Participatory videos to teach the use of renewable energy systems. A case study from rural Nepal.

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Abstract

Educating citizens about renewable energy and sustainable food systems is a global trend and the use of videos herein is a key component. Very little is known, however, regarding whether, and if so, how participatory videos can be leveraged in extremely rural areas involving villagers with very low levels of literacy and formal education. This gap was addressed by creating instructional participatory videos and researching their use regarding the construction and maintenance of high-altitude greenhouses in the Nepalese Himalayan area. The results point to the feasibility and value of using participatory videos. Findings from structured observations suggest that the videos permitted villagers to carry out concrete building and maintenance tasks, provided that this process was facilitated by representatives of a local NGO. The videos and the facilitated discussions enabled villagers to detect 90% of all shortcomings in their greenhouses. The findings of a randomised controlled experimental design suggest that the use of videos and oral instructions - provided by a member of a local NGO - led to slightly but significantly higher improvements of the status of greenhouses than oral instructions alone. Practical implications, limitations and suggestions for future research are discussed.

Keywords: participatory video; community development; renewable energy systems, ICT4D.

1. Background and rationale

The overarching goal of this research was to explore whether, and, if so, how participatory videos can support local villagers with no or very low levels of formal education and literacy in extremely remote areas in the development and use of renewable energy systems. To address this question, the case of the construction and maintenance of high-altitude greenhouses in rural Nepal was selected.

1.1 Participatory videos and renewable energy systems

Current renewable energy education programmes face many obstacles which range from a lack of funding to the unavailability of structured curricula (Kandpal & Broman, 2014). Teaching the introduction and use of renewable energy systems in marginalised and remote areas is a particularly challenging endeavour as it entails the change of established practices of villagers who typically have very low levels of formal education and literacy. In order to be effective, changes at the community level need to be fundamentally driven and owned by the communities themselves (Jerneck & Olsson, 2013; Reid et al., 2009). In these contexts, the use of participatory videos, i.e. videos in which local people are closely involved in the production processes, represent an increasingly popular method, particularly regarding the involvement of farmers. However, very little analytical attention has been paid to educational videos (Lie & Mandler, 2009). Prior research suggests that these videos should embrace lively testimonials and authentic demonstrations by local people rather than mere instructions in order to be accepted (Gandhi, Veeraraghavan, Toyama & Ramprasad, 2007). The effects of the use of participatory videos are far from being well understood. Although some studies demonstrate positive knowledge outcomes, the impact of videos on changes in practices - in comparison with other training methods - is unclear (Cai, Abbott & Bwambale, 2013; Cai, Chiwasa, Steinfield & Wyche, 2015) and requires further research.

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1.2 The setting: remote and very rural area in Nepalese Himalayan region

This research was carried out in the extremely isolated village of Syada. The village is located at 2'750 meters above sea level and it is typically reached by an 8-10 day walking trek. The area is part of the district of Humla, one of Nepal's least developed districts (CBS and ICIMOD/MENRIS, 2003). The research was part of a cooperation between a local NGO, RIDS Nepal, and the University of Applied Sciences and Arts Northwestern Switzerland.

1.3 Research questions

The research explored the instructional value that participatory videos offer to villagers in the construction and maintenance of high-altitude greenhouses in extremely remote areas in Nepal. The following questions were addressed:

> How do families use an instructional participatory video in *constructing* a high-altitude greenhouse (RQ1a)? Whether, and, if so, how can the use of a video help families in constructing a high-altitude greenhouse? (RQ1b)
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> How do families use an instructional participatory video in *operating and maintaining* a greenhouse (RQ2a)? Can they identify shortcomings / points for improvement by watching the video? (RQ2b); is the use of videos and verbal instructions by NGO staff more effective in helping families improve the status of their greenhouses than oral instructions alone? (RQ2c)

2. Approach and methods

2.1 Design of the videos

The development of the videos was guided by the findings of a selective literature analysis and prior experience with participatory videos in this region. A series of videos resulted from the cooperation between villagers, representatives of the local NGO RIDS Nepal and instructional designers and researchers from the University of Applied Sciences and Arts Northwestern Switzerland. Fostering high levels of local ownership, the videos featured local villagers and captured their experience in the building, operation and maintenance of greenhouses. In the videos (No. 19 – 31), local farmers presented advantages of their high-altitude greenhouses and demonstrated and explained key steps in developing and maintaining them. Local narrations and music were closely interwoven with instructions and task demonstrations (Gandhi et al., 2007).

