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## **DEVELOPMENT, CAPABILITIES AND TECHNOLOGY – AN EVALUATIVE FRAMEWORK**

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**Abstract:** In this paper we present a framework to be used for evaluation of Information and Communication Technology for Development (ICT4D) projects. The framework is based on Sen's notion of development as freedom where human capabilities and functionings are seen as key aspects to development. Sen's capability approach presents an alternative way of seeing and evaluating development (alternative to more traditional ways of measuring development). The approach is based on expanding freedoms, or eliminating unfreedoms, for people so that they can live a life that they have reason to value. Even though Sen is referenced a lot in ICT4D literature the analysis rarely goes further than stating that Sen presents an alternative to traditional ways of development. Reasons can be that the capability approach does not specifically mention technology, in addition to the lack of guidelines presented by Sen on how to use the framework. The aim of this paper is to operationalize the evaluation process and to include a clear role for technology in Sen's capability framework. The framework is validated with a case on distance education from Bangladesh.

**Keywords:** ICT4D, capability approach, evaluation, framework, education

# DEVELOPMENT, CAPABILITIES AND TECHNOLOGY – AN EVALUATIVE FRAMEWORK

## 1. INTRODUCTION

Development is a complex term that has changed over time (Schuurman, 2000; Simon, 1997). Traditionally, development thinking focused on income and GDP per capita whereas alternative approaches focused on human development (in addition to economic development) – e.g., education, healthcare, mortality (Peet, 1999). As this paper is situated in the field of information and communication technologies for development (ICT4D), we investigate how information and communication technology (ICT) can be used to foster development (Heeks, 2008; Unwin, 2009). Technology's role for development is not always clear and there is a need to explicate the meaning of development and the role of ICTs (Walsham & Sahay, 2006). ICT research in developing countries is challenged by critical issues associated with the role of technology when encountering questions on policy and practice of development (Avgerou, 2008). One such critical issue is the evaluation of ICT interventions (Heeks, 2010; Pather & Uys, 2010). Evaluation research has developed from the need of evaluating public programs of social change in order to show if services and improvement efforts were succeeding (Stufflebeam, 2001). In ICT4D there has been several attempts to develop frameworks for evaluation (see e.g. Harindranth & Sein, 2007; Heeks & Molla, 2009; Romm & Taylor, 2000; Sein, 2005; Sein & Harindranth, 2004). Despite the often unclear role of ICT, and many early reports on the failure of ICT4D projects (Avgerou & Walsham, 2000; Heeks, 2002), the focus in the ICT4D debate is now on how, not if, ICT can lead to development (De' & Ratan, 2009; Sein & Harindranth, 2004; Walsham, Robey, & Sahay, 2007). To help us answer the how question we turn to Amartya Sen's capability approach. By using the capability approach as the theoretical foundation we adopt a participation evaluation approach (House, 1980) where we see evaluation as an inductive process, and as a participation exercise that is based in personal situated knowledge.

Before we can start assessing ICT4D projects we need to “define which development paradigm we are working with and secondly, to refine our understanding of development processes to recognize their systematic nature” (Kleine, 2010, p.676). One of the most influential development theories is Amartya Sen's capability approach (see e.g. Sen, 1980, 1984, 1999, 2000, 2003, 2009). Sen proposed an alternative to traditional development theories by seeing development as the expansion of people's freedoms. The capability approach has had an impact both on the academic community (e.g., courses, associations and conferences) and on politics (e.g. UNDPs policy making) (Robeyns, 2006). It is much used in political and economic studies and has gained some interest in ICT4D studies. For example we find Zheng and Walsham (2008) using Sen's writings on capability deprivation as social exclusion as a basis for their analysis of two cases, one in South Africa and one in China. The analysis is focused on capability deprivation in terms of well-being freedom and agency freedom. Madon (2004) uses Sen's notion of capabilities to develop an evaluative framework to analyze the development impact of eGovernance projects in India. Alampay (2006) uses the capability approach to analyze the outcome of the implementation of universal access to ICT policies using survey data in the Philippines. These examples show the usefulness of the capability approach when evaluating the linkage between ICT implementations and development (as defined by Sen). Using the capability approach as an evaluative framework allows us to go beyond superficial variables of access or usage and focus on the ends instead of means, highlight the importance and variations of local conditions and understand the process of development (Gigler, 2004; James, 2006; Madon, 2004; Zheng & Walsham, 2008).

