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# Innovative Information and Communication Technology in Education and Its Potential for Reducing Poverty in the Asia and Pacific Region: Summary of Findings “**Where Desert Meets Technology: Findings from ICT in Education Initiatives in Rural Schools in Mongolia**” (Financed by the Poverty Reduction Cooperation Fund, Asian Development Bank)

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## Where Desert meets Technology: Findings from ICT in Education Initiatives in Rural Schools in Mongolia

### **Summary of Findings**

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#### **I. BACKGROUND TO THE STUDY**

1. With the aim of providing Developing Member Countries (DMCs) with better guidance for using information and communication technology (ICT) effectively in education, the Asian Development Bank (ADB) funded a 21-month Regional Technical Assistance (RETA) in Bangladesh, Nepal, Mongolia, and Samoa. The RETA researched approaches to using ICT in education to improve teaching and learning that are not only successful, but also feasible and sustainable given the region's development challenges. The study was implemented by RTI International in partnership with iEARN-USA. "Innovative Information and Communication Technology in Education and Its Potential for Reducing Poverty in Asia and the Pacific Region," commenced in April 2006.

2. Specifically, the study aimed at highlighting promising models of ICT integration and best practices; identifying drivers and barriers to successful ICT integration; and sharing lessons learned, with a specific focus on rural and remote areas. It combined policy analysis, program evaluation (mainly interviews and focus groups), and small-scale activities (professional development and provision of selected ICT resources). The study piggy-backed on existing projects in each of the four participating countries. In Bangladesh and Nepal, those were projects focused on the use of ICT for teacher training, in Mongolia and Samoa, the task was to focus on projects introducing e-Resources (electronic teaching and learning materials) to better reach remote and isolated areas of the country with up-to-date teaching materials.

3. Countries were chosen due to their specific geographic and demographic aspects to provide country context perspectives for the region. In the case of Samoa, this relates to its location as a remote island country with a small population. In the case of Mongolia to a small population inhabiting a vast and remote landmass. For Nepal relevant factors are the diversity of its topographic profile, coupled with a relatively low population density in the mountainous areas and relatively high population density in the flatlands (*'terai'*). In Bangladesh, important factors are its high population density and the flat, alluvial plains characterizing its terrain. Such aspects, among others, strongly influence the role and format ICT use can take to address education and poverty challenges. The RETA featured three technical components:

- Policy and Strategy (regional)
- e-Resources (Mongolia and Samoa)
- e-Teacher Training (Nepal and Bangladesh)

4. In Mongolia, specifically, the study was to piggy-back on the ADB-funded ICT for Innovative Rural Education in Mongolia (IIREM) project, and Second Education Development Project (SEDP), and to implement study components one (Policy and Strategy) and two (e-Resources). In this context, the study as such was not an extension or follow-on for either IIREM or SEDP, but focused on strengthening and complementing investments already done, while primarily aiming at studying the existing approaches and lessons learned under those existing initiatives.

5. Under SEDP, more than 100 schools in the country were provided with up to six computers, some also with a printer and related accessories. Basic training in computer set-up, trouble shooting and training in informatics instruction was provided to some of the informatics teachers in those schools. Under IIREM, 45 schools in the country have been provided with a equipment package of at least one laptop, one LCD projector and one digital camera, in addition to teacher training on equipment use, development of electronic teaching materials and basic introduction on integrating ICT with classroom teaching. IIREM has also provided a set of Mongolian education software titles for subject matter teaching, professional development and teacher productivity. In cases where no electricity was available, IIREM also provide diesel generators to selected schools.

6. While there have been efforts and studies in the region to identify the lessons learned on ICT in education, no systematic approach to cataloging drivers of effective ICT integration in classroom teaching had been done to date. Furthermore, the study is unique in that it couples indicators of teaching quality with ICT-related indicators in addition to contextual aspects. This was to highlight the myriad of factors that can have an effect on the effectiveness of ICT in education initiatives. In this sense, the study provides a very comprehensive contextual perspective to ICT integration and its relation to education quality than formerly available.