Fig 1: Screenshots from the participatory videos (left); villagers gathering in front of greenhouse for verbal instructions (right)

2.2. Design of intervention, data collection and analysis

The research project evaluation was carried out from April to May 2019. Addressing RQ1, the use of videos in greenhouse construction, an evaluator from the NGO provided three families with a tablet PC for the construction of their greenhouse. The evaluator instructed each family how to handle the tablet computer and the videos. The evaluator then observed the ways in which the family used the tablet in the construction work (RQ1a) and whether, and, if

so, how, the video supported the family in this process. To do so, the evaluator used a structured observation form including questions such as how is the video being used? At which stages / points is the video used? Who holds the tablet and navigates the video? Who views the video? Does the family learn anything from watching the video? What and how do they learn? What is difficult for them? In view of the exploratory nature of the research, the evaluator also took additional notes to document unexpected and novel aspect that emerges in the observation.

Addressing RQ2, the use of videos in greenhouse operation and maintenance, involved the application of an experimental two-group pre- and post-test design. The greenhouse sites involved in the study were built in autumn 2018 and the evaluation took place after the first winter season from April to May 2019. Before the evaluation, the greenhouse sites were randomly divided into two groups, with 15 greenhouses in each group.

Visit 1: In the next step, the evaluator inspected all the 30 high-altitude greenhouses, determining potential shortcomings using 13 predefined categories, such as airing, aerating and the functionality of windows. The evaluator assessed each category on a scale from one to ten (1 = very poor condition, 10 = excellent condition) and documented the results with a pre-structured form. The greenhouse status was calculated as the sum of the points achieved in each category.

Fig 2: Evaluator inspecting two greenhouses and filling in the assessment form

Greenhouse owners (husband and wife) of group one were provided with verbal instructions from the NGO staff member to inform them about the points for improvement. Greenhouse owners in the second group were provided with instructional participatory videos on a tablet computer. The families were encouraged to watch the videos and compare their own greenhouses with the greenhouses shown in the videos. Discussions were triggered during and after watching the videos. Addressing RQ2a, the evaluator documented how the families used the tablet and the videos with a structured observation form (RQ2a). The evaluator also noted whether the families were able to identify the shortcomings with the help of the videos (RQ2b). Finally, the families in both experimental conditions were informed about all shortcomings and how they needed to be addressed and they were encouraged to improve their greenhouses.

Visit 2: After one week, the evaluator re-inspected the greenhouses and re-evaluated their status using the same rating scheme. In this way, it was determined whether the additional use of the videos was more effective in encouraging the families to improve the status of the greenhouses compared to oral instructions alone (RQ2c).

The qualitative data (descriptions) gained from the structured observations were analysed systematically. The cases (greenhouses) were compared and commonalities and differences were identified in an inductive manner. The quantitative data were analysed descriptively and, in addition, within and between groups comparisons were calculated using the statistical software R.

3. Outcomes

3.1 Use and usefulness of a participatory video in the construction of greenhouses

The first question was addressed by observing the use of videos in the construction of three greenhouses. The ways in which the videos were used had several commonalities. In all three settings, the tablet PC and the videos were introduced to a group of three to six persons. At the third greenhouse site, three children were part of the video group as well. There was always one person who navigated the videos while the others were watching.

Fig 3: Villagers handling the PC table and watching participatory videos

In the first and third case, the greenhouse owners used the tablet and the video after the handling of these technologies had been explained to them by an NGO staff member. In these two cases, illiterate villagers were able to operate the video independently after the initial demonstration. At the second greenhouse, the builders found it difficult to navigate the video and thus this task was carried out by a staff member from the local NGO. At all sites, the use of videos was non-linear and highly interactive, with the videos being viewed and stopped repeatedly. More precisely, the respective video sequence was watched before carrying out a specific task, such as adding the UV plastic roof. In these situations, the process of video watching triggered discussions among the participants which were further facilitated by questions from the staff member of the local NGO.

