the most pertinent issues in the discipline and suggest a set of grand challenges for the ensuing 5 to 10 years. The following topics were identified: cross-cultural HCI, unique needs, design methods, and empirical studies.
- Dell and Kumar (2016) presented an empirical analysis of HCI4D literature (2009–2016). Their findings were based on a survey of 259 HCI4D publications selected from journals and conference papers that mentioned the keywords “HCI4D”, “ICTD”, “low-resource”, “developing world”, “developing regions”, and “development”. They summarised the evolution of the research, with an overview of the geographies it covers, technologies it targets, epistemological and methodological underpinnings. In addition, they discussed qualitative findings from interviews conducted with experienced HCI4D researchers, reflecting on the ground covered, the challenges and suggestions for future growth and diversification.

The findings from these two overview papers were compared and contrasted with the review on human-computer interaction and global development by Toyama (2010) in terms of the core themes and challenges. The keywords *context*, *design* and *development* emerged as core issues when comparing the trends and challenges towards differentiating HCI4D as a research area.

The focus on context, design and development is evident in the definition of HCI4D as understanding and designing technologies for under-served, under-resourced, and under-represented populations around the world (Dell & Kumar, 2016;) but more specifically in terms of user needs and cross-cultural design (Ho et al, 2009); respecting resource constraints and focusing on practicality when designing digital technology (Toyama, 2010). The centrality of these motor themes will be evaluated by considering how the findings from the literature reviews can be related to these themes in ways that support knowledge mobilisation. These motor themes are related and any HCI4D paper would probably mention all three. However, if the focus is on the context the research would probably be guided by interpretivism since the aim is to understand the context. A design focus would be guided by pragmatism when the aim is to reconcile design requirements under specific constraints and interpretivism, positivism (or post-positivism) when evaluating the artefact. A development focus signals change (Toyama, 2017) where neither interpretivism, positivism nor pragmatism or would suffice on their own.

RESEARCH DESIGN

Mixed-methods research is a methodology which involves philosophical assumptions that guide the direction of the collection, analysis and the mixture of quantitative and qualitative approaches in many phases of the research process (Creswell & Plano Clark, 2017). In this study the methodology aligns with the philosophy of pragmatism. This section describes the mixed-methods research design in terms of the following phases:

- First, we conducted a critical literature review of HCI4D literature over the last ten years and critically analysed the results. This systematic literature review was necessary since the field is dynamic and an updated review was warranted to verify the continued validity of the earlier reviews.
- Second, we applied the knowledge mobilisers framework (Ward, 2016), to structure the findings from the systematic literature review coherently. The results were synthesised and analysed and the HCI4D knowledge mobiliser's framework was presented to support the alignment and integration of the methodologies.

Design of the systematic literature review

A systematic literature review comprises a systematic search for, appraisal and synthesis of research evidence of comprehensive scope with clear inclusion and exclusion criteria (Pickering, Grignon, Steven, Guitart & Byrne, 2014). A critical literature review goes beyond a description of the identified articles to include a degree of analysis and conceptual innovation typically manifesting in a hypothesis or a model (Grant & Booth, 2009). The latter applies to the goal of this study, namely to present a model representing the overall state of HCI4D in terms of where the research has been conducted, who has been involved (researchers' location) and how the research has been conducted (geographies). Given the interdependence between the literature review and the findings from the literature review, a clear separation between the methodological description and findings was not practical. The methodology is now presented followed by the main results from the literature review.

A systematic literature review was conducted on the databases (ACM, Springer, Scopus, and Web of Science) using the search string "HCI4D" for items published between 2007 and 2017. Initially the string ['Human-Computer Interaction' and 'Development'] was used but that was not interpreted consistently by the database search engines and therefore we resorted to using the simpler term of 'HCI4D'. We selected only English conference and journal papers. Books were excluded since they were more difficult to access.

