2013

Interactive Radio/Audio Interventions in Elementary Schools in Karnataka, India: A Policy Simulation Exercise

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11/25/2013

Abbreviations

ASER	Assessment Survey Evaluation Research
BRC	Block Resource Coordinator
CAC	Civic Amenities Committee
CBPS	Centre for Budget and Policy Studies
CEA	Cost Effectiveness Analysis
CRC	Cluster Resource Coordinator
DISE	District Information on School Education
DSERT	Department of State Education Research and Training
EDC	Education Development Centre
EVS	Environmental Science
FGD	Focus Group Discussion
GDN	Global Development Network
GOI	Government of India
GOK	Government of Karnataka
GP	Gram Panchayat
GSDP	Gross State Domestic Product
HDI	Human Development Index
HM	Head Master
IAI	Interactive Audio Instruction
ICT	Information, Communication and Technology
IRI	Interactive Radio Instruction
KSQAO	Karnataka State Quality Assessment Organization
NCERT	National Council of Educational Research and Training
PTR	Pupil Teacher Ratio
RTE	Right to Education
SDMC	School Development and Monitoring Committee
SSA	Sarva Shiksha Abhiyaan
TLM	Teaching-learning Material
USAID	United States Agency for International Development

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1.0 Technology Based Solutions in Education: A Review of Literature

Today, technology is being used for distance education programs in elementary education in attempt to improve teaching–learning processes in classrooms. Governments and international agencies are collaborating to develop and implement technology based educational tools across regions. These are aimed at complementing the regular teaching–learning processes in school education for improving the learning outcomes of students. The premise of utilizing technology based solutions to provide quality education at low cost is supported by research evidence.

Research shows that technology leads to various kinds of improvements in educational outcomes. Dede (1998) mentions at least four kinds of improvements in educational outcomes: increased learner motivation; advanced topics mastered; students acting as experts; and better outcomes on standardized tests. Culp and MacMillan (2003) list three reasons for investing in technology for education: technology as a tool for addressing challenges in teaching and learning; technology as a change agent; and technology as a central force in economic competitiveness.

The range of technology in education has evolved steadily. It comprises use of computers, radio, multimedia players, and a range of wireless devices that can be used across regions by providing both audio and visual facilities for exchange of instructions. The role of the worldwide web/internet has grown immensely as it helps minimize the costs in reaching millions of students across geographical regions. In the context of Indian education system, Kurrien (2008) states that the choice of a particular technology—be it television, radio, computers, or others—must be guided not merely by its availability or wide accessibility, but by the innate characteristics that make it appropriate for the educational goals, curricular objectives and pedagogical styles we want to promote on a large scale, in keeping with our National Curricular Framework.

In the 1930s, radio became a popular education technology when the UK Open University first made use of it. The Open University demonstrated that radio has a greater value for weak students who benefit from radio as a supplementary learning tool (Vyas, Sharma, & Kumar, 2002) (Vyas, et al., 2002). The choice of technology tools in education has seen a widening of options, yet radio remains a popular medium in the elementary education system.

In elementary education, the use of high quality radio programs have been found to be successful for expanding access and quality of elementary education and teacher training. The radio interventions are used for both conventional school settings and also for children who are out of the schooling system. Radio is used to teach children who are not in school, who are affected by conflict, who are orphans, who live in countries where most social systems have broken down or never existed—the poorest, least supported and most remote learners to whom access to education has traditionally been denied. It is also is used in systems of huge scale, such as the 20+ million learners in India (Ho & Thukral, 2009). The use of radio is found to be

very appropriate in such settings where the education system is not very strong, qualified teachers are scarce, and instructional materials have to be provided on a large scale. They become very useful in the case of fragile nations like Somalia and Southern Sudan (Tilson & Thomas, 2009).

Research throws light on the positive aspects of the use of radio technology in education. Various studies around the world show that radio has emerged as an effective tool to bridge gaps in education as it helps in improving the learning outcomes of the students. (Improving Educational Quality through Interactive Radio Instruction: A Toolkit for Policy Makers and Planners, 2005) Several studies have shown that radio has been used as a tool to reach large audiences in Africa, Latin America and Pakistan at minimum cost (Ho &Thukral, 2009). Nations have adopted interactive radio in school education since the 1970s. The popular subjects have been mathematics especially mental arithmetic, English, etc. Nicaragua started radio math in 1974. This was followed by Kenya (1980), Dominican Republic (1981), Bolivia (1987), Papua New Guinea (1986), Ecuador (1988) Costa Rica (1989). The South Asian countries first started using radio in 1992 with Pakistan's Radio Math and English in Action projects. Bangladesh started in 1994. The Indonesian government started using radio in 1993 for instruction in civics, math and teacher training. Nepal started using radio for training rural health workers in 1996. India started using radio in school as early as 1937 (Vyas, et al.,2002). However, its popularity as a distance learning medium for elementary schools started catching up post 1970s, especially after the 1990s.

In general, the studies done in various countries where radio based instructions have been provided to students in various subjects show a positive result. According to Jamison and McAnany (1978), the educational uses of radio fall into three broad categories: improving educational quality and relevance; lowering educational costs; and improving access to education, particularly in rural areas. An analysis of various radio projects by Jamison and McAnany (1978) across regions showed that radio, if properly used, can teach as well as (or in some cases, better than) traditional instruction. Based on a detailed review of research studies on the uses of radio in education projects in developing countries, Nwaerondu and Thompson (1999) summarize their findings as follows:

> Evaluation of communication programs, projects, and experiments have repeatedly shown that radio can teach; it can present new concepts and information

In this regard, they quote Sweeney and Parlato (1982, p. 13) who concluded that "...radio plays an effective educational role both as the sole medium or in conjunction with print and group support."