Despite the above examples, the use of Sen's capability approach in ICT4D studies is low and reasons for that are that it is hard to apply methodologically (Zheng & Walsham, 2008), and because there is an absence of technology in Sen's writings. There is also a deficit in a clear development focus in many ICT4D studies – something which is highly needed when using the capability approach.

The aim of this paper is to develop a framework to be used for evaluation of ICT4D projects by including technology in Sen's capability approach and by operationalizing the evaluation process. The research question is: "How can Amartya Sen's capability approach framework be operationalized to evaluate ICT4D projects?"

## 2. DEVELOPMENT AS FREEDOM

Sen's notion of development (Sen, 1999) is inclusive. He does not specify which variables to base the evaluation of development on. This is in contrast to many other development theories that have defined variables that development should be measured by. For example economic theories measure development based on household income or gross national income (see e.g. WorldBank, 2010) and human development approaches measure literacy, nutrition, healthcare etc. (see e.g. UNDP, 2009a). Sen aims at expanding the information base for development and shifting the focus from a measurable variable to the process and the actual outcomes, i.e. the freedoms that people enjoy and have reason to value (Sen, 1999). The focus of the capability approach is the expansion of people's freedom that either can be done by making new freedoms available or by removing unfreedoms (Sen, 1999). The shift in focus involves looking at the reasons for introducing different functions, e.g. wealth and healthcare. Internet, for instance, has gained a lot of positive attention since it makes information available for all to use. But is a constantly expanding repository of information development? In Sen's view we instead have to ask ourselves what the reasons are for wanting more information and what we can do with it. How access to more information can expand people's freedoms and enable them to live the lives they want and chose. Hence, we have to look at what capabilities and functionings are enabled.

Functionings can be seen as a person's doings and beings, e.g., eating, reading, being happy, and a person's capability should be seen as the person's ability to achieve valuable functionings and choose between them (Sen, 1989). Capabilities are, hence, the set of functionings that persons can choose to utilize. In its most basic sense a functioning can mean to not be hungry by eating and the capability is having the means to avoid hunger (Sen, 1984) by having the choice between buying food from an income or growing your own food. A person's actual freedom is represented by having different choices and "by the person's 'capability' to achieve various alternative combinations of functionings, or doings and beings" (Sen, 1990, p.114).

The conversion of a potential functioning into a realized capability is determined by three conversion factors: personal (gender, literacy etc.), social (laws, public policies etc.) and environmental (infrastructure, resources etc.) (Sen, 1992). A strength with the capability approach is that it allows for individual diversity (Zheng, 2009) and "individual variations, as well as structural differences in society, are important factors to be taken into account in evaluating development initiatives" (Zheng, 2007, p.4). Freedoms, consequently, involve both the process to obtain freedoms and people's opportunity to convert potential functionings into achieved functionings given their individual and social circumstances (Sen, 1999). In the analysis of development based on the freedom perspective we must therefore look at both the functions that are made available to people and their opportunity to utilize them given their specific context. The two are interrelated and in the analysis we cannot exclude one in favor of the other. As an example, if a project aims to expand people's access to high quality education material and we in the analysis can show that the amount of material has increased we would be inclined to announce the project a success. But if people lack the opportunity to convert the new material into an achieved functioning due to e.g., illiteracy or gender inequality the project would have to be considered to have failed based on the freedom approach.