After completing the task, the group re-watched the video sequence and compared the specific element of the greenhouse with the house depicted in the video - in the form of moving and still images. The analysis suggests that the facilitated use of videos helped villagers in completing concrete steps (e.g. adding ventilation windows) and also in further enhancing elements of the greenhouse (e.g. improving the wooden doors).

3.2 Usefulness of a participatory video in maintaining greenhouses

The second block of questions focused on the maintenance and improvement of greenhouses already built. The first question captured the ways in which the maintenance videos were watched by the local people. The analysis of the observational notes suggests that the patterns and modes of video watching were similar across the 15 different families (greenhouses). The social arrangement included the greenhouse owners (husband and wife) and, typically, some bystanders, i.e. children and older people. The tablet PCs and the videos were operated by some of the younger family members, including young local females, who were taught how to use the technology by one of the NGO staff. The mode of watching was interactive in that the videos were stopped several times to discuss key aspects/learnings and to identify issues and shortcomings in the greenhouse. This was followed by further discussions after having watched the videos. The social interaction triggered by the videos was intensive and, with a very few exceptions, involved all people who viewed the videos. In one case, four older people (not greenhouses owners) who also watched the videos found it difficult to engage in the discussion and make reference to the topics that they saw in the videos.

Fig 4: Villagers handling the PC tablet and discussing participatory videos

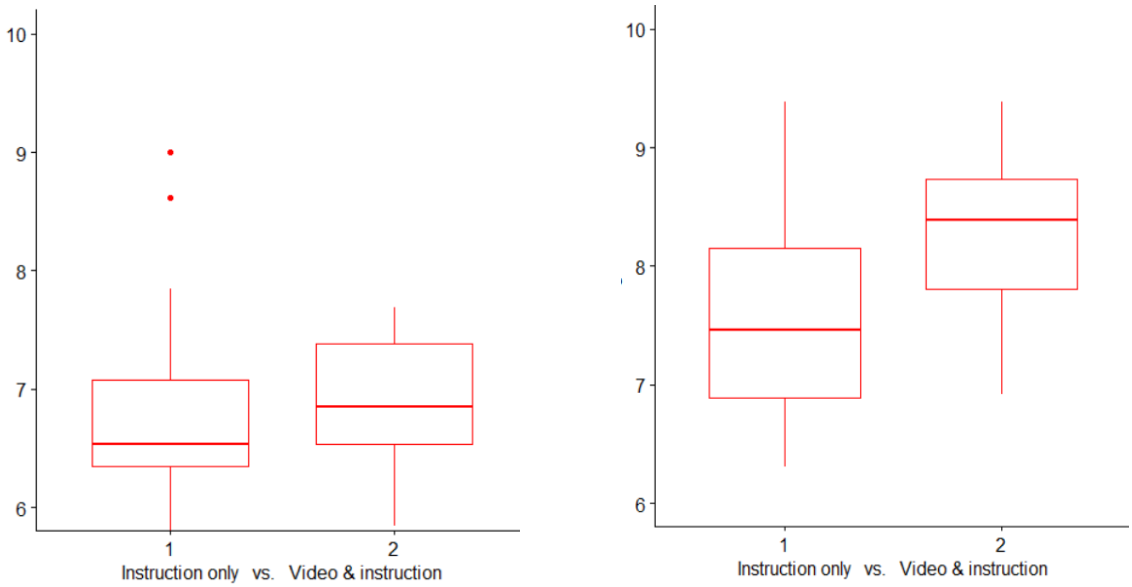
The question of whether the videos helped families in identifying shortcomings in their own greenhouses can be answered clearly. Out of the 15 families visited in which the videos were shown, only two families did not spot (some of the) shortcomings in their greenhouses. One family failed to detect five shortcomings (whilst identifying four correctly), and the second family missed four (whilst identifying seven shortcomings correctly). That means that out of the 103 shortcomings identified by the evaluator, nine (8.7 percent) remained undetected by the families.

In the next step, the status of the greenhouses between the group that watched the videos and received oral instructions and the group that received oral instructions only was compared. Table 1 shows the descriptive statistics of the two conditions.