- A total of 239 papers which included duplicates were found. Duplicates were then removed to be left with 159 papers.
- A further search for the string "HCI4D" was done in Google Scholar, which returned 314 items.
- Combining the results from the first search (159) with the results from Google Scholar (314) gave us a total of 473; from this total duplicates were then removed to remain with 349 items to analyse.
- During further analysis 136 papers were removed; these included panels, workshops, editorials, extended abstracts, forums, books, and book chapters.
- A total of 213 English conference or journal papers remained for the in-depth analysis.

The results of the analysis are presented in the next section.

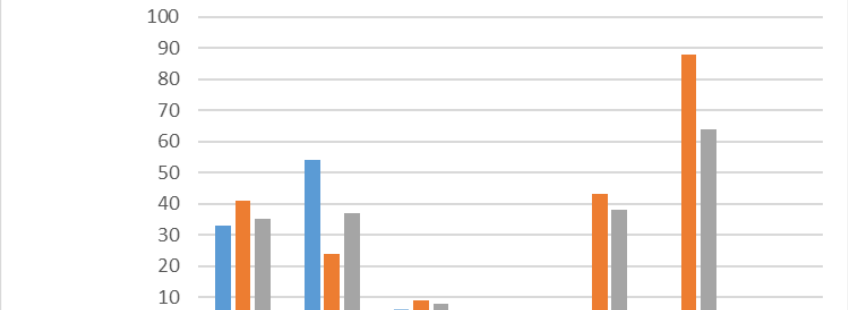
RESULTS

This section presents the results according to the *why, what, who and how* dimensions and critically reflects on the findings in terms of previous literature reviews. Note that the dataset is available from https://tinyurl.com/y7vlq76p .

Where: Geographical distribution of studies

Given the broad view of HCI4D which covers the technology interactions of all marginalised populations including groups like the elderly, HCI4D research is not confined to specific regions. Furthermore, some studies such as systematic literature reviews are not linked to a specific country and author affiliations (as used to determine the author's country of origin) can change. Despite these limitations, the geographical distribution per continent can provide some insight into where the most studies have been done during the past 10 years.

As depicted in Figure 1, most studies (52%) were done in Asia. This was followed by Africa (32%), Australia (6%); North America (5%), South America (3%), Europe (1%) and Eurasia (1%). The results for Eurasia and South America could have been influenced by the fact that only English papers were considered.



	Africa	Asia	Australia	Eurasia	Europe	North America	South America
Studies done	33	54	6	1	1	5	3
First Author	41	24	9	2	43	88	1
Second Author	35	37	8	1	38	64	1

Fig 1. Research location shown in broader geographical areas

From observation, the number of studies done per country (%) is not always proportional to the number of first or second authors from the same country. This means that much of the research in Asia and Africa is being led by researchers outside those countries. This issue of the Global South being an intellectual playground for Western ICT4D scholars has been raised before – for example, Gitau, Plantinga and Diga (2010) highlighted the then almost negligible representation of African researchers in formal academic publications. One of the consequences is that key theories in ICTD could be formed without significant influence by African scholars (Gitau, Plantinga & Diga, 2010), another is that the indigenous theories from developing countries are not being published. Considering developing regions, Bai (2018) differentiates between core countries and peripheral countries in the publication on information and communication technologies for development research. The fact that peripheral countries are studied by scholars from core countries without participation from authors from the peripheral countries means that besides the question whether the Global South has become an intellectual playground for Western ICT4D scholars, there is also the question whether the poorest countries in the peripheral region have become an intellectual playground for scholars in the core countries in the same region (Bai, 2018). On the other hand, foreign researchers provide much-needed funding, research skills and expertise on how to publish in high-impact journals. Therefore, the contribution of foreign researchers and the continued need for their involvement should not be underestimated.

