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Constraining and enabling factors in the use of ICT in Rural Schools in Nepal

Dhiraj Thapa¹[0000-0003-4660-307X] Dai Griffiths¹[0000-0002-6863-2456] and
Ann L. Kolodziejski¹[0000-0003-4411-9874]

¹ University of Bolton, Deane Road, Bolton, BL3 5AB
dt3eps@bolton.ac.uk / dthapa@email.com

Abstract.

The OLE-Nepal project has deployed over 6,500 XO laptops in schools in Nepal, pre-installed with materials designed to support the national curriculum. This has raised hopes that technology can transform the quality of education available in remote regions. In order to investigate if and how the technology can have this impact, a case study was carried out which gathered detailed data on the use of the computers in three schools in contrasting remote rural areas of Nepal. The principal data collection methods were interviews, focus groups, classroom observations, and questionnaires. The results show that the effectiveness of technology in transforming schools is strongly dependent on local conditions and practices. This paper identifies constraining and enabling factors which can be identified in the case study data: infrastructure, classroom management, gender, and teacher motivation and training

Keywords: Nepal, remote, rural, education, computers, XO, one-laptop-per-child, ICT, OLE-Nepal.

1 The motivation for this study

In early 2000, as a medical representative for a drug company, the first author travelled to different parts of rural Nepal. On visits to remote communities, he observed several challenges faced by small public schools in rural villages, isolated by land and lack of transport. Textbooks were limited and often delivered with long delays. Informal classroom observations and several conversations with the teachers and the locals in the village, showed that, in the absence of appropriate teaching material, not much teaching and learning was taking place, with little motivation for teachers to teach or learners to learn. A decade later, on revisiting some of the remote villages, it was intriguing to witness that some schools from the same community were now using computers in their classrooms. Although distant and isolated from the city, it was a surprise to watch children using visual content and learning to read with digital devices, just like the children did in the metropolitan cities. Computers and communications infrastructure seemed to be reconstructing the practice of education in many of these schools.

The teachers from some schools commented that since the deployment of the technology in schools, student enrolment had improved, and the dropout rate had dropped considerably. The teachers explained that the Non-Governmental Organisation (NGO)

Open Learning Exchange-Nepal (OLE-Nepal) had significantly contributed to providing access to computers and resources. OLE-Nepal has worked on this in collaboration with the Department of Education, and with the One Laptop Per Child (OLPC) initiative. These impressions, and the perceived potential of technology for remote schools, led the first author to explore further to understand if this was a situation for all schools located in other regions of diverse backgrounds.

2 Literature Review

ICT initiatives in education in the developing world are well studied and documented in the literature, see for example the literature review in (UNESCO, 2016; Toro & Joshi, 2012). Within this body of literature, the OLPC program has received its share of attention, for example (Nugroho & Lonsdale, 2010). However, the research which has been carried out has two limitations. Firstly, little work has been done with remote schools, presumably because they are too difficult to access. In the view of the authors, these schools are the most interesting to investigate, because they provide an opportunity to contrast the introduction of ICT in schools with a previous complete absence of technology, and because the effect ICT in negating distance should be at its strongest in geographically remote schools. Secondly, the focus in previous work has been primarily on evaluating the effectiveness of the technology or applications, or on documenting the attitudes and perceptions of learners and teachers regarding ICT. It is still unclear what happens in classrooms when computers are introduced into remote schools, and there is little evidence to explain why some rural schools perform better in examinations than other schools in different geographical location using the same technology. This study seeks to fill these gaps in knowledge, by examining how social factors, geographic situation, school, and pedagogic approaches all combine to enable or constrain the success of the OLE-Nepal programme in remote schools.

In undertaking this research, we take a realist position, informed by the insights of Pawson and Tilley (Clarke, Pawson, & Tilley, 1998). In practice, this means that our explanations are formulated in terms of causal mechanisms, which act within specified contexts to produce an outcome. In doing this, we seek evidence from as many sources as possible to confirm or discount the existence of proposed causal mechanisms, following the use of multi-methodology proposed by, for example in Mingers & White (2010). In our study, this has involved the combination of questionnaires, the analysis of documents, interviews, and observations.