7. Given IIREM and SEDP inputs and with study objectives in mind, we sampled twelve schools for participation in the study. Four schools that already participated in the IIREM project, four schools that received computer equipment under SEDP and four schools were sampled as control schools. We then conducted a number of activities guided by a site assessment and need analysis, to strengthen and complement IIREM and SEDP inputs. These activities included (a) a one-week intensive training program for teachers and training managers, as well as representatives from the Education and Culture Department (ECD)<sup>1</sup> in August 2006, (b) moderate procurement of equipment and software for SEDP schools<sup>2</sup>, (c) two-day, follow-on training interventions at each IIREM and SEDP school in the study in October 2006, and (d) a four-day training for trainers with three-day follow-on regional trainings in April 2007. Our training under the study strongly focused on providing teachers with methodological skills on ICT integration into their classrooms and with their curriculums. It focused on issues of pedagogical leadership and organizational integration for training managers<sup>3</sup> and ECD counterparts. SEDP and IIREM school representatives took part in all and the same study activities and had the similar new equipment and software available, which allowed us to add an additional level of experiment to the study: comparing teacher data from both, IIREM and SEDP schools with data from teachers in control schools, AND comparing data between participants from IIREM and SEDP schools for differences that may have been caused by the former having been exposed to ICT for a longer period of time and having received substantially more training due to their earlier participation in IIREM. In turn, SEDP schools were expected to have more

<sup>1</sup> Ministry of Education, Culture and Science on regional level.

<sup>2</sup> SEDP schools received the same equipment package IIREM schools had: one laptop, one LCD projector, one digital camera and some self-study software on desktop applications, such as Windows Explorer, MS Word, MS Excel and MS PowerPoint

<sup>3</sup> Usually deputy principals responsible for pedagogic leadership, teacher performance evaluation an school-based in-service professional development

computers available than their IIREM and control school counterparts, as this was that project's input.

8. The study aimed at providing an account and reliable documentation of lessons learned, good practices and successful approaches on integrating ICT into education, specifically to enhance classroom teaching, on the basis of the project under investigation. In order to define, however, what a "good" or "successful" approach constitutes we needed to clarify if there had been any tangible, positive outcomes on areas of education quality in the first place. Given the timeline of the predecessor projects, with IIREM having just recently concluded, and the focus of project inputs on teachers, it seemed appropriate to select the teacher as the unit of assessment and focus on teaching quality as a key aspect of education quality.

9. Following study activities, therefore, we conducted data collection in each of the twelve participating schools. We surveyed and interviewed a total of 57 teachers, 13 of their training managers, 11 of their principals and 125 of their students. In addition, we conducted focus groups with 71 parents, 70 students and 70 teachers, to address the following two main research questions:

(1) Are there differences to be noted on indicators of teaching quality in schools that featured an e-Resource initiative compared to schools that did not?

(2) Do e-Resources address specific needs or challenges of rural/remote schools?

10. Focusing on teaching quality, we researched and identified a number of indicator dimensions that are commonly used in assessing teaching quality. Our data analysis on these dimensions was to help define whether the e-Resource initiatives, as they took place, triggered any differences in teaching quality or not. If yes, then this would allow us to classify the e-Resource initiatives under investigation, including at least a number of their defining approaches, as having been "successful". IIREM monitoring and evaluation reports, as well as the IIREM final report also provided an account of specific project implementation approaches that seems to have worked well in this context.

11. To answer Research Question 1, therefore, we investigated a number of indicator dimensions of teaching quality, including (a) teacher pedagogical support, (b) teaching practice and evaluation/assessment, (c) teacher efficacy, (d) teacher lesson planning and material production, (e) teacher collaboration, (f) teacher job satisfaction and attendance, and (g) access and use of equipment and materials. To investigate subject matter knowledge, another crucial aspect of teaching quality, was outside of the scope of this research, but may provide the starting point for future research. In the chapter below, summaries of findings in each of these dimensions are being presented; followed by a conclusion for Research Question 1.

12. To be able to answer Research Question 2, we then complemented outcomes for research question one with detailed ICT case studies from the participating schools. Outcomes from case studies are being presented in Chapter III, along key aspects of ICT integration, followed by a list of drivers and barriers to effective ICT integration on teacher-level, school-level and system-level, as a summative overview. Drawing on outcomes from Research Question 1 and the ICT case studies, we addressed Research Question 2, for which findings are presented in Chapter IV below.

13. In addition to this study findings brief, a full country report is available. The report: "Where Desert meets Technology: Findings from ICT in Education Initiatives in Rural Schools in

Mongolia”<sup>4</sup>, provides detailed information on the IIREM and SEDP projects, the activities implemented under this study, information on the country and education system context and an in-depth presentation of study outcomes. The full report also provides a discussion of the outcomes in each of the dimensions under investigation and recommendations for future activities and research.