Ho and Thukral (2009) found that exposure to Interactive Radio Instruction (IRI) is associated with higher levels of student achievement, consistently producing learning gains among its participants of diverse ages and in diverse settings. In Haiti, Zambia and Sudan, IRI mathematics instruction has shown positive results with respect to pre- to post-test gains. Even for early learners, IRI has proved to improve not only increase in access to education, but more

importantly, improve student achievement (Radio Instruction to Strengthen Education (RISE) in Zanzibar, 2009).

In school education, radio interventions have been used primarily in subjects like mathematics and English education. There is evidences that suggests that the intervention has helped in improving teaching practices in an unfamiliar subject like a language that is not local to the region (English). It has been observed that in the state of Chhattisgarh in India, teachers were found to be using the radio technology in the prescribed format while teaching English. A possible explanation could be the teachers' own perception that they were weaker in teaching English (being a second language); as a result, they believed that such a tool is actually helpful to them in teaching English but not in other subjects like mathematics or science (where they feel they have the competence and ease to teach).

Kurrien (2008) brings out the findings of the radio program, "We Learn English". It was a bilingual radio program for teaching spoken English in urban and rural schools across various parts of India. The initiative was by the Center for Learning Resources, Pune, for the period 2000–2008. The program had a substantial impact on large numbers of urban and rural students studying in government schools, helping them to start speaking and expressing themselves in basic English. And this was possible despite the fact that their teachers themselves could not speak English. Neither were these students—a large proportion coming from poor families—exposed to any English at all in their homes or in their neighborhoods. Furthermore, improved oral ability indirectly influenced improvements in writing skills. Kurrien further highlights that it is important to note that in the Center for Learning Resources (CLR's) radio projects for teaching English, it was not classroom teachers' competence in subject matter but their professional commitment to students that determined the significant gains in learning. Ho and Thukral (2009) mention that the most remarkable result in primary learning was seen in an English-language program in Pakistan, where the average student outranked all or almost all of his or her peers in non-IRI classes. The Centre for Budget and Policy Studies (CBPS) has not conducted a sample study in English for the 30 schools that it observed in Karnataka. Hence, it would be logical to rely on evidence to suggest that performance of students in English could be a possible area of future research.

However, as early as 1973, McAnany pointed out a number of constraints of instructional radio and suggested some reasons for the failure of projects to provide convincing evidence of radio's effectiveness. The failures are generally not the fault of radio as a medium, and the interest in radio's potential for instruction in developing countries remains high (Jamison and McAnany , 1978). The present study also shows a perceivable loss of benefits due to poor implementation. It has been established worldwide that while radio could be a good medium to improve quality of education at low cost, it could fail to be effective if not planned and implemented well. Research highlights that radio technology has aided in improving the quality of teaching-learning in schools and, if not utilized appropriately, could negate the benefits Imhoof (1983) argued that while radio's strengths and its cost effectiveness can be used effectively to meet expanding educational needs in developing countries without a loss in quality of education, it could also lead to mixed performance if it's inadequately planned for and inexpertly used as a medium.

India has also experimented with utilizing the innovative tools in bridging the gaps in the education sector. India has not been able to ensure the availability of qualified and well trained teachers across all elementary schools. Hence, techniques like radio for education become an easier option to bridge the gap where qualified teachers are not available or where teachers

express difficulty in teaching certain portions of the school curriculum. It has been identified as a way to supplement the regular teaching-learning process in schools.

In the decade of 2000, India adopted radio technology through the IRI intervention to improve the quality of education in elementary schools. It claims to be a time-tested tool around the world to reach larger audiences in a cost effective manner. (EDC, 2010). From 2000 onwards, IRI was developed and broadcast for elementary schools in various mediums (English, Kannada, Hindi and Marathi) in several Indian states.

2.0 Problem: Low level Learning Outcomes at Elementary Stage in State Run Schools in Karnataka

India faces the biggest challenge of providing quality elementary education to all children. The issue of quality has many dimensions: academic development and related learning outcomes along with the development of creativity, life skills, confidence, and the desire to learn and negotiate, all of which are part of the quality of education. Assessing these dimensions of quality is equally a challenge. The most easily available indicator to measure quality is learning outcomes. Karnataka, one of the better performing states in India with respect to Gross State Domestic Product, still faces challenges in providing quality elementary education. In 2008–09, the state stood 16th in the overall ranking of the Education Development Index (EDI).[1] Looking at the performance of the students in the elementary schools of the state in the period 2005–08, the Karnataka State Quality Assessment Organization (KSQAO) shows that average state performance has improved from 50 percent to 72 percent. But the Assessment Survey Evaluation Research (ASER) survey[2] shows a lower level of performance at 36.8 percent in 2005–06, which rose to 60.6 percent in 2008.

Table 1: Overall Learning Achievement (%) at Elementary Stage in Karnataka (2005–2008): State's Average Performance

Year	KSQAO	Pratham/ ASER
2005–06	50	36.8
2006–07	63.8	41.5
2007–08	71.2	57.2
2008	71.74	60.6

Source: Economic Survey, Karnataka (2010-11)

In 2007–08, 16 of the 32 districts of the state fell in the high performing range while the remaining 16 districts were categorized as low performing districts by the (Report, 2007–08). Similarly, the AESR 2005–08 reports categorize 14 districts as low performing.

The Economic Survey 2010–11(Government of Karnataka) mentions that:

[1] The EDI is developed by the National University of Educational Planning and Administration (NUEPA). For more details refer to the website http://pib.nic.in/archieve/others/2008/oct/r2008101004.pdf
[2] For more details on the ASER survey, see http://www.asercentre.org/

While the state needs to be commended for its improved rank position both in access and infrastructure at the upper primary stage, it is teacher index and outcome index of the EDI which show considerable decline at this stage. In lower Primary Education, the performance in access, infrastructure and Teacher is appreciable but the outcome is not satisfactory. This clearly suggests that the state needs to consolidate the gains of primary education with focus on quality to sustain improvements in upper primary education.

