Digital Media to contribute to the development and dissemination of renewable energy systems

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Abstract

Awareness raising and education regarding the use and application of renewable energy systems is a key issue in many development projects. The goal of this practice-based research was to explore the potentialities of locally developed instructional videos on tablet PCs to create awareness about renewable energy systems and to train mostly illiterate communities in extremely secluded areas to operate and maintain these systems. To do so, a case study was carried out in the Nepalese Himalayan Mountains. The observational mixed-method evaluation indicates (a) that, upon initial instruction, local people were able to handle videos on tablets PCs well. In addition, (b) after studying the tablet-based videos, small groups of workers were able to carry out concrete manual and analytical tasks regarding the development and operation of renewable energy systems; the findings also suggest that villagers' understanding of more complex tasks was enhanced significantly by showing videos a second time; and (c), the facilitated screening of instructional videos with a battery-charged handheld projector in public areas allowed the whole community to participate, watch, and engage in awareness raising and learning processes.

The pilot study supports the tentative conclusion that videos, which are produced locally and shared via mobile technologies, can serve as viable means in raising awareness and creating learning opportunities regarding the use of sustainable energy systems in extremely remote communities with a predominantly illiterate population. Further research is needed to corroborate the findings of this exploratory and small-scale pilot study.

Keywords: digital media, instructional video, awareness raising, education, skill training, tutoring, low literacy, renewable energy systems, mobile learning

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1. Introduction and background

1.1 Challenges in the introduction and maintenance of renewable energy systems

The importance of implementing, operating and maintaining renewable energy systems is widely recognised. It is, perhaps most prominently, reflected in the sustainable development goals: Goal 7 highlights the access to affordable, reliable, sustainable and modern energy for all (SDG Goals, n.d.). The health-related, economic, educational and social benefits of sustainable and renewable energy systems are particularly important in low-income contexts. For instance, solar-based lighting would provide extra time for families to generate income and would allow children to do homework in the evening, let alone the health and ecological benefits of banning lighting sources such as open fire or kerosene lamps (The World Bank, 2016). However, the reality is still bleak for 20% of the global population who lack access to modern electricity and the 3 billion people who rely on wood, coal, charcoal or animal waste for cooking and heating (SDG Goals, n.d.).

The implementation of renewable energy systems in low resource contexts and elsewhere goes far beyond the introduction of new technologies. A change affects the overall system and often results in a novel configuration of actors, organization and practices which is in many cases, not a straightforward but a lengthy and dynamic developmental process (Negro et al., 2012). Accordingly, it is key to not only work together with local communities, but also to make them fully understand and drive these changes (Reid et al., 2009, Jerneck and Olsson, 2013). To do so, local people need to acquire the technical knowledge of building and maintaining renewable and sustainable systems. In addition, they also need to understand the underlying ecological, health-related and economical motives for this transformation.

A change in beliefs and practices requires systematic awareness raising, exposure and education. The organisation and realisation of these measures in the settings under investigation, i.e., the remote, underdeveloped and high-altitude villages in the North-West Nepalese Himalayan Mountain districts of Humla and Jumla, is a complex and challenging endeavour for a number of reasons. Yet the logistics of organising training events in the scattered villages are problematic, as it takes days of walking to reach these villages. This condition is further aggravated by the fact that many of the local people have very limited or no literacy or numeracy skills, which inhibits the value of written instructions and operation manuals. To address these contextual constraints, extended time and effort is needed, which, as past projects have shown, often exceeded budgets and time frames of smaller initiatives. Conventional training can be also problematic because it can reinforce existing power imbalances. Tensions can be created for example by community leaders who prioritise friends and relatives in the recruitment process (i.e., groups who are often more interested in receiving the per diem than in the training content) at the expense of the actual target group, as prior research has shown (Zossou et al., 2009).

1.2 Producing local videos to share local knowledge in community development context

One way in which awareness raising and training activities can be supported are videos. Video is seen as a powerful tool in development work, because it can attract people's attention, addresses barriers of illiteracy and it is reflective of the narrative culture and the oral traditions which are conspicuous characteristics in many rural contexts (Lie and Mandler, 2009). In addition, it can reach many people at the same time (Zossou et al., 2009). Although video has been applied in development cooperation for more than 30 years, recent developments, such as decreased costs and improved usability, have resulted in an increase in the use of this technology (Lie and Mandler, 2009). Advances in mobile and portable technologies have also widened dissemination and screening opportunities, for example by using handheld, battery-powered projectors (Cai et al., 2013, Kumar et al., 2015), or by directly distributing videos on users' personal mobile devices (Vashistha et al., 2016).