Who: Target users and researcher populations

Dell and Kumar (2016) discussed the target users under the categories of *ground-level users* (bottom of the information hierarchy), *human-access points* (individuals who have direct access to the ground-level users)*; collective entities* (organisations and communities) and a *general group* (ill-defined and all-inclusive). The application of this categorisation in our analysis yielded the following:

- Ground-level users: Agricultural community (Farmers) (3), Learners (2); University students (4); Teachers (4); Illiterate, semi-literate (7) Older people (4); Low-income (11); Migrants or

Refugees (7); Women (11); Mobile phone users (15); Households (6); Wi-Fi users (2); Patients (4)

- Human-access points: Healthcare workers (19); Microfinance (2); Researchers (12)
- Collective entities: Communities (45); Organisations (13); Citizens (9), Rural (22)
- General: Those papers not matching any of the above (33)

The findings on the user categorisation indicates a substantial number of papers in each of the categories. This confirms that those categories are relevant in describing the target populations.

WHY: Focus areas

An analysis of the application domains of HCI4D research provides insight into the larger purpose that motivates the researchers (Dell & Kumar, 2016). The work we surveyed covered a wide range of focus areas (see Figure 3). That excludes the 74 papers which stated the application domain as a marginalised *community* or those without any specific domain. It can be observed that the domains of health, education and access, which were previously identified as the most prevalent (Dell & Kumar, 2016) is still well-represented but theory building (including literature reviews) has increased and there is diversification into many new application domains such as Entertainment, Data4Dev, and Transportation.

Notably some papers belong to more than one application domain, for example the paper on mobile phone (cell phone) charging trials in off-grid Kenya (Wyche & Murphy, 2012) which deals with access and community; therefore the total of the application domains assigned (301) is more than the 213 papers analysed.

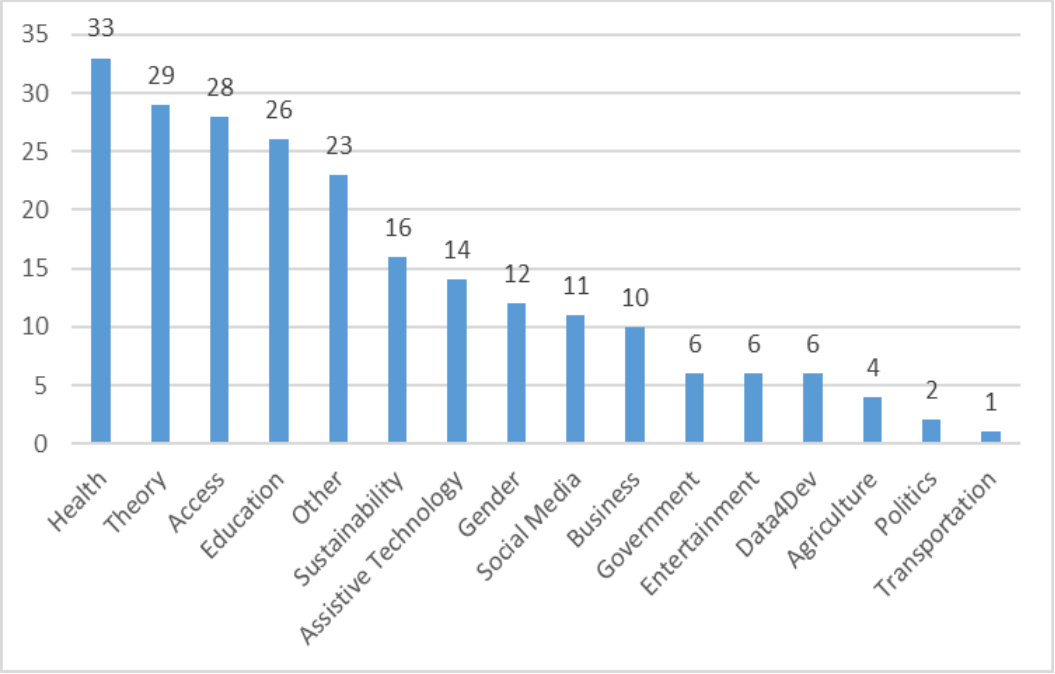


Fig. 2. Ranking the application domains

WHAT: Technology and interface

The papers were categorised according to the technologies of Mobile phone (58%), PC/Laptop (24%); DVD/Video (2%); Other (7%); No technology (9%). These categories were not exclusive since a study could involve more than one technology and hence the total number concerning technologies used was 251 where the number of papers analysed was only 213.