The latest survey by the National Council of Educational Research and Training (NCERT) for Class V students in government schools was undertaken in 2010. While Karnataka scores better than average for the states that were included at the same point of time, the scores are low by international standards. Gender differences in all subjects—reading comprehension, mathematics and environmental science (EVS)—are insignificant and rural–urban differences are notable for reading, which is better for rural areas as compared to urban areas. However, the ASER survey, which is not as rigorous as NCERT as it is based on a very limited number of test items and administered at home rather than the school, gives a slightly different picture.

Table 2: Learning Achievements in all Elementary Grades, Karnataka

Reading Results	**Nothing**	**Letter**	**Word**	**Para**	**Story**
2006	7%	14%	16%	24%	39%
2008	5%	13%	17%	19%	46%
2011	5%	15%	17%	19%	45%
Arithmetic Results	Nothing	Number Recognition_1	Number Recognition_11	Subtraction	Division
2007	6%	13%	31%	26%	24%
2008	5%	13%	32%	27%	23%
2011	4%	13%	28%	28%	26%

Source: Annual Status of Education Report Survey 2011, Karnataka State Report

According to ASER (2011) data, 59.7 percent children in Karnataka "can read standard one text and more" in Classes three to five, and 47.5 percent children enrolled in the same Classes "can subtract and more". This is slightly higher than the national average of 57.5 and 46.5, respectively, for the same Classes. As per the ASER, reading as well as numerical competencies in rural Karnataka are worse than in urban areas, a conclusion contrary to the NCERT survey. However, at the same time, rural Karnataka is better than the all-India average for rural areas. What is evident, however, is that although there are variations in data from different sources, and Karnataka is slightly above the national average in most cases, the learning outcome levels are generally low and therefore no cause for celebration. Table 2 shows that there has been no significant change over the years. In reading results, the state has witnessed only marginal changes over the period 2006–11 in both language and arithmetic results.

The state has been taking a number of steps to strengthen the capacities of teachers in handling classroom transactions in an effective manner and improve the outcomes. In-service training, audio and visual technology aids, and a host of innovative techniques have been introduced under the Sarva Shiksha Abhiyan (SSA), the main flagship scheme for achieving universal basic education in India[3]. Karnataka has been one of the pioneer states to adopt technology based solutions in teaching and learning processes at the school level by introducing radio and audio based interventions in elementary schools in 2004–05.

3.0 Interactive Radio/Audio Intervention in Elementary Schools of Karnataka

In 2004, the Government of Karnataka (GoK) was approached by the Education Development Centre, Inc (EDC), a global non-profit organization, to pilot radio interventions in Karnataka. The EDC had experimented with the idea of using radio as a medium to help students and teachers improve learning outcomes on a scale basis across various parts of the world (Somalia, Sudan, Malawi and Pakistan), and hence had the desired experience and expertise. The EDC has designed, delivered and evaluated innovative radio programs to address some of the world's most urgent challenges in education, health and economic opportunities. It was well received by the state level representatives of the SSA (2010), resulting in the collaboration between the EDC and the SSA for designing and implementing the radio programs based on school curriculum for all Kannada-medium elementary schools in the state. The intervention was known as Interactive Radio Instructions (IRI) and was implemented from the year 2005–06.

The main objective of the IRI program varied from country to country.[4] In Karnataka it was adopted to supplement the existing teaching system so as to help teachers teach and students to learn the so-called "hard spots" as identified in the existing curriculum. With the existing infrastructure, it was felt that radio could be a cost effective tool to reach a large number of government schools with low expenditure and comparatively larger reach. The IRI are prerecorded programs based on the school curriculum. They are aired through satellites and radio is used for the broadcast of the programs. The content was designed after a detailed analysis of the requirements of the targeted students and teachers. Teachers are trained to conduct the radio classes and are provided with guides and reference material to operate a radio class.

The special features of this intervention include:

- Instructional tool especially designed to deliver active learning by radio.
- Identifies radio as a potential tool for learning and dissemination.
- Usually 30-minute audio lesson allowing students and teachers to react verbally and physically to questions and exercises posed by radio characters.

[3] SSA is a time bound mission mode program adopted by all states in India with the objective of achieving universalization of elementary education across all states of India.
[4]Some African nations have used it to supplement the existing teaching tools or as an alternative method to reach out to the largest and distant groups.

- Use of imaginative local themes, songs, games, role plays and activities which unite the children at the local level so as to help them overcome difficulties in learning the curriculum; it also enhances teachers' capacity to impart the so-called "hard spots".
- Interactive session between teachers and students through pauses that are a part of the radio programs.

Karnataka also has a significant number of Urdu-medium schools (Table 3), and teachers of Urdu demanded a similar intervention for their schools. However, due to fewer Urdu-medium schools, the SSA decided to provide them with Urdu programs in CD format along with multimedia players. This was known as Interactive Audio Instructions (IAI). In 2007, the SSA funded the initiative and the EDC designed the Urdu-medium programs for Classes IV and V in three subjects: mathematics, science and social science. A needs analysis was done with Urdu teachers and resource persons, leading to the adaptation of resource materials.

Table 3: Schools in Karnataka by Medium of Instruction

Schools by Medium of Instruction	Number of Lower Primary Schools in Karnataka	Number of Higher Primary Schools in Karnataka
Kannada Medium	25859	23631
English Medium	NA	2944
Marathi Medium	443	613
Urdu Medium	2392	1973
Tamil	53	144
Telugu	63	76

Source: District-wise School Statistics (Educational management Information System - EMIS2007–08, National University of Educational Planning and Administration, New Delhi). The list includes government, aided, private unaided and other schools

The IAI and IRI are similar in approach, content and objectives, the only difference being the medium of dissemination. Unlike the IRI programs where a radio is used, the IAI program uses a multimedia player.