## II. FINDINGS ON RESEARCH QUESTION ONE

### A. Findings by Indicator Dimension

14. **Teacher Pedagogical Support.** Classroom observations and review of lesson plans and documentation are important tools to provide teachers with feedback, as well as pedagogical support. Data analysis shows that classes of teachers in control schools are significantly less likely to be observed by their training managers or principals than classrooms of IIREM and SEDP teachers and for most of them does not take place more than once a year. Furthermore, control school teachers’ lessons plans and other documentation are reviewed considerably less frequent than those of the participating IIREM and SEDP teachers, for the majority of them less than once a month. At the same time, teachers from all three groups mostly turn to their colleagues for support and guidance on specific challenges or questions they face. Data from this dimension suggests that control school teachers receive considerably less pedagogical support than their peers in schools that participated in e-Resource initiatives.

15. **Teaching Practice.** In order to gain more insight into teaching methodology and instructional practices, teachers were presented with a set of statements, some of which exemplify rather traditional, teacher-centered teaching methods, others that indicate a more student-centered and constructivist approach. Reviewing responses of teachers across statements indicates that there are no significant differences between teachers that participated in e-Resource initiatives compared to teachers that did not. These results have been confirmed by responses of training managers. However, there are selected methods for which frequency of usage considerably varies: For example, teachers in schools that participated in e-Resource initiatives are much more likely to let their students explain how they have gone about solving a problem, than their peers from control schools. Furthermore, control school teachers let the whole class repeat sentences that they say first more frequently than their colleagues from other schools.

16. **Student Assessment.** Participating teachers report several different ways of using results from student assessments. Least likely among them is using results to prepare the next lesson or to decide about student retention. A great many teachers use results to group students by ability. While differences are not significant between the three groups of teachers, control school teachers use results to a lesser extent for improving their teaching practice. More significantly, however, control school teachers feel less confident about their capacity to utilize a variety of assessment strategies, compared to their counterparts in IIREM and SEDP schools.

17. **Teacher Evaluation.** Qualitative definitions of a ‘good teacher’ by school principals do not differ very much between groups, and neither do training managers’ accounts of criteria of teacher performance evaluations. Training managers mainly state “student grades,” “getting along well with everyone,” and “experience” as the three main criteria playing a role in such evaluations. Teachers in control schools, however, are more likely to state that “seniority” plays a role in teacher performance evaluations than their peers from IIREM and SEDP schools. In

<sup>4</sup> RTI International. 2007. *Where Desert meets Technology: Findings from ICT in Education Initiatives in Rural Schools in Mongolia*. Mongolia Country Report. ADB TA6278-REG. Research Triangle Park.

addition, teachers from control schools are significantly less satisfied with the procedures of teacher performance evaluation at their school than IIREM or SEDP teachers.

18. **Teacher Efficacy.** As part of the study, teachers rated their efficacy on a validated set of 12 statements. The instrument captured teachers' feedback on three subscales: efficacy in student engagement, efficacy in instructional practices, and efficacy in classroom management. Data analysis shows, that while answers to individual statements may vary between groups, overall participating teachers have a similar sense of how well they are able to control certain situations and difficulties in their classrooms and with their students. Therefore, there were no significant differences observed on teacher efficacy between teachers who participated in e-Resource initiatives and teachers who did not.

19. **Lesson Planning and Material Development.** There are some differences to be observed in the time dedicated to lesson planning between the different groups, with IIREM teachers investing most, and SEDP teachers least of their time per week on this task. Training managers across the three groups estimate a lower level of time investment compared to teachers' estimates. SEDP teachers report spending least amount of time in the preparation of teaching and learning materials, but the three groups do not differ significantly on this item. They do differ significantly, however, in the amount of money they spend on the raw materials necessary to develop teaching and learning aids. IIREM and SEDP teachers spend about 30% less per month than control school teachers on items such as cardboard, paper, colors, etc. For selected control school teachers, the amount they spend may be up to a seventh of their basic monthly salaries.

20. As was expected given their participation in the project, there are also significant differences in the time teachers spend on developing electronic teaching and learning materials. Teachers who participated in e-Resource initiatives are much more likely to spend time in developing electronic teaching and learning resources than those that did not. Comparing IIREM to SEDP teachers in this regard did not yield any considerable differences.