In development and low-resource settings, videos are being used for manifold purposes including capacity building and awareness raising (Lie and Mandler, 2009) across a wide range of disciplines, such as agriculture (Gandhi et al., 2007), health (Kumar et al., 2015) and climate change (Plush, 2013). In context of the present research, both training and awareness raising were of relevance. The idea was to use short videos to support the technical training regarding the implementation, operation and maintenance of a community-owned village drinking water system. Other videos were aimed at educating and raising the awareness of local communities regarding the underlying causes and benefits of this transformation.

However, despite the identified opportunities and potentialities, there is still relatively little systematic research on the use of videos in very marginalised and remote settings. Yet, there are a number of good-practice principles that

can guide and inform practitioners in the development and deployment of persuasive, educational and awareness raising videos.

In the video production process, it is recommended to follow the principles of participatory design, which requires the close involvement of the target group from the very beginning (Kumar et al., 2015). Local participation is important because it ensures the appropriateness of the verbal and visual language and it enhances the persuasiveness of the video (Lie and Mandler, 2009). For example, in an Indian agricultural extension service context, videos which featured farmers who spoke the same dialect and accent and who had similar levels of education as the target group were much more trusted by the audience than the ones which involved educated and outside experts. In the same vein, farmers were more convinced to adopt a new agricultural technique if they realised that peers to whom they could relate had already endorsed and implemented this practice (Gandhi et al., 2007). Another influencing factor was the type of content. It was witnessed that videos which featured engaging forms of content such as concrete demonstrations, testimonials and entertainment were clearly preferred over videos in classroom-style lectures (Gandhi et al., 2007).

In the training itself, it is important not to conceive videos as self-explanatory and standalone tools. Instead, it has been suggested to combine them with hands-on practical tasks and printed materials to help increase the understanding of the video content (Lie and Mandler, 2009). For example, a quasi-experimental study found that although both video training and traditional lecture-based demonstration increased agricultural knowledge of men and women, only the combination of these two methods decreased the pre-existing gender knowledge gap (Cai et al., 2013). In addition, the screening of videos should be facilitated, for example in the form of moderated group training sessions at the community level. Facilitators should seek to trigger reflection and enhance learning by highlighting the main points, moderating the discussions, raising questions and collecting feedback (Lie and Mandler, 2009). The value of facilitation is confirmed in the empirical literature: Whereas the screening of videos alone was received poorly and resulted even in people leaving the events, yet minimal facilitation positively impacted their interest (Gandhi et al., 2007). If need be, the facilitator can also screen the whole video or specific sequences a second time (Lie and Mandler, 2009), which is relevant because it was found that the audience frequently required a second viewing to better grasp the contents (Gandhi et al., 2007).

An emerging body of studies has confirmed the instructional value of videos, and especially of participatory videos, in sensitizing and educating local communities. For example, the facilitated screening of participatory videos in an agricultural extension project in rural India increased the adoption of certain agricultural practices by a factor seven while being 10 times more cost-effective in comparison to common training and visit-based extension services (Gandhi et al., 2007). The authors emphasised that it was not the technology but the people and social dynamics which ultimately triggered the change (Gandhi et al., 2007). Positive effects were also achieved through the facilitated screening of farmer-to-farmer videos of a rice parboiling process to communities in Benin. The video caused 95% of the audience to improve their practices compared to about 50% who received the conventional training (as a 2-day community workshop). No differences were found between people who only watched the video and people from a third cohort who watched the video and attended the training. This underscored the value of video as the most effective instructional means.

Open video screening is also considered a more democratic form of education compared to closed training sessions. Research from Benin has shown that neither ethnic group, age, number of dependents in the household, education level, perceived importance of and motivation for the topic, experience, religion and membership in a farmer organization influenced the participation in the viewing practices (Zossou et al., 2009). However, not all studies confirmed the superiority of facilitated video screening over traditional training methods (Cai et al., 2015, Cai et al., 2013). Although a participatory video on nutrition, which was shown to smallholder farmers in Malawi, increased the participants' knowledge as much as the control group with the conventional demonstration, it was less effective in changing the farmers' nutrition practices in the short term. Reasons were seen in the video cohorts' inability to taste and smell the food (Cai et al., 2015).