Table 4: Coverage by IRI and IAI Interventions in Karnataka

Coverage in Karnataka	Interactive Radio Instructions (IRI)	Interactive Audio Instructions (IAI)
Schools Covered	47,000 Kannada-medium Elementary Schools	2,294 Urdu-medium Elementary Schools
Students Covered	5,725,006	106,159
Teachers Covered	68,163	19,587
Subjects Covered	Kannada, English, Environmental Science, Mathematics, Social Science	Maths, Social Science, Environmental Science
Classes Covered	I to VIII	IV and V
Radio Programs	Chinara Chukki (I,II,III) Chukki Chinna(IV and V) Keli Kali (VI-VIII)	Chukki Chinna (IV and V)
No. of Programs (Annual)	290 Programs	50 Programs

4.0 Rationale, Method and Framework for Policy Simulation

The rationale for choosing the IRI and IAI strategy for the policy simulation exercise comes from the fact that India faces a serious challenge in improving teaching-learning practices and the learning outcomes. Even states such as Karnataka which have invested significantly in elementary education continue to face the problem.

The present policy simulation exercise attempts to answer three questions:

1. Whether radio/audio based interventions are helping in improving classroom transaction and learning outcomes?

2. Whether these are cost effective solutions for improving the classroom transactions and learning outcomes?

3. What is a more cost effective mode of delivery: radio or audio, or a combination of both?

In 2010–11, CBPS undertook a study on the radio/audio intervention in Karnataka. It looked into three aspects of the intervention: (i) costs in terms of per child expenditure for both the radio and audio modes of delivery, (ii) outcome in terms of students' learning outcomes in mathematics and science, and (ii) outcome in terms of the effects of the intervention on the classroom practices in non-intervention classrooms. This was based on empirical data collected from a sample of 1,392 students in 30 schools (10 receiving the radio, 10 receiving the audio, and 10 receiving neither intervention). The present analysis is primarily based on this study.

The answers to the three questions translate into five policy alternatives, as shown in the following Table

Framework for Policy Simulation Exercise

Policy Simulation Exercise
Policy Objective: Enhance the learning outcomes of students and improve the classroom transaction processes through the use of low cost, technology based interventions.
Policy Alternatives 1. To continue with the present practice of providing IRI to all Kannada-medium and IAI to all Urdu-medium schools without any change. 2. To continue with the present practice of providing IRI to all Kannada-medium and IAI to all Urdu-medium schools with improvements in implementation to make these instructions more effective. 3. To implement alternative two through a change in the mode of delivery by providing all the Kannada- and Urdu-medium schools with IAI. 4. To implement alternative two with a change in the mode of delivery by providing all the Kannada- and Urdu- medium schools with IRI. 5. To close the program.
Cost Analysis The actual costs incurred by the GoK for the year 2007–08 have been presented and used as the reference point for arriving at the costs of other alternatives as proposed in the simulation exercise. Annual recurrent costs have been estimated for comparison, as most of the one-time costs have already been incurred. Equipment replacement costs have been annualized.
Outcome Analysis The CBPS study on the impact of the radio intervention in 30 schools of Karnataka forms the basis for this section. Results from the study have been presented to gauge the effectiveness.
Recommendations Taking cost and outcome analyses into account, the recommendations for policy options have been made. The recommendations are conditional to suggestions made for improvements. Based on the study, suggestions for improvement in implementation have been made. These

form the basis for cost estimations. Suggestions have also been made for convergence with other states to harness economies of scale.
Benefit Incidence Analysis The CBPS has conducted a separate exercise on Benefit Incidence Analysis of public expenditure in the education sector of Karnataka. This has been used to support the choice of recommendations.
Source of Investment An analysis of the overall expenditure required for the recommended policy options vis-a-vis the current allocations in Karnataka has been carried out.

5.0 Cost Analysis

The actual cost of the present model

In 2007–08, the total expenditure on IRI and IAI was `17.4 million and `1.3 million, respectively. This was based on the actual expenditure data provided by the government. Two important facts to note in the cost analysis are: one, the costs for IRI include the broadcast fee which is a huge component of the total expenditure; and two, the expenditure is only for 50 programs for the IAI while for the IRI the expenditure was incurred on developing 290 programs. Hence the total expenditure on IRI is much greater than that for IAI. However, the coverage in terms of intended number of children is much higher in IRI, and therefore, per child cost is lower (Annexure Table 1). Taking 2007–08 as indicative of the present cost, the cost of inflation adjusted per child in the radio mode for 2012–13 is about `45 (less than a dollar) for the radio mode and `184 (a little above three dollars) for the audio mode. This is based on the assumption that although there would be some change in the number of students, per capita costs would remain in broadly the same range, and therefore can be taken as indicative of the present cost of maintaining the same model of delivery without any change.

The annual cost estimates for various options

The CBPS study highlighted certain gaps in the delivery and recommended some changes in the implementation process to make the intervention more effective. The next section on effectiveness discusses these aspects in detail. Here, we present the cost analysis in terms of improving the present model, taking those recommendations into account. This estimate therefore refers to Policy Option 3 mentioned in the framework in the previous section. This estimate is based on 2012–13 prices. The qualitative information collected during our study forms the basis for estimating the costs for improvement. These additional costs are mainly for improving monitoring, evaluation and provisions for maintenance as these components were found to be particularly weak. We will discuss these improvements in detail at a later stage. The following heads have been added for improvement:

- Printing and distribution of schedules, teacher guides (recurring - annual).