Tab. 1: Descriptive statistics of greenhouse status before and after intervention (1=very poor, 10 = excellent)

	n	mean	SD	median	min	max
Pre-test (at the first visit)						
Group 1: videos & instructions	15	6.85	0.72	6.85	5.08	7.69
Group 2: instructions only	15	6.85	0.95	6.54	5.77	9
Post-test (at the second visit)						
Group 1: videos & instructions	15	8.23	0.76	8.38	6.92	9.38
Group 2: instructions only	15	7.57	0.99	7.46	6.31	9.38

The means of the two conditions did not differ at the time of the first visit (m=6.85). Whereas the status of the greenhouses had improved in both conditions at the second visit, the mean of the video group (m=8.23) was slightly higher than the one of the instruction-only group (m=7.57). The same pattern can be observed for the median, with similar values at the first visit and pronouncedly higher values in the video group at the second visit (See Table 1). These observations are affirmed by the analysis of variance (ANOVA test) showing that the increase between pre- and post-test in Group 1 (Video and instruction) was significantly higher than the increase in Group 2 (instructions only) with ($F(1,28) = 6.014$, $p= 0.0207$). Figure 5 visualises the differences between the two groups.



Greenhouse status Visit 1 **Greenhouse status Visit 2**

Fig. 5: Boxplot: Greenhouse status of conditions at visit one and two (1=very poor, 10 = excellent)

4. Discussion, limitations and conclusion

The findings of this study point to the feasibility and the value of using participatory videos in the development of renewable energy systems in extremely remote and mostly illiterate communities. The results suggest that videos, which were used flexibly and in an iterative way, supported villagers in carrying out concrete manual tasks, i.e. constructing and improving their greenhouses. These findings affirm observations from a previous study in a very similar context in which videos on Tablet PCs supported villagers in developing a community-owned village drinking water system (Zahnd, Pimmer & Gröhbiel, 2017).

The role and value of the videos can be best described by conceiving them as socio-cognitive tools, where the multimodal stimuli sparked intensive social interactions among villagers which led to a more in-depth engagement with the topic at hand. Reflection-on-action (Schön, 1987) was triggered in that the video users compared their own greenhouse with the houses depicted in the videos via still and moving images. This process enabled the identification and improvement of shortcomings, as the quantitative results of the present study suggest.

In addition to knowledge gains measured in previous studies (Cai et al., 2013), the experimental findings of this study further support the argument that the combination of videos and oral instructions can trigger short term practice changes. This effect was proposed in a previous study arguing that the testimonies and the display of “good local practice” persuaded villagers to change their behaviour, which, however, did not measure this observation quantitatively (Zahnd et al., 2017). Other studies have reported inconclusive results, saying that short-term practice improvement through facilitated video-based discussions varied with the topic of the training (Cai et al., 2015).

Fig 6: Inspection of greenhouse (left) and discussion while watching the video (right)

The experience also shows that the videos should not be seen as standalone tool, but their application needs to be guided and facilitated by trained locals in order to be effective. Relevant facilitation and support measures include the dissemination and initial instruction about how to navigate the videos as well as prompts and questions to stimulate discussions among the villagers upon watching the videos. The first aspect is relevant because several, but not all villagers were able to navigate videos properly, with older persons and women typically experiencing challenges (Zahnd et al., 2017). It is incumbent on any community development effort to ensure the inclusion and learning of groups who are already disadvantaged in order to prevent their further marginalisation. In the setting investigated, this requires that facilitators pay particular attention to involve and support these groups in the processes of technology use and in associated discussions.

The findings of the study need to be interpreted with attention to the methodological limitations, most of which are linked to the practical challenges of carrying out research in very remote areas with limited infrastructure. Firstly, the evaluation and research approach was small scale. For example, the use of videos was only observed in the construction of three greenhouses and also the experimental design with a total number of 30 cases is limited. Whereas this study has measured practice changes, they were short term in nature (measured after a week) and any longer-term implications could not be investigated. Another aspect is that no interrater agreement was measured, and, in addition, the analysis of the status of the greenhouses was not blinded. These issues, together with the cultural and geographical specificities of the setting, a very remote mountainous area in Nepal, limit generalisation and caution should be exercised in the interpretation of the results.

However, the findings, which point to the viability of the use of participatory videos in remote areas, add value to the body of literature by affirming and extending previous studies, particularly with regard to the use of the videos in very remote settings. It is thus our hope that the results will inform future, more large-scale research, for example by re-using and evaluating the videos in similar cultural contexts involving a larger number of villages and villagers.

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