2. Approach and evaluation methods

2.1 Research question

The research questions were centred on the feasibility of using locally produced, participatory videos in very remote areas of the Nepalese Himalaya region. Concretely, they were formulated as:

(1) Whether, and if so how, can poorly literate and illiterate people in extremely secluded areas access and handle videos on tablet PCs?

(2) Whether, and if so how, can poorly literate and illiterate people in extremely secluded areas use participatory videos on tablet PCs to learn and perform concrete manual and analytical tasks regarding the installation, operation and maintenance of renewable energy systems?

(3) Whether, and if so how, can the screening of videos with battery powered handheld projectors during community meetings engage and raise the awareness of poorly literate and illiterate people in extremely secluded areas?

2.2 The setting: an extremely remote and poor Nepalese mountainous area

The practice-based research was carried out in the remote Nepalese mountain village of Syada (210 families and at 2'750 meters above sea level). It can be reached either by an 8-10 day trek from the nearest road or by a one-hour airplane flight to Simikot from Nepalgunj in the South and an additional one-day trek. The research site is in the district of Humla, which ranks among the country's three least developed districts regarding poverty, gender inequality and deprivation (CBS and ICIMOD/MENRIS, 2003). The Swiss-Nepalese NGO RIDS-Nepal/Switzerland has been working and partnering with the Syada village community since 2003 in small scale community development projects. The request of the village community to build a village drinking water system in 2015 in partnership with RIDS-Nepal formed the jumping-off point for this practice-based research project.

Fig. 1: Syada Village's (yellow pin) geographical location, in the northern part of Humla district, ©2017 Google Earth / 2017 CNES / Airbus Image Landsat / Copernicus Image © 2017 Digital Globe.

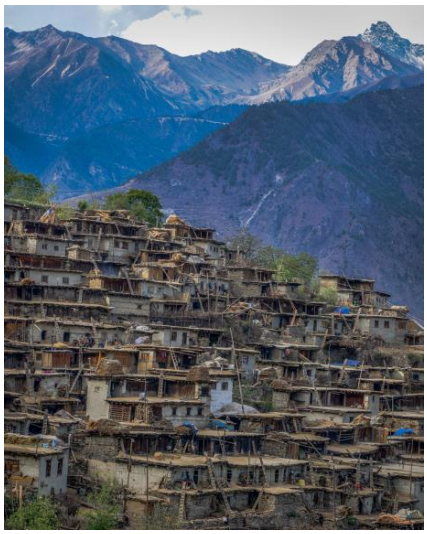

Fig. 2: Syada Village in northern Humla with 210 farmer families 2750 meters above sea level.

2.3 The production and use of the videos

The design and use of the videos was informed by the findings of the literature described in the previous sections. The videos were filmed and cut by RIDS-Nepal/Switzerland, a Swiss-Nepalese NGO. The local cameraman and video editor, who was from one of these remote villages, was trained and supervised by the NGO. The training and production took place in the form of face-to-face working phases, e-mail communication and Skype calls from the RIDS-Nepal head quarter in the Jumla district, when Internet was available. A number of 23 videos was produced (RIDS-Nepal/Switzerland 2017). The videos featured local actors directly from the communities who explained the rationale for and benefits of implementing renewable energy systems in story-like narratives and demonstrated specific tasks. The task-oriented videos adhered to the following design principles: providing a brief verbal overview of the process; an itemization of the required resources; step by-step instructions in which the local actors

demonstrated how a task was carried out (Gandhi et al., 2007). The use the videos was combined either with practical instructions and follow-up hands-on tasks, or in the community setting in which it was actively facilitated by a member of RIDS-Nepal/Switzerland, as specified in the following.

2.4 Task 1: Accessing and handling of videos on tablet PCs

First, local people were instructed regarding how to handle and use the tablet PCs. The RIDS-Nepal/Switzerland staff invited small groups of 4-6 people to participate in this learning event. Each group was informed about the activity. Then the staff member demonstrated the handling of the tablet to the group, which included the following steps: (1) switch on the tablet and log in; (2) navigate to the video folder; (3) select the correct video; (4) adjust volume (5) start playing the video (see Task 2). Then the tablet was switched off and handed over to the group with the task to repeat this step-by-step process. Each of the steps was evaluated on a scale from one to five. One signified that the step was not accomplished and great difficulties were experienced. Five meant that the step was very well accomplished. This procedure was carried out two times, i.e. with two groups in each of the four villages involved.