- Training of teachers, support officials, members of school development and management committees etc. (recurring, annual).
- Monitoring and evaluation both by department officials and a third-party independent evaluation (recurring—once in three years).
- Regular funds for maintenance of equipment (recurring—annual).

The estimation for the annual recurrent expenditure shows that per child cost without improvement is very low, at less than two rupees for the radio mode for Kannada-medium schools. Per child cost for the audio mode for Urdu-medium schools is more than ten times higher. However, when one adds the improvement costs, which include teacher-training and support materials, maintenance grants and training for academic as well as local community monitoring, the per capita costs go up significantly for both the modes and the difference comes down drastically (Table 5).

Table 5: Annual Cost Estimates for the Present Model with no Change and with Improvements

Annual Cost Estimates at 2012–13 prices	IRI (Radio)		IAI (Audio)	
	Total in Rupees	Per Student Expenditure in Rupees	Total in Rupees	Per Student Expenditure in Rupees
Option 1: Present Model* without Improvements	10283500	1.79	2318200	21.84
Option 2: Present Model with Improvements	306878300	53.60	6325200	59.58

* IRI for all Kannada-medium schools and IAI for Urdu-medium schools.

Source: Annex Table 2.

Cost estimations for changing the delivery mode to all Kannada- and Urdu-medium schools either through radio or audio show that audio is definitely not a desirable mode for any school as the per student cost rises sharply (Option 4). On the other hand, despite the small number of Urdu-medium students and high broadcast fees, the radio mode is much lower (Option 3), although still higher than the estimates for the present model with improvements (Option 2). The difference between Options 2 and 3 does not appear to be very significant, even though the costs are lower for Option 2 (Table 6). The choice of options would of course take into consideration the outcome and the ease of implementation, in addition to the costs. This will be seen in the next section.

Table 6: Comparison of Annual Costs for all Five Policy Options

	Total Annual Expenditure in Rupees	Per Student Expenditure in Rupees
Option 1: Present Model* without Improvements	12601700 (IRI + IAI)	2.161 (Average Cost to State)
Option 2: Present Model with Improvements	313203500 (IRI + IAI)	53.72 (Average Cost to State)
Option 3: All Kannada- and Urdu-medium Schools with Radio	316416400	55.27
Option 4: All Kannada- and Urdu-medium Schools with Audio	37559200	353.8
Option 5: Closing Down the Intervention	0	0

* IRI for all Kannada-medium schools and IAI for Urdu-medium schools.

Source: Annex Tables 2 and 3.

6.0 Outcome Analysis of the IRI/IAI

Impact on outcome and teaching-learning practices

The CBPS study was conducted in three districts (Raichur, the district for implementation, Chamrajnagar, the control district-as it does not receive radio signals for IRI-and Bangalore Urban for IAI). These districts and schools were controlled for their location and facilities including teacher-child ratio, and for socio-economic background of students. The study had attempted to gauge the outcomes of the IRI and IAI interventions from two perspectives:

1. impact on learning outcomes of children in mathematics and environmental science; and
2. impact on teaching practices in terms of making it more activity-oriented in non-radio or non-audio classes as well.

The study was planned and conducted in parts and there are some methodological concerns. While the IRI study was conducted in two rounds, the IAI was added to the design in Round 2 when additional funds were made available. However, despite limitations, some important pointers emerged and are being used in this exercise.

The assessment of the students' learning outcomes showed that while the mean scores of those in the implementation group for IRI were higher than the control group, the differences were not statistically significant. While the study showed that students receiving neither audio nor radio scored less in mathematics and science as compared to those who received radio instructions, they were performing better than those who received audio instructions. Those who received audio instructions performed better in EVS. Overall, the results are statistically

inconclusive (Table 7). The performance of students (as cohorts) availing of the radio mode when seen across two years (2010 and 2011) also does not indicate any clear trend (Table 8).

Table 7: Mean Score of Sample Students

2011	Subject	Radio (Kannada-medium Schools)		Audio (Urdu-medium Schools)
		Chamrajnagar (Control Group)	Raichur (Treatment Group)	Bangalore Urban (Treatment Group)
Class 4	Mathematics	49.41	50.81	31.88
	EVS	40.08	44.84	42.48
Class 5	Mathematics	43.97	50.65	39.73
	EVS	39.01	41.03	50.29

Source: Based on findings drawn from the report, *Cost Effectiveness and Impact Evaluation of Interactive Radio and Audio Interventions in Elementary Schools of Karnataka,* CBPS, Bangalore 2012

Table 8: Mean Score of Sample Students

Class/Cohort	Subject	Year	Analysis
III-IV	Math	2010	The treatment group performs better than the control group (statistically significant)
III-IV	Math	2011	The average performance of both groups has reduced and the mean of the treatment group is higher than that of the control group (but not statistically significant)
III-IV	EVS	2010–2011	The performance of both groups has reduced over time (difference not significant)
IV-V	Math	2010–2011	The average performance of the treatment group has reduced, but the control group does not differ much (5 percent range) (difference not significant)
IV-V	EVS	2010–2011	The average performance of the treatment group has reduced and does not differ much (1 percent range) for the control group (difference not significant)
Source: Based on findings drawn from the report: *Cost Effectiveness and Impact Evaluation of Interactive Radio and Audio Interventions in Elementary Schools of Karnataka,* CBPS, Bangalore, 2012			

The classroom observations of non-radio or non-audio classes did not show any impact in terms of the use of child-friendly materials or activity-centered methods. In fact, a common observation

was that while radio/audio classes were interactive to an extent because of their very design, the rest of the classes were largely lecture based.