### 3. THE CAPABILITY APPROACH FRAMEWORK

We base the design of the framework (Figure 1) on Sen’s writings, and on operationalizations of the framework by researchers outside the field of ICT4D (e.g. Alkire, 2002, 2010; Alsop & Heinsohn, 2005; Frediani, 2010; Robeyns, 2005a, 2005b, 2006) as well as ICT4D operationalizations of the framework (e.g. Gigler, 2004; Kleine, 2010; Madon, 2004; Madon, et al., 2007; Zheng, 2009; Zheng & Walsham, 2008). Many of the operationalizations have similarities to the framework presented here but there are also differences. For example, Zheng and Walsham focus on capability deprivation and Kleine focuses on the choice aspect for human agents. In our approach we focus on the difference between potential and achieved functionings and the importance of context. We also add a role for technology in the framework. In order to validate the framework we apply it to a case in Bangladesh.

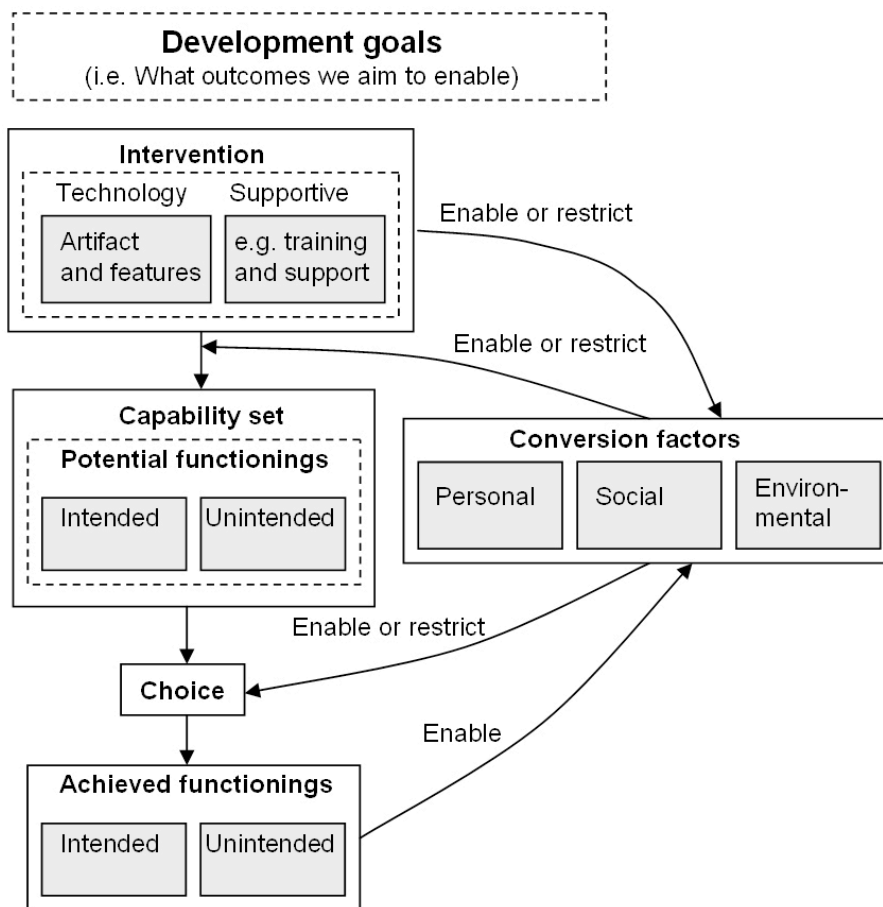


Figure 1: The capability approach framework

#### 3.1. Intervention

##### *The role of technology*

Even though Sen does not mention technology it is not hard to fit technology into his capability approach. Technology is a commodity and just as Sen argues for seeing income as a means to development and not an end in itself (Sen, 1999) the same logic can be used for technology. Technological artifacts should not be seen as the end result, technology is a means to achieve freedom. Shipping computers to third world countries, building broadband across Africa etc. is in itself not development; it is a means to enabling people to develop. We can also argue that it is not the technology in itself that is enabling; it is the features within the technology (e.g. software applications) and the use of them that are enabling and should be the analytical level. As an example, when analyzing the impact of mobile phones for development the focus should not be on

the technology but rather on what it enables, how different uses of mobile phone features have impacted human lives (their freedom to live a life they value). This means that evaluating the development of countries, and ranking them according to e.g. number of mobile phones reveals little in terms of development as enabling of capabilities.