3 The Research Context

In Nepal, private school learners perform better in examinations than public school learners, and the contrast is even higher with rural public schools (Shrestha, 2016). To improve the quality of public schools, the Government of Nepal developed the ICT in Education Master Plan 2013-2017. The plan foresaw the use of ICT in education at all levels to improve classroom delivery, increase access to learning materials and ensure quality primary education for all. One of the initiatives identified as contributing to

achieving these goals was OLPC (Munyantore & Mbalire, 2017). OLE-Nepal explored the contribution which ICT could make to improving the education sector in Nepal, mainly targeting public schools in rural regions Thapa & Sein (2016)¹. A collaboration resolved problems for both organisations, and OLE-Nepal launched the OLPC programme in 2008, to provide rural schools with access to XO laptops with pre-loaded software (Nugroho & Lonsdale, 2010).

OLE-Nepal convinced the Department of Education (DOE) of the Government of Nepal to work with them to develop digital learning content. Subject specialists, translators and technical experts were provided to review and prepare educational materials and created interactive educational software together with a team of OLE-Nepal (Thapa & Sein, 2016). The result was E-Paath activities, which is closely aligned with the national curriculum for years 1 to 8 in English, Maths, Science and Nepali. All the digital contents from OLE-Nepal are freely available online (OLE-Nepal, 2020).

According to the OLE-Nepal official website, the program has been running in more than 200 schools in 54 districts across Nepal and has reached over thirty-five thousand learners using over 6,500 OLPC laptops (OLE-Nepal, 2020). OLE provides digital libraries known as E-Pustakalaya, where thousands of e-books and videos are available through its server to schools in the remote areas (OLE-Nepal, 2020).

4 Methodology

4.1 Adoption of a case study approach

This study explores the consequences of technological intervention in rural schools in Nepal. This could be done by surveying all the rural schools in Nepal and comparing their reported experiences. The results would provide some insight but would have two principal drawbacks. Firstly, the data would not be reliable if schools presented themselves as 'good' users of the technology. Secondly, the educational context for the use of ICT in education is complex and varied, and explanations for the way that the technology is used, and the consequences of that use, are dependent on the experiences of individual schools, classes and individuals. To understand these processes, a rich data set is necessary. As Yin, (2013) describes, a case study offers an in-depth, multi-sided approach used in case studies that can shed light on aspects of human thinking and behaviour that it would be unethical or impractical to study in other ways. Consequently, a case study was used to observe and document the use of technologies in selected schools, identifying patterns of use and the factors which enabled or constrained the effectiveness of the use of computers.

4.2 Identification of the case study

Schools were selected entirely at random from a list provided by OLE-Nepal. The schools considered were actively participating in the OLE-Nepal programme and willing to participate in the research. However, this selection was constrained in three ways.

¹ Thapa is no relation to the present author

Firstly, all selected schools had been involved in the programme for at least two years. Secondly, one school was selected from each geographical area to facilitate comparison between regions. Thirdly, A spectrum of technological experience was explored to assess if variations in experience of learning via technology had an impact on the attitudes and practise of learners and teachers. Of the three schools selected for the study 'Annapurna' had been using the XO laptop for over two years, 'Everest' had been using them for more than four years, and 'Makalu' school had been using for over six years. Everest School is located in the mountain region; Annapurna School is located in the hilly area, while Makalu School is located in the plains. The schools' identities are anonymised.

4.3 The role of the researcher

In order to ease tensions and allow participants to express their views openly, the first author spent at least 2 - 3 days in each village community, rather than the minimum time needed to collect data. He engaged with learners in activities such as sports and engaged with locals in tea shops, with talks about their communities, their culture, and their everyday lives. Such interactions, as indicated by Wertsch, (1993), led to understanding the social meaning and cultural values that are closely interrelated with the participants' understandings.