The study made it clear that the intervention is not really being well implemented for a variety of reasons. In such a situation, it is perhaps wise not to attach too much importance to the outcome analyses as a more rigorous implementation may show a different picture. Schools where teachers were motivated to utilize IRI/IAI, though small in number, exhibited a positive energy in the classrooms. Students were seen to be actively participating in classroom activities. The teachers in these classrooms found the intervention useful in explaining difficult concepts.

The implementation issues

During the course of the study, three kinds of situations arose:

. Schools not availing of the program due to limited reach—due to difficult geographical location (for instance, the schools in the control group were not receiving radio signals).

- Schools receiving the radio program yet not benefitting from it as it is not being implemented as envisaged—no radio/audio program was reported in 70 percent of schools visited in Raichur and Bangalore Urban.
- Small proportion of schools receiving the radio/audio program—only 30 percent (three schools: two in Raichur and one in Bangalore Urban) — conducted the radio/audio program as envisaged in the intervention.

A deeper analysis of the situation (by observing the classroom processes, and through discussions with various stakeholders involved in the design, implementation and monitoring of the intervention) revealed the following constraints.

Lack of flexibility to cope with students' absenteeism and irregularity: There was a fair degree of absenteeism on visits to schools both in Raichur and Chamrajnagar. There were also discrepancies in actual attendance and class enrollments in the sample schools. Students' absenteeism makes it rather difficult for students to benefit from programs which are relayed according to fixed schedules. There is the scope of recap, but because the students miss classes for fairly longer durations, they do not seem to be benefiting much.

Mismatch between school routine and IRI relay: The classroom schedules do not necessarily match with the relay schedules for some of the schools receiving the radio mode of intervention. Radio classes were often being aired while the students were out for recess.

Low teacher motivation to use the intervention: the intervention arose from teachers' demand, but the ground reality remains; i.e., barring the use of the intervention for English lessons, most of the teachers lacked initiative to use the intervention. They consider it an additional task and often blame the environment as being non-conducive for such interventions.

Lack of a facilitative environment and support: fourteen out of 20 schools receiving the radio/audio intervention reported facing many or all of the following implementation issues:

Implementation issues	IRI	IAI
Lack of Availability of Equipment	✓	X
Lack of Availability of Teachers' Guide/Manual	✓	✓
Lack of Support for Maintenance of Equipment	✓	✓
Lack of Training of Teachers on the Specific Intervention	✓	✓
Lack of Support by the Cluster and Block Level Official	✓	✓

Weak monitoring and no evaluation: the intervention depends on the teachers' initiative and engagement. The block and cluster level officials including cluster resource persons (CRPs), along with members of the school development and monitoring committee (SDMC)[5] are supposed to assist them in the functioning of the intervention. The study showed that nine out of 10 SDMCs in Raichur were not even aware of the intervention. The situation was similar in schools receiving the audio mode of intervention. The CRPs reported that they had only vaguely heard about the intervention. They were unaware about their roles towards effective implementation of IRI/IAI. Also, there appeared to be a lack of understanding regarding mutual complementarity of interventions. While they seem to be aware of their role in the *Nali Kali*[6] intervention, they were clueless about other interventions like IRI/IAI. No external evaluation of the intervention has been conducted so far.

Comparison between the two modes of delivery

	Advantages	Limitations
Radio	- Cost per unit is low due to larger coverage of schools. Marginal cost of including an additional school is minimal. - No dependence on grid power. Battery operated radio sets have little maintenance costs.	- Fixity of schedule: student absenteeism is a big problem and the link of modules is broken if the child is absent for a longer period. - Schools' daily "routine" and calendar do not necessarily match the broadcast sessions. - High cost if the number of schools is less because the broadcast fee is one of the major cost components.
Audio	- Flexibility. - Takes care of the need to repeat modules based on	- In a resource-scarce system, it is cost effective only if the number of schools is few. - Totally depends on the motivation of individual

[5]Since 2001, all elementary schools in Karnataka are mandated to form an SDMC. In fact, with the new RTE (Right to Education Act), all schools across India need to form SDMCs. The SDMC has monitoring and supervisory roles in schools, as also financial powers. The radio and audio interventions have assigned roles for SDMCs.

[6] *Nali Kali* is a major initiative under SSA. *Nali-Kali* teaching-learning is adopted in a situation where multi-grade, multi-level, existing and individual pace of learning is considered. For details refer to http://ssakarnataka.gov.in/pdfs/int_lep/nk_report.pdf

	classroom requirements.	teachers whether they ultimately use it. - Constant power supply and power backup is a must to use the multimedia kits. - Maintenance of the audio playing system is more difficult as compared to radio.

7.0 Policy Recommendations

Given that the outcomes are not clearly evident and the implementation challenges are fierce, it is not easy to make an outright policy recommendation in this case. The study serves as the base for policy simulation and has its own limitations. Therefore, the following is a set of conditional recommendations.

	Policy Options	Recommendation
1.	To continue with the present practice of providing IRI to all Kannada-medium and IAI to all Urdu-medium schools without any change.	Not recommended due to poor implementation.
2.	To continue with the present practice of providing IRI to all Kannada-medium and IAI to all Urdu-medium schools with improvements in implementation to make these instructions more effective.	Recommended only if improvements are carried out (improvements being outlined later in the section).
3.	To implement alternative two with a change in the mode of delivery by providing all the Kannada- and Urdu- medium schools with IRI.	Could be considered as an alternative to Option 2 in certain circumstances where economies of scale could be harnessed (outlined later in the section).
4.	To implement alternative two with the change in the mode of delivery whereby all the Kannada- and Urdu-medium schools would be provided IAI.	Not recommended due to high cost
5.	To shut down the programme	Recommended if changes required for Options 2 and 3 are not explored/ implemented.