### *Supportive functions*

Only focusing on technology in the analysis would be erroneous (in most cases). Introduction of technological artifacts and applications have to be supported by non-technological functions. Computers with educational applications (that could act as a means to development) are being locked away because the teachers lack the necessary computer skills or even more fundamentally, they lack electricity. Supportive functions needed could be teacher training, training of IT support personal and improving the infrastructure.

### *Enabling or restricting conversion factors*

Introduction of technology and applications can also have an effect on the conversion factors:

“The exploitation of commodities, such as technology, certainly contributes not only to social conditions but also the personal characteristics which, in term, feed back to conversion factors and decision making mechanisms. Therefore, commodities are important for their contributions to both individual capabilities and to conversion factors.” (Zheng & Walsham, 2008, p.227)

As an example, expanding Internet access will, of course, both enable functionings related to Internet access as well as improving the infrastructure (conversion factor).

In the analysis of technology as a means to enabling functionings we must therefore focus on the features within the technology that can enable capabilities, what supportive features that are needed and how they affect the conversion factors.

## **3.2. Functionings and the Importance of Context (Conversion Factors)**

### *Conversion factors*

Humans are diverse and have different opportunities to benefit from interventions. This is essential in our analysis of ICT4D interventions.

“We are deeply diverse in our internal characteristics (such as age, gender, general abilities, particular talents, proneness to illness, and so on) as well as in external circumstances (such as ownership of assets, social backgrounds, environmental predicaments, and so on)” (Sen, 1992, p.xi)

In our analysis we have to take this into consideration and look at what conversion factors (personal, social and environmental) prevent individuals from expanding their capabilities. In our development projects we can either design the intervention to fit within the context or design interventions that change the context (i.e. the intervention can remedy problematic conversion factors). As an example, the technology chosen for the case study (discussed later) is mobile phones instead of the Internet. The reason is that the mobile phone infrastructure is more developed than the Internet infrastructure in the given context. Conversion factors will influence both the enablement of potential functioning and the ability of people to utilize the potential functioning i.e. their ability to make choices. What functionings the intervention enables must be evaluated within the context where it is deployed.

### *Potential and achieved functionings*

Sen differentiates between two different outcomes: culmination outcomes (a list of capabilities without taking the process into consideration), and comprehensive outcomes (involving the process of choice) (Sen, 1997). Since functionings are people's doings and beings we have to evaluate what the intervention enables people to do and be. If the development intervention aims

to inform rural children about the HIV virus the primary functions are to be “informed about how to prevent getting HIV” and ultimately “to be healthy”. Most interventions are, however, not just enabling one functioning. Additional functionings that may be enabled are literacy, sex education etc. In our analysis of functionings we have to be sensitive to the social and economical context of the intervention. If we were to develop an application for information about HIV the best option from a technical perspective may be to build an interactive website. But if the target audience does not have access to the Internet, are not trained in using the Internet or do not have electricity it will, of course, not be the best solution in the given context (if the supportive features cannot enable it). The capabilities that are enabled can either be intended or unintended (but sometimes predictable) (Sen, 1999). As an example, the introduction of mobile phones in Burma was not intended to facilitate the publishing of the oppressed people’s images and videos but that is still a capability (unintended) that the introduction of mobile phones enabled.

There is a difference between a potential functioning and an achieved functioning (Robeyns, 2005a). An intervention can enable a potential functioning but conversion factors may hinder the choices of the people to utilize it. If we, e.g., introduce better facilities and access to education for girls we have enabled a potential functioning (i.e. to be educated). But the girls’ ability to convert the potential functioning into an achieved functioning may be hindered by their choices (or lack there of). They may have to work instead of going to school to help support their families or they may live in a culture where it is hard for girls to get an education etc. The choice aspect is therefore essential in the capability approach.