As Hellawell (2011) argues, a researcher may have comparative data about research sites, but be unable to interpret this because the environment in which those sites are situated is insufficiently understood. The first author was born and brought up in a similar community in Nepal and has been a teacher in a rural school for around three years. He may, therefore, be considered an insider. Although he visited these schools before conducting the research, he was unknown to the respondents in this study and, in this sense, he was an outsider. Unluer, (2012) believes that, depending on the circumstances, a qualitative researcher may have different roles, such as a friend, acquaintance, or researcher and that these different roles need to be explained. During the data collection, the researcher was treated as a community member, welcomed to the school and asked for an evaluation of the teaching activities in the classroom. Nevertheless, this appeal was politely refused to maintain the unbiased position of the researcher as an observer. In this case, shifting between insider and outsider characters required management and reflection.

4.4 Data Collection

As Norman (2011) affirms, "obtaining socially and contextually meaningful information in a natural setting is critical". Accordingly, the primary data collection methods used were qualitative interviews and focus groups, asking open-ended questions to teachers, parents, principal and learners about the overall experience of learning with the computer in the classrooms. However, Creswell & J.W., (2007) points out that the inclusion of data from documentation and questionnaires allows for investigation from many perspectives. Consequently, quantitative data were collected from student questionnaires, and documentation of annual examination results for selected learners before and after the introduction of OLE-Nepal activities.

Data was gathered in two periods—Phase One in 2017 and Phase Two in 2018. Phase one study was carried out in two schools, as described in Table 1. Phase one showed that there was a variation in the performance of the schools in standardised examinations in the two regions. Similarly, questionnaires and interviews uncovered differences in the use of computers by boys and girls and differences in teachers' interest in computers. It became clear that questionnaires and teacher interviews alone would not be sufficient to clarify the use of computers in the classroom. Furthermore, interviews with parents and headteachers, as well as classroom observations, were required. There was also a decision to add a third school in another area.

Phase two data collection was conducted a year later in August 2018, again with Annapurna and Makalu schools, and with the addition of Everest school, as shown in Table 2. Interviews with teachers ranged from 20 to 50 minutes and mainly discussed the ways that the computers were used in classrooms. The interviews with parents focused on their perception of technology and the importance of schools in rural villages. Focus groups with learners discussed learners' attitudes, opinions and reflections on learning with the technology. The classroom observations lasted 30 to 45 minutes and documented pedagogic practices with computers and the interactions of learners and teachers during classroom lessons. An observation checklist was used, and field notes were taken on teaching and learning atmosphere, classroom infrastructure, teaching and learning activities, and behaviour of the teacher and learners. Also, classroom facilities and the arrangement of the furniture were recorded.

All interviews and focus group discussions were conducted in Nepali, transcribed, and analysed in Nepali to maintain the accurate response messages. All details regarding respondents and their schools were immediately anonymised after compilation and data were stored in a safe location.

Table 1. Phase One data collection

School (Pseudonyms)	Interview		Questionnaires	Observations
	Teachers	Headteachers	Students	Classrooms
Annapurna	2		33	2
Makalu	2		32	2
Total	4		65	4

Table 2. Phase Two data collection

School (Pseudonyms)	Interview			Focus group	Observation
	Teachers	Headteachers	Parents	Students	Classrooms
Annapurna	3	1	5	3	3
Everest	3	1	5	3	3
Makalu	3	1	5	3	3
Total	9	3	15	9	9

4.5 Data Analysis

The data collected in each phase was compiled, transcribed and analysed at the end of that phase. The qualitative data were coded and categorised using Nvivo 11, while the questionnaire data from phase one was analysed using a spreadsheet. Sixty-five questionnaires were distributed, with a response rate of 100% because they were completed in the classroom. Six themes have been generated concerning the use of computers in classrooms and students' perceptions of digital learning, which are merged into four areas in the findings below. Quantitative data from the learners' records from the schools were anonymised and stored in the spreadsheet, giving an overview of each learner's performance for the last few years.