21. **Teacher Collaboration.** Control school teachers on average spend less time working with other teachers compared to teachers who participated in e-Resource initiatives. When they do, they prefer to work on issues of lesson planning and school events, and comparatively little on issues of teaching and learning material development. Most notably, is it significantly less common for teachers from control groups to exchange such materials with each other, compared to teachers who participated in e-Resource initiatives. In addition, teachers who participated in such initiatives have more exchange with other schools. More than a third of control school teachers have this chance only once a year or less.

22. **Teacher Job Satisfaction and Attendance.** Data analysis shows that there is a significant difference between teachers who participated in e-Resources initiatives and those who did not in the area of teachers' satisfaction with their jobs. Teachers who were part of such initiatives are more likely to agree to statements that exemplify satisfaction with their jobs than teachers in schools that were not part of e-Resource initiatives. While SEDP teachers show the highest mean score on this dimension, there were no significant differences between the IIREM and the SEDP group to be observed.

23. Although there were hardly any differences in teachers' self-assessment of the quality of their attendance, there was some difference in their training managers' evaluation. Most training managers from control schools rated their teacher's attendance worse than training managers from IIREM and SEDP schools assessed that of their teachers.

24. **Teacher access and use of Equipment and Materials.** Teachers in all three schools are able to draw on resources, such as teachers' guides and student textbooks, or books in their libraries. The general availability of student textbooks and teachers' guides seems to be appropriate across all three groups of teachers. However, many of the participating teachers report problems with fact that their students do not have their textbooks in time for the start of the school year. Principals confirmed this challenge, outlining a number of reasons and highlighting their school's remote location, and textbook affordability for parents as key among them. In addition, a big part of the books and science models available in all schools are not usable for teachers because they are either damaged, too old, or not relevant to the curriculum.

25. IIREM teachers state to make most use of the library books, cassette recorders, TV, computers, and education software for lesson planning, professional development, or teaching. Control schools, according to their teachers, are less well equipped, not only in terms of new media, such as computers, but also in terms of more traditional technology, such as radio, cassette recorders, and TV, as well as traditional science models. For several of these items, however, their training managers' replies did not confirm the lack or shortage reported by their teachers.

26. When known to be available, teachers in control school tend to make less use of these tools for educational purposes than their counterparts from schools that participated in e-Resources Initiatives. Triangulating results confirms this pattern, and both training managers and students agree with their teachers' assessment. Comparing usage between IIREM and SEDP teachers, data suggest that the latter make considerably less use of most of the items under discussion, except for the use of the digital camera to develop teaching and learning materials.

## **B. Conclusion Research Question One**

27. In regard to Research Question 1, study outcomes indicate that there are indeed differences to be noted on dimensions of teaching quality between schools that participated in the e-Resources initiatives and schools that did not. On some dimensions teachers from schools that participated in the e-Resources initiatives show more positive results than their peers. This is the case specifically for teacher collaboration, teacher job satisfaction and teacher use of equipment and material. On other dimensions no significant differences could be found. These dimension include teaching practice, teacher efficacy and teacher attendance. However, on none of the dimensions did teachers from control schools show significantly more positive results. Our research suggests, therefore, that the e-Resources initiatives under investigation have had a positive effect on teaching quality, as assessed by this study.

## **III. FINDINGS FROM ICT CASE STUDIES**

28. Outcomes for Research Question 1 suggests that the e-Resource initiatives under investigation have been successful in advancing critical aspects of teaching quality. To better understand the context in which these changes have taken place, it will be important to have a clear understanding of ICT-related aspects on school level in these schools. We therefore conducted detailed case studies in each of the participating schools to gain insight into the contextual factors that may play a role for the effective integration of ICT. In the following sections, summary data from these case studies in the participating schools is being presented along key dimensions of ICT integration on school level, such as ICT infrastructure, access to ICT, purpose of use of computers, ICT-related policies and strategies on school level, access to resources and guidance on ICT and attitude to ICT.

## A. Findings along ICT-related Aspects

29. **ICT Environment.** Electricity is the key challenge among all of the schools that are not located in the *aimag*<sup>5</sup> center. *Soum*<sup>6</sup> schools have electricity only on an hourly basis, mostly from diesel generators, but also use wind and solar power. Electricity in most *soum* schools is available only outside school hours, in the evening.