Fig. 3: Task 1: people handling the tablet PC

2.5 Task 2: Videos to learn and perform manual and analytical tasks

The second task consisted of the evaluation of the extent to which the groups were able to perform concrete manual and analytical tasks after watching short, tablet PC-based instructional videos. The first video (Task 2a) explained the evaluation of the suitability of a village owned water source. The goal was to learn how to determine systematically whether or not a spring provides sufficient water throughout the year so that it can be used as the village's central water source for their village drinking water system. This process involved several steps ranging from organizing and collecting the necessary items (two different sized buckets and a stopwatch) to measure the water source and calculating the water flow per minute.

Fig. 4: Task 2a: Village-owned water source measurement

The second video (Task 2b) required a group of female and male participants from the respective villages to moderate a process to identify suitable positions for tap stands in their village. First, a video was shown to the groups regarding how to organize and moderate this procedure. Water tap stand identification is a complex process, which requires the consideration of several infrastructural, social and cultural aspects. The final decision needs to be taken and supported by all community members. For example, a certain distance to houses and fields needs to be maintained to ensure that excess water would not flow into the people's premises. Upon viewing the video, the group moderated this process. Together with the community they developed a social map of the village on a rooftop of one of the houses (Figure 5). They used diverse items (e.g., stones, wooden sticks, charcoal, and leaves) to map the major infrastructure such as houses, walking paths, temples, fields and forest in and nearby the village as accurately as possible. On this basis, the community discussed locations for each of the water tap stands. The selection of the location of each tap stand was organized in the form of a democratic decision-making process.

Fig. 5: Task 2b: Social Mapping - Village water tap stand identification led by one of the participants

In each of the tasks, the video was shown to a group of about 4-6 people. This was followed by a question-and-answer session moderated by a facilitator from RIDS-Nepal/Switzerland. Then the participants performed the task. The task water measurement was more complex and thus the participants watched the video and carried out the associated hands-on water source measuring tasks two times (evaluated as a first and second trial). The accomplishment of steps and other criteria, for example the involvement of a sufficient number of female participants in the tap stand identification process, was evaluated according to a predetermined schedule on a scale of 1-5.

2.6 Task 3: Videos publically screened through a handheld, battery powered projector to raise awareness and educate communities

Also Task 3 was managed by an NGO staff who organised a community meeting. The video featured messages on the importance of a holistic community development (HCD) approach, the "Family of 4", which included the four basic and most often identified needs of the local village communities to be addressed as part of a long-term village development process. The four pillars of the "Family of 4" HCD are: (1) a toilet for each family; (2) a smokeless metal stove in each household; (3) basic indoor lighting powered by tapping into one of the locally available renewable energy resources and transformed through a contextualised renewable energy technology (such as solar PV, wind turbine or small hydro power plant; (4) clean and sufficient drinking water from the village-based water tap stands. After watching the video, facilitator asked the community the following questions: (1) name the four different "Family of 4" programs; (2) list the sequence of implementation, (3) explain the rationale behind the sequence, and (4 a to d) explain how the short- and long-term impact on families and community differ if 4, 3, 2 or only 1 of the "Family of 4" programs would be implemented. The video screening took place (see Figure 6) in the evening, using a tablet PC, a battery-powered handheld projector and an improvised screen (a white cotton sheet). After screening the video, the NGO staff asked up to 6 people (each 3 women and men respectively) the predefined questions. Apart from the answers elicited from the persons who were explicitly addressed, further discussions were stimulated and a number of additional people shared their opinion or experience. In this sense, the level of knowledge was evaluated as a collaborative product of the community.

Fig. 6: Task 3: Public video screening, awareness raising and educating the whole village community

The evaluation of all of the three tasks was carried out according to a predetermined assessment protocol. The participants' responses and actions were evaluated based on a set of previously developed criteria. For example, the step "collecting items" in the task water measurement was evaluated according to the following scheme: 5 points if all 4 items were collected, 4 points if 3 items were collected etc. The evaluator also took field notes, which were collected and analyzed in addition to the quantitative data.