5 Findings

The findings not only focused on the patterns of usage of technology in rural schools but also the teachers' and learners' experience of working with computers in different geographical settings, and on teachers understanding of the equipment and the teaching methods that could be used with it. Equally important is the insight gained into how similar schools with a different background in a different geographical region using the same technology and following a related curriculum can vary in the outcome of the learner. The study proposes that the differences in the performance of learners and the patterns of usage can be associated with four aspects, as we now discuss.

5.1 Infrastructure

All schools had allocated a computer room, referred to as a laboratory. Annapurna and Everest had XO laptops. However, OLE-Nepal has experienced problems in obtaining adequate XO laptops, the E-Paath software has also been integrated on desktop PCs, and this is the case in Makalu. In observations, the learners appeared comfortable with the devices, which they operated without much difficulty, and were able to follow the teacher's instructions quite easily. Not all the computers were in working order, as shown in Table 3 below.

Table 3. Number of Equipment in Case Study schools

School	Year received	XO Laptops received	Desktop PCs received	Functional	Out of Order
Annapurna	March 2015	40	0	32	8
Everest	June 2014	35	0	31	4
Makalu	August 2011	0	20	18	2

All the schools were initially equipped with electrical supply, batteries and a backup power supply inverter, internet connection, routers and network servers. Table 3 above shows the number of devices in each school and the number of devices that were functioning during the observation class. Schools are responsible for maintaining this infrastructure, but the data gathered showed that some schools were unable to fulfil this commitment and had a number of slow or non-functional laptops, as shown in Table 3. Partly as a result of this, in all schools, some learners had to share their devices, making it difficult for them to follow instructions. It is interesting to note that PCs were more reliable. Non-functioning and slow-performing devices had implications for the effectiveness of classes, as the lesson did not start until all the laptops lessons were on the screen and ready. In almost all schools, one or two computers were sluggish. Although the allocated laboratory class is 45 minutes, one particular lesson in Makalu lasted for only 25 minutes, because of technical issues. It also was clear that if the number of learners in the laboratory was higher than the number of computers, then problems surfaced in time management and focus on tasks. The Everest school backup power supply was out of order, so in power cuts, the learners would have to miss the laboratory class. Despite the original provision of an internet connection, none of the participating schools had functioning internet access due to financial constraints, so computers ran pre-loaded applications and resources. Teachers and learners were, therefore, unable to upgrade their devices, which reduce the value of computers as a tool to look for new resources and position teachers and learners as consumers of resources.

Interviews with headteacher and teachers, and observations at the schools, reveal that remote location, a poor local economy, the budget constraints of schools and the lack of interest from school administrators are contributing causes of infrastructure problems, and particularly of the lack of internet access. The importance of school management providing internet access, so teachers can update their knowledge of technology and improve their teaching skills, has long been recognised as a critical factor in the success of IT in classrooms and was emphasised some years ago by Yuen et al. (2003). Similarly, Tezci (2009) showed that limited access to the internet impacted on teachers' use of ICT in instructional activities.

In summary, the schools have difficulty maintaining their infrastructure. The schools do not have replacement computers, and even minor malfunctions with an individual computer can have an impact on learning effectiveness for the entire class. The lack of internet connectivity means that materials cannot be updated and that teachers cannot develop their skills, and open web learning is not possible. Thus, it is not possible to make a generalised statement on the effectiveness of XO computers, or of OLE-Nepal, but only in terms of how they fit into the infrastructure available in a specific context. In the present case study, the infrastructure available in the schools is a significant constraint on the educational effectiveness of the computers, and on the patterns of use which are observed.

5.2 Classroom Management.

Classroom management is strongly linked to the role of the teacher and to the way the teacher handles the daily issues that may arise in the classroom (Vairamidou &

Stravakou, 2019). Laboratory observations have shown that classroom management is a crucial factor in the organisation effective classroom environment, and we now discuss the key aspects.

Classroom Scale and Furniture Layout.