30. Excluding the generally larger and better equipped *aimag* center schools, principals in *soum* control schools report on average a larger number of functioning computers than IIREM or SEDP principals. At the same time, computers in those schools are more likely to still run under the Windows 98 operating system. None of the schools mentions utilizing any open source applications and the operating system and desktop applications in use are all in English and Arabic script.<sup>7</sup> The majority of all schools has most of their computers situated in a computer lab, and also has at least one printer. There are more control schools in the sample that still have a more “traditional” computer room set up, organizing computers in rows, facing the front. All IIREM schools have their computers organized along the wall, with the screens facing the room.

31. Except for one SEDP school, none of the *soum* schools has Internet access. In addition to the number of functioning computers, control schools are also better equipped when it comes to overhead projectors. Otherwise, however, it is clearly participation in e-Resources initiatives that allows IIREM and SEDP schools to report laptops, LCD projectors, and digital cameras in their inventory. IIREM schools are in general better equipped and feature more fax, scanner, and copy machines than participating SEDP and control schools.

32. **Access to ICT.** IIREM teachers mainly report using the school laptop<sup>8</sup>, whereas SEDP teachers make also use of the computers in the computer lab, much more than their IIREM counterparts. Most responding control school teachers indicated that they don’t make use of computers at all. Those that do tend to use a computer from the school administration for access. Some teachers also have a computer at home. Training managers in IIREM schools mostly use the school laptop, whereas training managers in SEDP schools also use the computer lab and computers available to the school administration. Training managers in control schools share a computer with other school administrators. Most principals from all three groups have a computer in their office.

33. A clear majority of students from control school never used a computer, where as the majority of IIREM and SEDP students clearly make use of computers, and do so mostly in the computer lab. It is apparent that more students in schools that participated in e-Resources initiatives report access to computers than students in schools that did not.

34. **Purpose of ICT Use.** In general, there are no significant differences in the purpose for which teachers are using computers; mainly, computer use is for student and class administration or lesson planning. IIREM teachers are more likely to make use of computers for information research than their peers. Training managers mostly use computers for school administration. Notably, training managers from IIREM and SEDP schools make use of computers for a larger variety of purposes than their control school counterparts. There are no major differences between groups in terms of how principals are using computers: mostly for

<sup>5</sup> *Aimag* – second biggest administrative unit of Mongolia after capital city Ulaanbaatar, similar to a “province;”

<sup>6</sup> *Soum* – third biggest administrative unit of Mongolia, similar to a “district”.

<sup>7</sup> Mongolian (Khalkha Mongolian) is the dominant national language of Mongolia and its dominant script is Cyrillic orthography.

<sup>8</sup> Laptops were provided under IIREM for IIREM schools and under this study for SEDP schools.

school administration. Students across all groups who report using a computer, mainly tend to do so for their informatics subject.

35. **ICT-related Policies and Strategies.** There is a significant difference between schools that participated in e-Resources initiatives compared to those that did not in the existence of policies guiding teacher ICT competence. Nearly all of the IIREM and SEDP schools feature such a tool. There are also different approaches to providing incentives for teachers to utilize ICT in their teaching. Control schools tend to provide access to electricity and computers, whereas SEDP and IIREM schools offer more personalized and targeted schemes, such as salary increases and scholarship nominations. Furthermore, a large number of participating teachers think there are teacher performance evaluation criteria related to the use of ICT in the classroom in their schools. However, they did not mention a specific criteria, but rather general guidelines that exist at their schools. Training managers interviewed pointed out that some teachers have achievements regarding ICT integration in their performance contracts<sup>9</sup> with the school.

36. **Resource and Guidance on ICT.** Most IIREM and SEDP teachers report receiving and utilizing resources and guidance on ICT integration which they received under IIREM and this study. They also find support from the ECD on this issue. Control school teachers do not report many sources for guidance on this topic, neither receiving much support from ECD. In fact, most control school teachers did not know where to find such guidance. Notably, nearly all IIREM and SEDP training managers feel confident about providing methodological feedback to their teachers in this area. This is significantly different to their peers from control schools, who don't share that same confidence.

37. **Attitudes to ICT.** While there are some differences to be seen on selected statements capturing teachers' attitudes toward ICT, summative results did not yield any significant differences in this dimension. In fact, the group with the lowest mean score on this dimension is that of the SEDP teachers. Overall, however, our data did not indicate a significant difference in attitudes toward ICT by teachers who participated in e-Resource initiatives compared to teachers who did not.