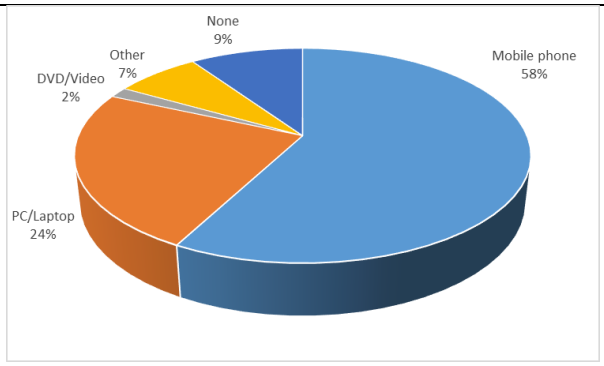


Fig. 3. Technologies used in the research

HOW: Research methods

Finally, we analysed how the research was executed by considering the methodologies used. Previous studies described the methodological approaches as quantitative, qualitative and mixed-methods but did not report on the methodologies. The histogram of the methodologies found in this research is depicted in Figure 4. The prevalence of design science research and participatory design reflects the design and implementation orientation of HCI while the presence of systematic literature reviews and specifically grounded theory is promising in terms of improving the theoretical focus – an aspect in which HCI4D has been lagging (Dell & Kumar, 2016). The range of methodologies identified and the number of mixed-methods studies support the statement that HCI4D, like HCI has been able to respect the unique strength of different methodologies and accept diverse epistemological leanings. Only two papers explicitly mentioned the philosophy, namely the papers by Salerno, Ouma and Botha (2015), and Zewge, Dittrich and Bekele (2015) – and in both cases that was interpretive. However, the focus on *participatory design* and *design science research* suggests pragmatism as a philosophy since the latter is often associated with design-focused research (Hevner, 2007). Critical realism was never mentioned as a philosophy but then, only two papers did explicitly mention a philosophy. The HCI4D focus on real-world problems and commitment to intervention aligns with the goals of international development. According to Heeks and Wall (2017) critical realism offers two particular types of value for ICT4D research. The first type includes the generic values of critical realism while the second type comprises the goal of realising international development. The following generic values are associated with critical realism: exposure of context, a contingent causality that reflects real-world ICT4D experiences, legitimisation of different stakeholder views and reduction of research bias, and finally support for ICT4D's interventionist approach (Heeks &Wall, 2017).

An analysis of the Mobile for Development Conference papers (2008–2016) revealed that philosophical and theoretical underpinnings were under-reported and the methodologies were not clearly articulated (Van Biljon & Renaud, 2018). However, they contend that the lack of models and frameworks may not necessarily imply a lack of theorisation but rather the use of alternative levels and formats of the contribution – for instance, specifications, standards and guidelines (Van Biljon & Renaud, 2018). Furthermore, in some disciplines like Computer Science the focus

on epistemologies and ontologies are less pronounced and that can affect theorization in multidisciplinary, interdisciplinary or transdisciplinary outputs.