3. Results

3.1. Task 1: Accessing and handling of videos on tablet PCs

The evaluation regarding the handling of the tablet was carried out in four villages with two pilot groups each. The results indicate that, in total, the small groups managed to handle the tablets well, with an average (mean) of 3.9 out of 5 points (Table 1). The more difficult tasks appeared to be the navigation to the video folder and the adjustment of the volume. It was also observed that women had more difficulties in using tablet PCs and they needed more support and repeated instructions. However, the most remarkable differences were found between villages and not between tasks. One village (4) scored particularly low. This might be explained by the fact that this village had an especially high number of poorly literate and illiterate people. According to RIDS-Nepal/Switzerland's evaluation, Village 4 could be also qualified as the least developed village from the cohort involved.

Tab. 1: Task 1 Accessing and handling of videos on tablet PCs

	Group 1				**Group 2**				
Steps / Villages	**Village 1**	**Village 2**	**Village 3**	**Village 4**	**Village 1**	**Village 2**	**Village 3**	**Village 4**	**Means**
Switch on tablet	5	5	5	2	5	4	4	3	**4.1**
Login	5	3	5	2	5	3	5	4	**4.0**
Navigate to video folder	4	4	5	1	4	4	4	3	**3.6**
Select correct video	5	5	4	2	5	5	4	4	**4.3**
Adjust volume	4	3	3	1	5	4	4	3	**3.4**
Play video	4	4	4	2	5	4	4	3	**3.8**
Means	**4.5**	**4**	**4.3**	**1.7**	**4.8**	**4**	**4.2**	**3.3**	

3.2 Task 2: Videos to learn and perform manual and analytical tasks

The video instructions on tablet PCs were regarded highly by the involved participants and, with a few exceptions, the tasks were carried out well (Table 2). It was observed that the group which found the videos particularly useful was illiterate women. This could be explained by the fact that their illiteracy and social position excluded them otherwise from similar participatory learning and community events.

Table 2 shows the participants' performance regarding the individual steps of the task water source measurement. As indicated, this task was more complex and the participants thus watched the video and carried out the associated tasks two times (labelled here as trial 2). In comparison with the first trial (Mdn = 3), showing the video a second time significantly enhanced the performance of the participants (Mdn = 5), as determined through a Wilcoxon signed ranks test ($Z=-3.704$ $p<.000$).

Tab. 2: Task 2a Water Measurement

	Trial 1				**Trial 2**				
Steps / Villages	**Village 1**	**Village 2**	**Village 3**	**Village 4**	**Village 1**	**Village 2**	**Village 3**	**Village 4**	**Means**
Organize equipment	4	4	4	4	5	5	5	5	**4.5**
Measure time	4	3	3	1	5	5	5	3	**3.6**
Measure water flow	4	4	3	2	5	5	4	3	**3.8**
Calculate water flow	3	3	3	2	4	4	5	3	**3.4**
Means	**3.8**	**3.5**	**3.3**	**2.3**	**4.8**	**4.8**	**4.8**	**3.5**	

The most difficult step was the calculation of the water flow (in litres per second), as it involved the solving of an arithmetic problem. This required the facilitator to demonstrate the task in addition to viewing the video at the measuring site in the second trial. However, after this demonstration, participants were able to calculate this measure rather easily, as some of them had a mobile phone with a calculator. In general, it was observed that younger men who had mobile phones and were familiar with the calculator app understood the calculation task better than elder people and women.

In the task water tap stand identification (Task 2b), the participants organised a group of villagers to develop a map of the village and to discuss and agree on the distribution of the water tap stands. In this task (like in the task water measurement), differences appeared to be more pronounced between groups (villages) than between steps, as can be seen in table 3. In particular in Village 1 and Village 2, the people and spokespersons were more actively engaged than in Village 3, which resulted in better results (Table 3).

Tab. 3: Task 2b Water tap stand identification through social mapping as a whole community

Steps / Villages	Village 1	Village 2	Village 3	Village 4	Means
Organise people & materials	5	4	4	4	**4.3**
Correct mapping	4	4	2	4	**3.5**
Identification of tap stand locations	5	5	2	4	**4.0**
Justification of tap stand locations	4	3	1	3	**2.8**
Means	**4.5**	**4.0**	**2.3**	**3.8**	

3.3 Task 3: Videos on handheld projectors to sensitize and educate communities

The public screening of the videos in each of the four communities raised considerable interest and the events were very well visited - with a total of approximately 380 participants (about 140 in Village 1, 120 in Village 2, 60 in Village 3 and 60 in Village 4). The video was received very well and participants requested to watch it at least two times. Again, illiterate women in particular provided positive feedback. They indicated that the spoken and visualised instructions helped them understand the rationale behind and the benefits of the "Family of 4 " HCD project concept, thus overcoming their illiteracy constraints and being active members of the village's awareness and knowledge building processes. As can be seen in Table 4, the quality of the responses from the community participants was found to be satisfactory. The importance and prioritisation of each of the "Family of 4" HCD programs was explained well. However, the participants had more difficulties in explaining the relation of the individual programs, and even more so, the possible synergistic benefits of the "Family of 4" programs (Questions 4a to c). The observations also point to helpfulness and persuasiveness of additional testimonies provided by some people who described their personal experience and especially the benefits that they experienced with the "Family of 4" programs.