38. Applying the same scale to training managers and principals, however, yields more differentiated results. Due to the very small sample size of these groups of respondents, these have to be considered with care, however. Training managers in IIREM and SEDP schools share the same results on this assessment; however, training managers from control schools show a significantly more positive attitude toward ICT than their IIREM and SEDP counterparts. Principals from control schools are the most positive in their attitude toward ICT compared to their IIREM or SEDP counterparts or any other group in the study.

39. On an adapted scale, a slightly more positive attitude to ICT was recorded for students whose teachers participated in e-Resources initiatives, compared to those who did not. While differences are not significant, students in IIREM and SEDP schools tend to have a more positive attitude toward ICT than their control school peers.

40. **System Level Support on ICT Integration.** Principals from participating schools tend to receive non-financial support regarding ICT from the *soum*, *aimag*, or state mostly in form of training for themselves or their staff. There are no significant differences between groups of schools on this item. In addition, most participating principals stated that they have an

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<sup>9</sup> At the beginning of the school year, a contract is drawn up between every teacher and her/his school, that specifies aims and targets (both for their students, their professional development, but sometimes also for "innovative" elements or professional achievements in other form) for the year and the incentives or "bonus", to be received upon their achievement

opportunity to express their views on ICT (e.g. on access issues, integration issues, etc) at least on regional level, e.g., during general principals and teachers meetings.

41. **ICT Financing, Servicing and Procurement.** Data does not indicate a clear relationship between expenditures for equipment maintenance and servicing and group membership. Except for two IIREM schools, all participating schools make explicit budget allocations for this item. The IIREM *aimag* center school, being the largest, most affluent and best equipped in the region, shows the largest expenditures on this item. In terms of percent of the annual school budget, the control school in the *aimag* center spends the least, even less than any of the *soum* schools that make budget allocations. Among *soum* schools, SEDP schools spend most money on this item in absolute terms. At the same time, it is the control schools that allocate the highest percentage of their annual school budget. With information from only one IIREM *soum* school, however, results of data analysis are not fully conclusive.

42. In terms of decision making on procurement of new equipment, there are considerable differences between schools that took part in e-Resources initiatives and schools that did not. In both, IIREM and SEDP schools, the decision of ICT procurement is made jointly by school management and teachers and often on teachers' initiative. In all control schools procurement decisions rest with the school principal.

## B. Cataloguing Drivers and Barriers to Effective ICT Integration

43. Study outcomes in these dimensions indicate that there are a number of barriers and drivers to effective ICT in education, specifically the use ICT to enhance classroom teaching. Such barriers are on teacher-level, school-level, but also on system-level. In table 1, below we outline the drivers and barriers of effective ICT integration into classroom teaching as we identified them from our data collected and the data analysis conducted. The table also draws on discussions on each of the dimensions under investigation, which are featured in the full country report.

**Table 1. Drivers and Barriers to Effective ICT Integration into Classroom Teaching**

Teacher-level	
Drivers	Barriers
Motivation to change and learn	Aversion to change
Advanced methodological skills	Lack of encouragement for innovation
Ability to translate theoretical instructional models into active student-centered teaching practices	Lack of methodological skills
Encouragement and support for innovation by school management	Lack of basic computer skills
Basic computer skills	Lack of clarity and information on potential of ICT for personal productivity and to enhance teaching and learning
Positive attitude to ICT	Lack of appropriate professional development programs that take teachers' existing skills and experiences into account
Confidence to use technology in didactically appropriate ways	
Ongoing access to resources, guidance and models for appropriate instructional ICT integration	
Capacity to develop locally appropriate content	
Flexibility in the allocation of some curriculum hours and topics	

Ongoing pedagogical support from colleagues and school management	
Alignment between student assessment, instructional practice and teacher evaluation	
Incentives for professional development and innovation	
Integrated, ongoing professional development	
Pedagogical leadership and follow up on ICT integration by school management (e.g., via classroom observations and in-school professional development)	