Considering that the intervention is hardly being implemented in the majority of schools, it does not make any sense in continuing without improvements. In its present shape, it is leading to either no or very limited results. However, in view of the evidence available from most other countries where such interventions have been cost effective in improving quality, and also the enthusiasm seen in schools where proper, albeit in small degree, implementation is taking place, it may be worthwhile to consider making further investments and efforts to make the intervention properly implementable and effective.

Ways of improving the intervention in Karnataka

In view of the constraints faced in implementation, the following suggestions could help in carrying out improvements:

1. Review of time slots for the radio broadcasts: In the present schedule, programs for Class II are run at noon. A number of young children leave school around that time and often do not return. There is merit in reworking the broadcast schedules to allow the maximum number of children to be present. This does not have any cost implication.
2. Engaging the SDMC and parents in local monitoring: The SDMC is a body that consists largely of parents and their engagement would help in *(i)* influencing parents to make their children more regular in attending these classes, and *(ii)* putting pressure on teachers to arrange these classes regularly and effectively. This would require orientation for the SDMC members on a recurrent basis and will have cost implications.
3. Regular teacher training, feedback and material support: provision of training for teachers on an ongoing basis to provide them with new ideas and materials, clear their doubts, and exchange experiences, all of which are essential if the intervention is to play an important role in improvement of quality. This also has cost implications.
4. Strengthening academic monitoring by cluster and block resource persons: It is important to integrate these interventions with other strategies being used for improving quality so that it does not remain isolated and therefore unimportant. Block and cluster resource persons need orientation and training for improving their perspectives, and to be able to provide meaningful academic support for strengthening this intervention. Again, this has cost implications.
5. Provision of regular funds for maintenance of equipment: Both radio and audio interventions require regular upkeep and maintenance and it would be difficult to continue in the absence of a regular maintenance grant. This too obviously has cost implications. However, if the SDMC and teachers can be encouraged to use the fund for both purposes, the costs for improvement will come down by some extent.
6. Periodic third-party evaluation: This would help in bringing improvements and gauging the impact of the intervention. In this context, it may be worthwhile to see the impact on English teaching as some feedback suggests that the use of this also has cost implications.

Convergence with neighboring states to harness economies of scale

The very appeal of using radio as a medium lies in its ability to reach large numbers in distant and faraway locations. This is what makes it the cheaper option for large numbers, and an expensive one for a small population. In addition to Urdu, Karnataka also has a small number of English-, Marathi-, Tamil- and Telugu-medium schools. On the other hand, neighboring states like Andhra Pradesh, Maharashtra and Tamil Nadu also have some Urdu- and Kannada-medium schools. Although the states follow varying curricula, the basic concepts covered under these subjects at the primary level remain the same. It would be worthwhile for these states to

come together and explore the possibility of having radio sessions on basic concepts and information on these languages; this would allow for economies of scale.

8.0 Benefit Incidence Analysis in the Elementary Education Sector in Karnataka

As the Public Budget Analysis of Education in Karnataka by CBPS shows, Karnataka has invested a great deal in elementary education, as is apparent from the real increase in its allocations over the past one decade. The Sarva Shiksha Abhiyaan (SSA), the national program for achieving universal basic education, started in 2001, also contributed to this trend. Out of the total estimated population of 4.8 million children in the 6 to 10 years' age group, approximately 92 percent were attending school in 2001 (Census of India, 2001, Government of India). The attendance ratio for this age group has shown a consistent increase. However, there are concerns related to age group, location and gender. The latest report of NFHS-3 for 2005–06 shows that 73 percent of children aged between 6 and 17 years in Karnataka (78 percent in urban and 71 percent in rural areas, respectively) attend school. Eighty-nine percent of primary-school age children (6 to 10 years) attend school (92 percent in urban and 88 percent in rural areas, respectively), which drops to 77 percent for children in the age-group 11 to 14 years and to only 40 percent for children in the age-group 15 to 17 years. Also, the report mentions that among children aged 6 to 10 years, there is a small degree of gender disparity in school attendance in favor of girls in urban areas and in favor of boys in rural areas. Gender disparity in school attendance in favor of boys increases with age, but only in rural areas. In the age group 15 to 17 years, a much higher proportion of boys (45 percent) than girls (27 percent) attend school.

Based on the 55th Round of the National Sample Survey Organisation data on enrollments and access, and the CBPS Study on Program Budget Analysis of Eductaion in Karnataka for 2007–08, one finds that the unit subsidy for the elementary level is the lowest and the highest for higher education (nearly 10 times that of elementary education).

Table 9: Per Unit Public Expenditure in Education (2007–08)

Education	Unit Subsidy (`)
Elementary	**13**
Secondary	**21**
Tertiary/University	**134**

Source : Derived from the *Report on Public Financing of Education Sector in Karnataka , 2007-08,* Centre for Budget and Policy Studies, Bangalore.

From our data on per subsidy unit and the enrollment figures in each of the quintiles as given in the following tables, ranging from poorest to richest, it is observed that beneficiaries of the elementary level are the poorer section of society. They have the highest enrollment in the

quintile class 20 to 40 of MPCE (25 percent), whereas at the secondary and higher education levels, the benefit incidence of public spending is more pro-rich since the distribution of benefit stands at 22 percent and 55 percent, respectively, in the MPCE class of 80 to 100. This observation is indicative of the fact that enrollment is high at the elementary level as compared to both secondary and higher education. The increasing proportion of the richer quintile at secondary and higher levels of education indicates that subsidized facilities have not been adequate in encouraging the poorer sections to access education.