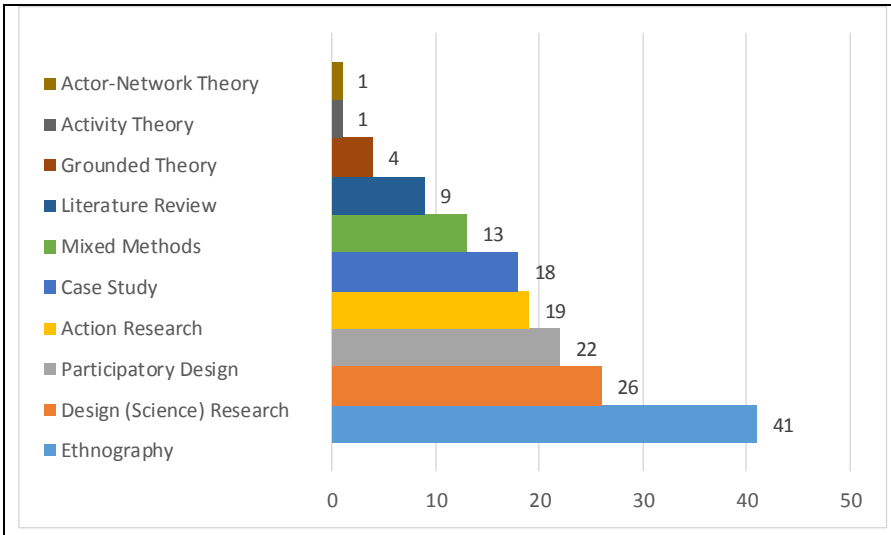


Fig. 4. A comparison of the methodologies used in terms of the actual number of studies

4. Discussion

4.1 Framework

The findings from this study are summarised in Figure 5. The core constructs are grouped under the three clusters of *context* which includes constraints, cross-cultural and unique needs, *development* which includes the real-world focus and the commitment to improvement (change) towards realising international development goals, and *design* which includes user participation, design methods, evaluation methods and technologies. These core constructs originate from the definitions of the term HCI4D as discussed in the literature review, and were confirmed by the foci of the papers reviewed. The overview of the HCI4D field is summarised by delineating the field in terms of the following dimensions: focus areas (why), the technology and interface (what), the target users and researchers (who) and the research methodologies (how).

The recurring themes are based on Toyama (2010) with the addition of "lack of theorization" (Ho et al, 2009); sustainable development (Heeks, 2018); ethical issues and participatory design

(Abdelnour-Nocera & Densmore, 2017). Later discourses include user aspirations (Toyama, 2017), choices and capabilities (Kleine, 2010) and postcolonial computing (Irani et al, 2010). According to a more recent study by Bailey and Osei-Bryson (2018) the intersecting concepts of inclusive, sustainable and responsible social innovations in local and global contexts continue to be key focus areas for researchers exploring the development of, access to, and usage of ICTs, by people living in resource-constrained environments. The *why, what, who and how* insights depicted in Figure 5 can be applied according to the three tiers of *context, development and design*, summarised as follows:

Development

This focus relates to theories conceptualising development, theories conceptualising the use of ICT and theories on the transformative processes linking ICT to development. While most papers did not specify any philosophy, critical realism can be considered as an overarching philosophy to ensure that the outcomes of the research serve the development goals. This focus requires an explicit explanation of the contribution to development in terms of linking the outcomes to development goals. The under-representation of the researchers from the countries where the research is conducted has been noted as an issue that could have an effect on the discourses and theorisation.

Context

This implies an understanding of the unique user needs, expectations and constraints in interacting with the artefact. Here the individual end-user is mostly the unit of analysis; however, the group interactions may be considered in some cases. The interpretive philosophy usually guides this phase where abstractions such as the Choice framework (Kleine, 2010) can be used to ensure the validity and rigour of the data capturing. The under-representation of the researchers from the countries where the research is conducted is particularly problematic when the goal is to understand and describe the context.

Design

The aim of iterative design with user participation resonates with the design science research (DSR) approach where DSR is used to structure the design, implementation and development phases – but here it has the additional qualifier of "for development". Based on our literature review, most papers do not propose a philosophy but given the generally acknowledged commitment to user-centred design and context-awareness it means reconciling development goals with usability. Toyama (2017) highlights the tension between *international development*, which is understood to refer to internal traits that require changes in human capital, institutional capacity, and mass values, and the *technologist's conception of needs* suggesting solutions that change external context through technological artefacts. The philosophy in this phase is usually pragmatism to allow in situ prototyping and evaluation.

Participatory design principles are fundamental to guiding the design process but positivism (or post-positivism) or interpretivism can be used in guiding parts of the usability assessments. Participatory design is the core methodology but user experience and usability including the components of effectiveness, efficiency and user satisfaction are used to guide the selection of the evaluation methods. Therefore it is important to acknowledge the related philosophies and epistemologies.