Laboratory observations showed that schools with adequate classroom furniture that is arranged appropriately have enabled more productive use of computers. The laboratories in participating schools tended to be smaller than other classrooms in the same school, showing that schools were not willing to reduce traditional class provision to maximise the effectiveness of computers. In Annapurna, the laboratory furniture was set up as a regular classroom, per row of six benches and tables, with three lines. Learners would pick up laptops from the docking station and take them to their desk. The teachers used eye contact to confirm understanding and to check that the learners were on task. However, the case was different in Everest and Makalu, desk and benches were positioned in such a way that some of the learners were facing the teacher or the whiteboard and others were facing the wall. Both schools had a two long rectangular table in the middle of the room, placing their devices on the desk with benches on both sides of the long table for eight learners to use. These long tables in the middle seemed to cause a significant challenge for teachers walking around and guiding learners when necessary. Makalu had desktop computers arranged against the three corners of the wall to utilise maximum space. Everest had a similar set up of the desk and benches against the wall where learners carried their laptop from the docking station to the desk. The pupils facing the teacher and the board were in eye contact with the teacher but, the ones facing the wall had opportunities for inactivity and concealed activities.

In contrast to the sitting arrangements at Makalu and Everest, the classroom layout at Annapurna's allowed teachers to have more eye contact with learners and move around the classroom more swiftly, making it easy for teachers to get to the students' tables. This may be partly due to the fact that the room used for the laboratory in Annapurna was wider than the other two schools. Nonetheless, observations suggested that unnecessary and unused furniture could have been eliminated from the room, providing more space in Everest and Makalu schools.

ICT and learners' behaviour.

Teachers recognised that technology offers a way to manage a large number of learners in a crowded laboratory by keeping learners occupied with audio and visual lessons. They also said that digital devices made learning materials more accessible to learners than traditional books. This is consistent with the notes in the laboratory observations diary. Still, it should be noted that teachers could not provide comments about which learners were using the computers productively, which suggests that the use of computers constrained their teaching activities. In particular, in Makalu and Everest, the teachers were not able to establish eye contact or gain access to the learners' desk to

check whether the learners were working on lessons or engaged with other activities. Teachers also mentioned that if they assigned an unplanned computer activity to their class, then monitoring learners was an extra burden. The majority of teachers at all schools confirmed that digital devices enabled them to engage the learners, particularly when they had a large number of learners. Still, it prevented them from evaluating each student's activities individually. Teachers were asked whether the computers had relieved them of certain of their academic management responsibilities, such as checking for activities or assessing individual progress. They reported that computers enabled learners to revisit and validate their learning, using self-assessment activities included at the end of the lessons of E-Paath. This supported teachers in carrying out the assessment, as they could keep a record of the learners' performance. Observations in the classroom showed that when there were more learners than devices, the class was distracted, and the learners were unable to focus on their assignment. It is not clear to what extent this issue could have been mitigated by improved practice in the control of classroom behaviour.

To summarise, the teachers recognise the potential of computers for learner engagement and classroom dynamics. However, comparison between schools shows that computers are not resources which can simply be added to existing classroom activities. They represent an active intervention into classroom management, and the classroom layout and teaching methods need to be designed accordingly. Differences in these aspects may explain much of the difference in performance between schools, because if the classroom teacher is unable to manage the class, then planned learning would not take place, regardless of advances in technological resources.

5.3 Gender

All the participating schools were public and co-educational. The questionnaire and focus group results showed that in all the schools the boys were more interested in computers than the girls. However, the questionnaires and focus group discussions also showed that girls have lower attendance at school. From the first author's personal experience, and teacher interviews from Annapurna and Everest schools, in most rural communities menstruating girls are considered impure untouchables. Moreover, school observations showed that toilet facilities are inadequate in all the participating schools. The data from teachers and parents confirmed that because of the condition of the toilets, even girls who do not come from families who hold this belief tend not to go to school when they are menstruating. It is reasonable to propose that this irregular attendance contributes to the lower achievement of girls in examinations. Data from parents shows that girls are encouraged to do housework at homes such as cooking, cleaning, farming and washing clothes, and as a result, they arrive late for schools or miss school. During the focus group discussion, two girls from Everest school reflected on their low attendance:

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I wake up early in the morning at five o'clock. I have to milk the cows, feed them and start cooking food for the whole family. By the time we all eat and finish I hear the school bell. I always try to be on time, but I only manage it once or twice a week.