<b>School- level</b>	
<b>Drivers</b>	<b>Barriers</b>
Electricity during school hours	Lack of electricity
Access to functioning equipment appropriate for educational objectives	Absence and poor quality of ICT infrastructure
Availability of locally appropriate content, suitable and easy to integrate with curriculum and instructional practice	Limited access to ICT equipment
Policies on teacher ICT competencies and strategies/planning for professional development and their follow-up	ICT infrastructure not aligned with educational objectives (e.g. only computer labs and no computers in classrooms or mobile units)
Incentive structures for teacher innovation and engagement, that align with policies and teacher evaluation practices	Lack of Internet
School management with experience in whole school reform	Lack of change management capacity
School management with ability for strategic planning and financial management	Lack of integration of ICT with school development strategies
Participatory planning and decision making regarding ICT	Lack of appropriate solutions for equipment maintenance and servicing
Explicit use of ICT to achieve school development goals (organizational and financial integration)	High teacher-student ratios
Opportunities for regular collaboration among teachers	Lack of information and communication to parents and the community about role of ICT in achieving educational objectives
Opportunities for exchange with other schools	No specific ICT champion(s) and resource persons at school to promote ICT integration and innovation
A critical mass of champion teachers that promote ICT integration and lead exploration of innovative practices	

<b>System-level</b>	
<b>Drivers</b>	<b>Barriers</b>
Flexible elements in formal education system (e.g. in regard to some portion of the curriculum hours)	Rigid curriculum structures
Alignment of ICT in education policies with national education development strategies (on all levels)	Rigid student assessment structures
Ownership and awareness by regional/national government agencies (e.g., ECD)	Rigid teacher evaluation approaches

Consultations and forums for teachers and school managers on regional level	Rigid school budget structures
Certain flexibilities in regard to utilization of school budgets and funds	Uniform, per-capita funding structures for schools, without adjustments for rural locations
System level support, starting on school level, via regional government and to national level	Lack of clarity on role of ICT to achieve educational objectives
Well-documented pilot experiences that provide the anchor for future initiatives	
Information based decision making regarding role of ICT in education	

#### IV. FINDINGS ON RESEARCH QUESTION TWO

44. Complementing findings and data from Research Question 1 and the ICT Case Studies, targeted questions were integrated in the interviews with principals, training managers, and teachers to answer Research Question 2: “Do e-Resources address specific needs or challenges of rural/remote schools?” Questions were aimed at identifying what challenges to delivering high quality education schools face due to their geographic location in the country. Conclusions for this research question were then made on the basis of outcomes from Research Question 1 and what we found in terms of the ICT-related context of each of the participating schools.

45. Outcomes of data analysis indicate that there are common challenges participating schools and teachers are facing. These include the following:

- Lack of electricity and appropriate infrastructure
- Lack of information and communication
- Lack of teaching and learning materials
- Inadequate learning environment
- Insufficient professional staff and teacher capacity
- Lack of community and parent engagement

46. In the following sections, the potential of ICT to address specific challenges in rural schools is being discussed in the context of the schools under investigation, drawing on data from Research Question 1 and the ICT Case Studies.

##### A. Discussion by Problem Area

47. **Lack of Electricity and Infrastructure/ Lack of Information and Communication.** Some of the communication and information access challenges contribute to the fact that it is very difficult for teachers and school managers from such *soums* to attend any in-service training programs, conferences, or other events. These challenges also limit the opportunity for regular professional exchange with peers. In most *soum* schools, there is only one teacher per subject. While this teacher may be able to draw on other teachers’ support for some areas, such as general methodological issues, possibilities of subject-specific didactical and pedagogic deliberations, or peer-to-peer capacity building, are extremely limited. This does not help to alleviate issues of teacher capacity, especially in areas of didactical skills. Internet access, repeatedly requested by teachers and school managers in the study, would alleviate some of

these issues; however, it is not yet available in most of the *soums*. Practices established under IIREM, where teachers would develop emails offline, and then every two to three weeks connect the laptop to the Internet in the *aimag* center, have, as study outcomes show, made a difference to teachers already. While not regularly or on a daily basis, the IIREM teacher email network alleviated some of the isolation *soum* teachers are experiencing, and increased opportunities for professional exchange and peer-to-peer capacity building.

48. **Lack of Teaching and Learning Materials.** The lack of materials and resources for teaching was key among the challenges raised by school principals, training managers, and teachers. For teachers additionally the cost of the raw materials to develop teaching and learning aids is a barrier to engage in this more often than necessary, and contributes to a limited use of visual aids and teaching and learning materials other than teacher guides and textbooks in classrooms (see section on *Teacher Access and Use of Equipment and Materials*). In this environment, the CD ROMs provided to teachers, including graphics, pictures, texts, and a myriad of other resources, have shown to be of significant value. Complemented by the ability to take pictures and video-clips with the digital camera, participating teachers have capitalized on this and engaged in preparing their own electronic teaching and learning materials and sharing them. This did not require any financial investment, other than time, but greatly enhanced their information sources and classroom teaching practice.