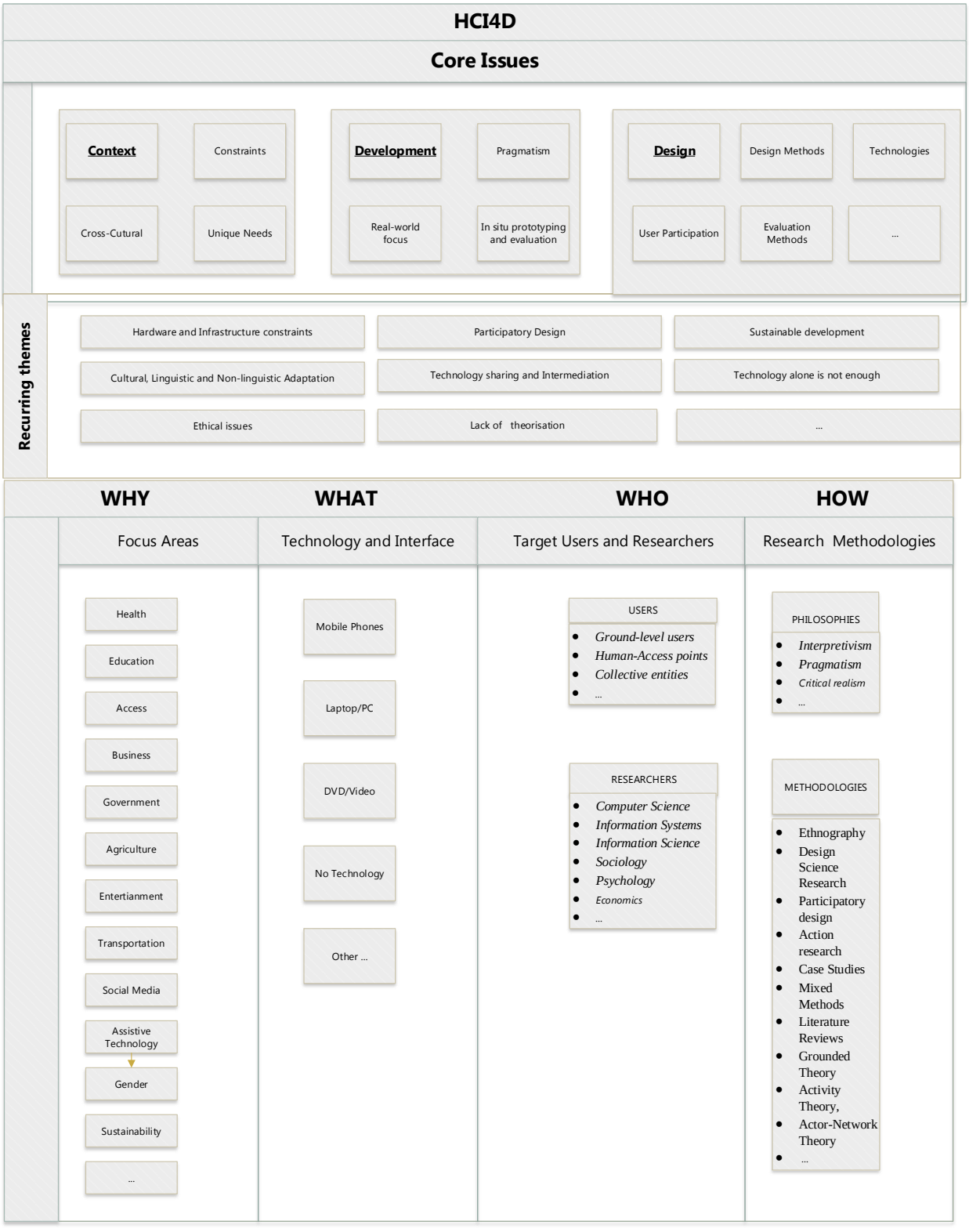


Fig 5: The Human-Computer Interaction for Development – knowledge mobilisation framework