“Mainly the outcome component will map or measure the achieved functionings resulting from an individual’s choices as a proxy for the capabilities” (Kleine, 2010, p.679)

In our analysis of ICT4D interventions we have to focus on both the choice aspect, (i.e. why do people chose to utilize the functioning and what prevents them from making the choice) and the outcome of their choices (i.e. expansion of peoples freedoms as achieved functioning). An achieved functioning can also have an effect on the conversion factors and enable individuals to make additional choices.

## **4. APPLYING THE FRAMEWORK**

To validate the framework we apply it to a case that one of the authors has been involved in from 2007-2010.

### **4.1. Case Description**

The case is in Bangladesh which is ranked as a medium human development country by UNDP (2009b). UNDP also ranks Bangladesh as one of the poorest, and most densely populated, countries in the world with a population over 150 million. The education system is segregated among poor and rich. The richest 20% of the population attend 8 years of education on average whereas the poorest 20% only attend school for 3.6 years (UNESCO, 2010). The literacy rate for the whole population is 47.9% (CIA, 2009) but for youth the literacy is over 70% (UNICEF, 2010).

Infrastructure is poorly developed in Bangladesh with insufficient power supply and poor access to Internet and computers - only 0.36% of the population are Internet users (CIA, 2009). The mobile network coverage is, however, well developed and reaches 97% of the population and 82% of the land area (Grönlund & Islam, 2008). The number of mobile phone subscribers is, however, low (29% of the population, CIA, 2009) but the number of actual users is higher as studies show that people share phones in their communities (Islam S. M. & Grönlund, 2007; ITU, 2010). At the household level it is estimated that around 90% of the people in the urban areas and 70% in the rural areas have access to a mobile phone (Grönlund & Islam, 2008). Bangladesh also has among the cheapest rates in the world for sending SMS and calling on mobile phones.

The intervention used to validate our proposed framework is the Bangladesh Virtual Classroom (BVC). BVC is the development of a methodology and software for delivery of interactive distance education using mobile phones and TV. The aim of the project was to provide interactive education to distance students using available and appropriate technology (Andersson, 2010; Andersson & Hatakka, 2010; Grönlund & Islam, 2008). The rationale behind the development project is that communication and interaction in education is paramount to develop critical and self-reliant students (see e.g. Andersson, 2010; Freire, 1970; Hatakka, 2010). Bangladesh also suffers from low throughput in education which is said to be due to ineffective teaching methods (Grönlund & Islam, 2008).

BVC started in 2005 with the development of a methodology and software for interaction using constructivist pedagogy, as well as a teacher training program. The methodology was tested and deemed appropriate for distance education (Islam T, Rahman, & Rahman, 2006; Islam Y. M., Rahman, Rahman, & Ashraf, 2005) and in 2007 negotiations were started with Bangladesh Open University (BOU) to test the methodology on one of their courses. BOU is the only public university in Bangladesh that teaches in distance mode. The aim of BOU is to help facilitate education for those that “for various reasons drop out of the conventional system of education” (BOU, 2010). For many students in rural parts of Bangladesh BOU is the only viable option to attend higher education. BOU enrolls over 250,000 students all over Bangladesh and the majority of those are located in rural areas with poor living conditions. Traditionally BOU uses radio, television and printed material in their education. In addition to broadcast lectures students also have the option to visit BOUs learning centers that are located all over Bangladesh (Andersson, 2010; Andersson & Hatakka, 2010). Students can go to the learning centers every Friday to get lectures and help from teachers; the learning centers do, however, teach the old curriculum and are not equipped with the technology needed for the BVC project.

In 2007 the software for the project was re-developed. The plan was to develop functions so students could, a) interact with teachers (sending in questions and comments, answering questions, sending in homework etc.), b) interact with the course material (take self quizzes, download text paragraphs etc.) and c) interact with peers (learning partner assignments and homework). With the system the teachers could interact with students and monitor the student's interaction and progress.