Tab. 4: Task 3: "Family of 4" Holistic Community Development Concept Video

Questions / Village	Village 1	Village 2	Village 3	Village 4	Means
Q1: Name all four "Family of 4" programs	3.5	2.7	3.0	2.0	**2.8**
Q2: Describe implementation prioritization	3.5	2.7	3.0	2.0	**2.8**
Q3: Describe importance of each measure	4.0	3.3	3.3	3.0	**3.4**
Q4a: Describe benefits 4 measures	3.5	2.0	2.0	2.5	**2.5**
Q4b: Describe benefits 3 measures	3.0	2.0	2.0	2.0	**2.3**
Q4c: Describe benefits 2 measures	3.5	2.7	2.7	2.5	**2.8**
Q4d: Describe benefits 1 measures	3.5	3.7	3.3	3.5	**3.5**
Means	**3.5**	**2.7**	**2.8**	**2.5**	

4. Discussion and conclusion

The findings of this practice-based study point to the feasibility and value of using locally produced awareness raising and educational videos for poorly literate and illiterate people in very isolated and secluded mountainous areas in the design, implementation and use of sustainable renewable energy systems. The videos were received very well by the individual study participants and the community as a whole. The public screening produced considerable effects in terms of interest, and increased awareness and collectively building up new knowledge. It was observed that the people in the community frequently wanted to view the video more than one time (as in the study of Gandhi et al., 2007), which, as the findings of the present study indicate, enhanced their understanding of the content significantly.

The findings also suggest that, upon initial instruction, local people were able to handle videos on the tablet PCs well. In addition, the tablet-based videos enabled small groups of workers to carry out concrete manual and analytical tasks regarding important community development measures for their village. The increased levels of knowledge and practical skills resonate with results from prior studies (Cai et al., 2015).

Perhaps the most genuine value offered by the videos was to allow groups of people, especially females and older people, with otherwise severely constrained educational and participatory opportunities, to acquire knowledge and to engage in central social processes in the community. This confirms previous research, for example from Benin, which revealed the democratising potentialities of public video screening, especially in comparison to closed training sessions (Zossou et al., 2009).

The qualitative observations indicate that one key to success was the incorporation of story-like elements (Lie and Mandler, 2009), which was regarded highly by the viewers. It was also observed that the testimonies and the local "good practice" examples demonstrated in the videos, such as a clean and hygienic kitchen, had a persuasive impact on the participants who appeared to transform their practices as could be often seen in the follow-up visits. However, this aspect was not measured systematically. Another practice-based observation was that, in the cultural context under investigation, the use of songs in the videos allowed the creators to highlight delicate and critical issues in the respective communities, such as the importance of gender equality, e.g. with regard to firewood collection, and the damaging exposure of women to indoor air pollution. Drawing on this insight, the project team has decided to film and incorporate songs about individual developmental measures in the production of future videos.

Although this study points to the feasibility and potential of using videos in highly secluded areas, the validity of the findings is constrained by a number of limitations which were mostly tied to the particularities of working in an extremely remote area. Firstly, only the immediate reception and knowledge output was measured and no longer-term transformation or knowledge effects were considered in the research design (for practical and logistical reasons). This is a constraint because prior research has shown that increased knowledge does not automatically amount to changes in local practices (Cai et al., 2015). In addition, the measurement was carried out on a group level, which causes bias with regard to the performance of individual members and needs to be viewed critically in terms of reliability. Moreover, although a detailed evaluation framework was developed a priori, the measurement was constrained in that only one observer, though experienced in the local culture and language, evaluated the tasks and no interrater-agreement could be taken into account. These constraints mean that the findings can only be considered preliminary in nature and further and more robust research is warranted. Finally, any generalization has to be treated with caution, given the socio-cultural particularities of these communities. Yet, we believe that future research can draw on these insights and this work can provide a jumping-off point for future investigations.

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