4.2 Limitations

Some design decisions have affected the relevance and rigour of the findings. This section discusses the trade-offs and consequences of the design decisions. The choice of the term "HCI4D" for the keyword search limits the results by possibly excluding relevant studies. Furthermore, the term may have been used more in certain regions and thus that could influence the selection of the results. On the other hand, this provides a clear focus as a point of departure. Adding the terms "ICTD", "low-resource", "developing world", "developing regions", and "development", as previous studies have done, dilutes the focus by adding publications relating to development but not HCI4D – given the fact that not all search engines and databases follow Boolean logic consistently.

The period, namely 2007–2017 excludes important earlier papers. However, the fact that the previous literature reviews were conducted consecutively provides the opportunity for comparing and contextualising the findings from this study (2010–2017) with the situation in 2009 (Ho et al, 2009) and again in 2016 (Dell & Kumar, 2016). Despite significant differences between HCI and HCI4D, both communities have the capacity for reflection and self-critique (Toyama, 2010) and this study will hopefully build on that tradition.

In terms of generalisation, the core constructs are stable yet incomplete. The items listed in some of the dimensions may change somewhat – for example, under technology but most of the knowledge elements are unlikely to change fast. The recurring themes, challenges and discourses may change over time but the structure of the framework and the core explanatory sections will remain stable.

The visual presentation of the framework highlights the boundaries and the incompleteness of the knowledge elements. However, any theorization of HCI4D research would have to deal with these complexities and focusing on the limitations rather than the potential for integration and synthesis may well be one of the reasons for the lack of theorisation. Therefore, we propose this knowledge mobilisation framework as a point of departure in positioning HCI4D

4.3 Contributions

First, the paper provides a concise, high-level overview of recent research that enables readers to take stock of the current state of HCI4D and how the body of work has developed as a whole. Specifically, this study builds on existing literature by following the idea of a conceptual map (Ho et al, 2009) and then using the dimensions proposed by Dell and Kumar (2016) to structure the systematic literature review conducted. Second, the findings from the extensive literature survey are presented as a knowledge mobilisation framework in response to the fundamental domain questions. That is significant since the response to the fundamental domain questions can form the basis of a theory (Gregor, 2006). The framework is proposed as a point of departure in generalising and integrating the reflections towards descriptive theorisation. On a practical level the framework can be used to inform multi-disciplinary teams developing theoretical explanations about phenomena in the world where the application domain is the integrated design, development and iterative evaluation of (digital) artefacts for development.

ICT4D research can be enriched by the approaches to design, and the body of methodologies, specifically the evaluation methodologies from HCI (and by extension, HCI4D). On the other hand, both aspiring and seasoned HCI researchers can better understand how their work could connect with broader global realities. With these aggregate insights we aim to inform HCI and ICT4D researchers, particularly those whose primary domain may be outside of HCI4D, about the depth and breadth of HCI4D research and the associated opportunities.

The abstracted data is available from https://tinyurl.com/y7vlq76p and the methodology has also been recorded to make the study more replicable than any of the previous literature overview studies. The knowledge visualisation conceptual framework provides an accessible, though not complete or prescriptive theorisation of the field as a point of departure in furthering HCI4D research.

Conclusion

This paper presents an overview of the HCI4D research domain based on a systematic literature review. The findings are integrated and synthesized to form the basis of a knowledge mobilisation framework; a theorisation to be interrogated and critiqued towards aligning and

linking the sub-domains in HCI4D research across philosophical and methodological bases. Note that each focus area (development, context and design) has a prevailing philosophy which suggests appropriate methodologies and therefore HCI4D research requires multidisciplinary, interdisciplinary or transdisciplinary teams. Acknowledging the continued growth and diversification in the field, the HCI4DF framework is proposed as a non-prescriptive point of departure for verification and further research in the field of HCI4D.

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