In the fall of 2008 BOU agreed to test the methodology on a Higher Secondary Education course. Five teachers were selected to teach the course and a workshop was held to explain the BVC methodology and technology. The teachers were also trained in writing scripts for the recordings of the interactive lessons. The BOU teachers were not used to talking to students directly as their main teaching duties consisted of providing students with printed material and recording radio or TV lectures. Neither the teachers nor the students were used to interactive education as Bangladesh traditionally adopts a transmitting and authoritarian pedagogy (Andersson & Hatakka, 2010) which can be traced back to the British colonial era (Heitzman & Worden, 1989). Therefore, in addition to introducing new technology for interaction in education the project also had to change the pedagogical culture (Andersson, 2010). Lack of computer literacy was also a challenge for the teachers, all of them had used computers, but to a limited extent. In early 2009, 28 interactive lessons were recorded and broadcast to the students at 07.00 am every Saturday.

## **4.2. Analysis of the Result of BVC**

### *Intervention*

Most of the planned technological features were developed but with one exception. The functions to enable collaboration among peers were tested in the initial recordings but not implemented in the final version.

The supportive intervention was workshops with teachers so they could use the technology and teach according to the new pedagogy. This was done on several occasions. First, material for teacher training was developed called “Educate the Educator”. Second, several workshops were



held with the teachers to teach them how to interact, how to write scripts for interactive teaching etc. Several test recordings were also made and analyzed. The plan was also to equip learning centers with technology needed to teach the new pedagogy and curriculum. This was, however, abandoned and the project relied on the learning centers traditional facilities and teaching methods.

### *Capability Set*

The potential functionings that the system supported was that it enabled students to interact with teachers using SMS (asking questions, answering broadcast questions, sending in comments, submitting homework etc.). It also enabled students to assess their learning by taking quizzes after each lecture (i.e. testing if they had understood the lecture) and access content for self studies (e.g. download short paragraphs for reading comprehension). By submitting homework to teachers it also enabled a validation of the knowledge. The potential functionings were, however, restricted by a number of conversion factors. First, the TV lessons were not broadcast live (since national regulations prevented this) which resulted in less interactivity with teachers as the functions that were planned to be live were only simulated (i.e. broadcast lectures gave the appearance of live interaction). Teachers also lacked a user-friendly interface for adding and updating content on the server which had an effect on both the teacher-student interaction (teachers had no easy way to see what students asked or reply to their questions and submissions). It also limited the amount of content for students to use for self assessment and learning as there was no intuitive way for teachers to add more content. Even though this clearly was a mistake in the intervention it can also be ascribed to teachers' computer illiteracy. As the supportive function to equip learning centers with the appropriate technology was abandoned students had to rely on their own access to the needed technology. The mobile infrastructure in Bangladesh is fairly well developed but the lack of supportive tools for students did prevent some students from using the system (e.g. due to their financial situation).

### *Choice and achieved functionings*

Students' choices to convert the potential functionings into achieved functionings were hindered by an additional number of conversion factors. As the technology for educational purposes as well as the concept of interactive education were new to both students and teachers the conversion factors of technology literacy and educational culture were essential for the project's success. Students were neither used to interactive education nor to the use of technology in education. Students were quick to adapt to the new technology but observations of their interaction revealed that they had a hard time adapting to the new pedagogy. They chose to use it according to their "old" transmitting pedagogy and not as intended by the new constructivist pedagogy. Instead of thinking for themselves they were more prone to just repeat what the teacher had just said. So even though the system enabled new means of interaction it did not necessarily enable the functionings that were intended (i.e. in accordance with a constructive pedagogy). They were dependent on the teacher and did not use the tools to develop their critical thinking or assess the teacher's knowledge. Their deeply rooted pedagogical culture determined how they chose to use the system. The plan was to let the learning centers help students with the new pedagogy, but since this was not achieved the students were left on their own. As the learning centers did not teach the new pedagogy, it had an impact on the student's ability to take the course and adopt the new pedagogy. Even though their use was limited the system did have an unintended consequence as students felt more prone to interact with teachers. Some students expressed that they previously were too shy to approach teachers but the technology allowed them to hide and remain anonymous.