49. **Inadequate Learning Environment.** It is questionable if e-Resource initiatives can have much impact on the overall learning environment, unless accompanied by structural changes. Under IIREM, one room in each school was rehabilitated and equipped with tables, chairs, bookshelves, and other items in order to provide an adequate environment. In some IIREM schools these rooms now function as the teachers' room, a classroom, or the computer lab. Calibrated to the specific equipment package provided, these, even small, structural improvements may be required to protect equipment and ensure its operation<sup>10</sup>. The many broken PCs in basically nearly all of the participating schools<sup>11</sup> are a clear indicator for the gravity of this issue. Classrooms are not secured, electricity outlets are faulty, leading, together with the challenges of generator performance, to equipment damage. In many schools, sand and dust are an additional problem, especially in *soums* located in the south of Bayankhongor, at the northern Gobi Desert. While initiatives as such don't address some of the challenges schools are facing in regard to their larger environment, appropriately designed e-Resources initiatives need to include some basic rehabilitation, if only for the sake of equipment and project sustainability, and in this case will make a small, but noticeable difference for these schools.

50. **Insufficient Professional Staff and Teacher Capacity.** Our data suggests that the opportunity for professional exchange with peers, facilitated through email networking, and augmented through the possibility to share teaching and learning resources, has already had a positive effect on teachers' collaboration, but according to participants also on their methodological skills. In focus groups, teachers also report that they feel their subject matter knowledge has increased. Appropriately designed e-Resources initiatives, therefore, following the example the study has set, that focus on teachers' didactic and pedagogical capacity in regard to ICT integration, rather than their computer skills, can have a positive effect on teacher capacity.

51. **Lack of Community and Parent Engagement.** As in other whole school reform approaches, and ICT integration certainly counts as a similar change, community and parent engagement are critical for success, and as current knowledge about education indicates, a key dimension in education quality. E-Resources initiatives, therefore, if properly designed, should

<sup>10</sup> The study equipment to SEDP schools was all provided with protective bags for this purpose.

<sup>11</sup> See full country report for reference.

take this into account and explore ways to engage parents and communities in support of schools' development objectives. Neither under IIREM nor under this study specific efforts been made to include the community (beyond holding informational meetings at the outset of the IIREM project). Focus group discussions with parents indicate that across all three groups, parents are concerned about their children's schools' capacity to appropriately equip their students with informatics skills. According to those parents, such skills are critical in the "21<sup>st</sup> century" and in "modern society", and they don't want their children to lack behind. It is obvious, that parents have a rather limited perspective on ICT in education, mainly in form of the informatics subject that provides computer skills to their children. At the same time their demand and interest do drive ICT development at the schools, with principals reporting to receive frequent inquiries and demands.

52. **Student Motivation.** According to participating principals, student motivation and engagement seems to be a challenge for schools, especially in the absence of appropriate and stimulating learning environments. The dire situation not only in the schools, but also in the dorms, seems to contribute to students' disengagement in their own learning. Focus groups with students clearly showed that students are very excited about their teachers' use of ICT in classrooms and about having the chance to access technology themselves. For many, computers and especially computer games open a new door into a world hitherto unknown. Teachers, in focus groups and discussion, were unanimous in their affirmation that using technology in the classroom increases student motivation.

## **B. Conclusion Research Question Two**

53. Study outcomes indicate that e-Resources can address challenges such as lack of teaching and learning materials and lack of information. The value of e-Resources, however, just in the form of providing schools with electronic teaching and learning aids and educational software, however, is limited. Data clearly indicate that while all the schools have such resources, unless they were accompanied by, 1) familiarization with the resources, 2) training on using a computer to make them work, 3) access to appropriate equipment for their use, and 4) models of their integration with instructional practices, the resources are not being utilized as tools for teaching and learning in the classroom, nor as tools for self-study and professional development.

54. In the form of such more systemic and holistic initiatives, our data suggests that e-Resources, if designed appropriately, have the potential to address some aspects of a variety of challenges schools in remote areas of Mongolia face. These include aspects of teacher capacity, the learning environment, and student motivation.

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