Both my parents are labour workers in the fields. When one of my parents is not well, they ask me to miss school and nurse them. I do not like to stay at home and miss my lessons. But I have no choice. Sometimes I wish they would ask my brother instead.

To summarise, while boys make more use of computers than girls, and achieve better academic results, it cannot be assumed that this is because of the innate gender characteristics. The girls may be interested in learning but cannot spend as much time at school. As a result, they are less familiar with computers and achieve less expertise.

5.4 Teacher motivation and training

The level of professional commitment shown by teachers varied considerably between the case study schools. In the first author's experience, many of his former colleagues in rural schools in Nepal joined the profession because they needed a job and saw teaching as an employment opportunity. Such teachers tend to see the activities of education as a list of tasks to be completed. The introduction of computers means the addition of new and unknown tasks, which are unlikely to be welcome. On the other hand, the teachers from Annapurna school were very committed to the purpose of the school in transforming the lives of their learners, to the point that they have contributed a part of their small salary to employ additional teachers to meet the needs of the children. In this context, any initiative which has the potential to improve outcomes will be welcome, including the introduction of computers.

In the interviews, all three principals confirmed that some teachers were motivated by teaching with computers in the beginning, but when the performance of the laptop deteriorated, they started to feel that running the computers took time from the classes and that it would be more effective to teach from a book. Nevertheless, the school has scheduled classes with computers that they have to carry out. This can lead teachers to have a negative perception of lessons with computers.

Out of the thirteen teachers interviewed, ten of the teachers confirmed that the training provided by NGOs was useful, but not sufficient. For example, Bishnu a teacher from Everest said

After the NGO installed XO laptops in our schools, we had a week training on how to operate the computer. The training included presentations, interactions, hands-on activities, and practice teaching to prepare to conduct classes with computers. The training was conducted many years ago; we need regular exercise so we can update our knowledge

The training needs to be refreshed and updated, especially in the absence of the internet. The NGOs have to deal with hundreds of schools, and they are in no way able to track and support them all, and Rabi Karmacharya, the founder of OLE-Nepal, admitted that the support provided to teachers was limited (Wodon, 2015). Consequently,

there is a gap between the expectations of schools and teachers and the capacity of NGOs. This also applies to the maintenance of computers.

In summary, the success of the use of OLPC computers depends on the existing motivation of teachers to focus on the outcomes for learners, rather than on their own tasks. Teachers' belief in the capacity of the computers to achieve these outcomes can be eroded by inadequate training and maintenance.

6 Concluding remarks and future work

This case study has documented the way in which OLPC XO computers and PC's are used in schools in rural Nepal. It has made use of this data to identify the factors which enable and constrain the success of the OLE-Nepal programme, which have been discussed under the categories of classroom management, infrastructure, gender issues and teacher motivation and training

The findings show that the effectiveness of educational IT projects in general, and the OLE-Nepal programme in particular, depend on the way in which they interact with the local context in schools. Any progress in the use of technology must focus on detailed planning for the use of computers, process improvements and the development of infrastructure at the national, regional and village level. Much of this work will not be possible without the assignment of resources and decision-making capacity to the appropriate level.

We note that the XO laptops in the OLE-Nepal programme are primarily used as a means to deliver teaching materials. This is indeed a valuable capability for remote schools that cannot receive sufficient printed teaching materials. The lack of internet makes the schools entirely dependent on these pre-loaded materials. However, this fits poorly with the vision of XO as "A project developed and distributed with a low-cost machine for children with an intention for the children to learn without or despite their teacher and schools" (Warschauer & Ames, 2010, p.34). At this most general level, we again see how the ambitions and design of systems are transformed by the local context in which they are deployed.

In future work, the results presented here will be contrasted with data examination results and school performance, and patterns of use of the technology in the classroom will be identified. The results will also be contrasted with a school which no longer participates in the XO project and a school which has never used laptops.

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