The TV-lessons were aired at 07.00 am on Saturdays and students that worked or had other engagements were unable to view the lessons. When they had the choice between viewing the lessons on TV or earn a living they of course chose the latter. The time was set by Bangladesh National TV so the implementation of the program was restricted by their regulations. The plan was to let the learning centers show the lessons from a DVD but it was not made available.

Due to lack of functionality and content in the system students also, after initially trying it, chose not to continue using it. They did not feel that they gained anything from it that they could not learn by just watching the lessons and reading the text books. Hence, they did not have any incentives to use the system and did not feel that the costs for sending SMS were worth it. As both the pedagogy and tools were new to them it was planned to make interaction via SMS mandatory to pass the course, thereby, enabling them to see the benefits of the interaction. This was however not possible due to university regulations so the interaction remained optional for students and teachers.

### *Lesson learnt*

The project was too focused on the actual system and did not sufficiently address the conversion factors needed to make the project successful. Pedagogical training was needed for students and the project had to support the low computer literacy among the teachers. National and University regulations were also a hindrance for the project. Many of those could, however, have been avoided by supportive interventions. Equipping learning centers with the appropriate tools and technologies would have made it possible for students to take the interactive classes at a time that was more convenient for them. We also underestimated the importance of the traditional educational culture in Bangladesh which is deeply rooted in the students mind.

## **5. CONCLUSION**

If the test case was analyzed from a technological perspective the project could be seen as successful. The system and the methodology was developed, tested, and implemented. Interactive lessons were recorded and broadcasted on Bangladesh National TV. However, when we analyze the project using the capability approach we can see that few new functionings were made available and even fewer were utilized by the students. The capability approach thus allows us to go beyond superficial variables of technology implemented and focus on actual outcomes. In order to capture which capabilities that are enabled and what contextual factors which may influence both the transformation into potential functionings and the user's choices a deep analysis is needed including the socio-cultural conditions of the users (i.e. demographics, infrastructure, location, economic situations etc.). When applying the framework to the case we can see that not enough attention was given to the context of the students, the intervention was focused on the technology and the teachers. The analysis also shows that just because an option is made available (as a potential functioning) it does not necessarily mean that students gain any value from it (achieved functioning). In our example we can see that students chose not to view the interactive lessons at 7 am because the alternative, to earn a living, has a greater payoff for them. In this case we can even question if viewing the lessons is an actual choice they have, the social and economic context of the students may prevent enabling of an achieved functioning. In our analysis we must, hence, be sensitive to which choices people actually have and not just what choices are made available.

When using the capability approach we also have to take a bottom-up approach. Which capabilities may be enabled to enrich people's lives have to come from the users themselves. This means that the analysis has to be individualistic as there will be variations within otherwise heterogeneous groups (both in term of which capabilities they value and what factors that hinders their choices). In our test case we can see that students used the system (although limited) but they did not use it as intended by the designers. Hence, the achieved functionings were based on their context, their choice and their ability to use the system as they deemed appropriate. If the project were analyzed strictly from the intended consequences of the use the achieved functionings would most likely be ignored (as they were not in line with the aim of the project). The framework helps us to capture the students use based on their context and their appropriation of the system. Using a bottom-up approach we can capture the functionings that the system actually enabled and not just how the outcome maps against the implemented intervention.

The framework presented is relevant for both academia and practice. For academia the framework presents a better lens for analysis. Better in the sense that we focus on ends and not means, the project is viewed within the context where it is deployed and we gain a better understanding of why and how development come about. As the test case shows, we have to look at the whole process and the actual outcomes of our development efforts. For practice it can be used when planning and initiating ICT4D projects. The framework will focus practitioner's attention to all aspects of the intervention, including the context (conversion factors) and the notion of choice.

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