Table 10: Estimated Enrollment Level by the Expenditure Quintile and Facility Level

LEVEL	EXPENDITURE QUINTILE				
	00-20	20-40	40-60	60-80	80-100
Elementary	6897	7906	6174	5806	4455
Secondary	1223	2191	2094	2649	2286
Tertiary	198	458	449	907	2475
Total	8318	10555	8717	9362	9216

Source: *Education in India: 2007-08*; *Participation and Expenditure, 2007-08, Government of India*

Table 11: Distribution of the Benefits of Education Expenditure by Expenditure Quintile and Facility Level

	Q1 (Lowest)	**Q2**	**Q3**	**Q4**	**Q5 (Highest)**	**TOTAL**
Elementary	22 %	25%	20%	19%	14%	100
Secondary	12%	21%	20%	25%	22%	100
Tertiary	4%	10%	10%	20%	55%	100
Total	**38%**	**56%**	**50%**	**64%**	**91%**	
Average	13%	19%	17%	21%	30%	100

Source: For more details refer to the full report on *Benefit Incidence Analysis of Expenditure in Education Sector in Karnataka*, CBPS, 2012.

Given the concerns regarding quality of education at the elementary level, the Government of Karnataka has initiated a number of interventions. Although quality is an issue for private schools as well, the very fact that the majority of the poor do access the public schooling system, any expenditure on improving quality at this level will directly benefit low-income students, something that is indeed desirable.

9.0 Source of Investment

Currently, the SSA funds both IRI and IAI. The SSA spends less than 50 percent of its annual budget on IRI/IAI. It covers about 6.5 percent of the budget head “Innovations”. The increased expenditure would change it marginally by covering about 11 percent of innovations cost for either Option 2 or 3. The total expenditure would still remain less than 50 percent of the entire SSA annual budget (Table 12). This is based on the assumption that the total SSA budget and allocations for innovations within that would remain unchanged. In reality, the budgets have increased and therefore, the relative share of this intervention may remain unchanged.

Table 12: Allocations for IRI/IAI Under SSA, 2009–10

SSA Annual Budget 2009-10	2009-10 (Actual)	Option 2*	Option 3*
Expenditure on IRI/IAI	`18.7 million	`31.32 million	`31.65 million
Budget Allocations for Innovative Activity	`290 million	`290 million	`290 million
Percent Share of IRI/IAI under Innovative Activity	6.45 %	10.8	10.9
Total SSA Budget	`9610.5 million	`9610.5 million	`9610.5 million
Percent Share of IRI/IAI under Overall SSA Annual Budget	0.19 %	0.325	0.329

* Assuming that the total SSA budget and total “Innovation” budget remain unchanged.
Source: Based on *Sarva Shiksha Abhiyaan, Annual Report, 2010–11.*

The analysis makes it clear that sourcing the increased investment is not an issue in this case. However, what is more important is to assert the potential of the intervention and make improvements accordingly. In case the improvements are not feasible, it is better to close down the program as every small investment has an alternative cost, and therefore cannot be wasted on a program that is not yielding results.

10.0 Conclusions and Next Steps

This exercise leads to the conclusion that although there is no straightforward policy choice, some pointers for future policy action can be provided. It is clear that the radio and multimedia options in their present form do not show any noticeable gains in either learning outcomes or in impacting classroom practices. Therefore, the program should either be shut down or improved to be able to reap the potential that such interventions are credited with in other countries. Limited evidence of the interventions being beneficial in places where it is being implemented well does exist, but a larger body of evidence is needed to fully support the case. Improvements are possible, but require both financial and technical resources. Financial resources do not seem to be an issue in Karnataka’s case. Technical resources are also available, but what is required is proper planning so that these are integrated with other interventions rather than implemented in isolation.

Another area that is worth exploring is English teaching. The literature suggests that radio and similar modes have been more successful in cases where teachers acknowledge their own deficiencies. Karnataka has introduced English at the primary level, but most teachers are not trained and are unable to cope. The IRI interventions include English lessons and it would be worthwhile to explore if that is being implemented with greater commitment and seriousness, and if so, has it led to any significant change in learning outcomes. This is an area of research where immediate investment will be able to provide useful feedback for policy choices.

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Annexure I: Detailed Cost Tables

Annexure Table 1: Expenditure on IRI and IAI in 2007–08 (` Million)

Heads of Expenditure (2007–08)	**IRI**	**IAI**
Design and Development	0.22	0.22
Master Trainer's Training	0.015	0.015
Printing and Distribution of Teachers' Manuals	0.275	0.07
Monitoring Evaluation	0.11	Not specified
Broadcast Fee	9.43	NA
Purchase of Radio Sets*	7.05	NA
Purchase of Multimedia Players	NA	1.03
Printing Costs for Schedules and Guidelines	0.3	Not specified
Total Costs	**17.4**	**1.335**
Total Beneficiaries (Students availing of IRI/IAI)	57,25,006	106,159
Cost Per Student	**` 31**	**` 126**

*Assuming Radio Sets will have a usability cycle for 3 years

Annexure Table 2: Estimation of Annual Cost of Improvement in the Existing Model (for Option II) (` Million)

2012-13 Prices	Type of cost	All Kannada-medium Schools with Radio			All Urdu-medium Schools with Audio		
		Physical	Unit cost in `	Total (`)	Physical	Unit Cost in `	Total (`)
Printing of Teacher Guides/ New Materials	2 Teachers per School per Year	94,000	200	188,000	4,588	200	917,600
Training of teachers	2 Teachers per School per Year	94,000 (2 Teachers per School per Year)	200	188,000	4,588	200	917,600
Training of BRC/CRC Resource Persons for IRI / IAI Monitoring	All BRC, CRC Resource Persons to be Trained once in Two Years	1,188	100	118,800	72	100	7,200
Training of SDMC Members on Their Role in Intervention	One-day Orientation for each SDMC Every Year	47,000	300	14,100,000	2,294	300	688,200
External Evaluation	Once in 3 Years			400,000			100,000
Repair and Maintenance for Electricity	Recurring	470,000	600	282,000,000	2,294	600	1,376,400

and Battery Cells							
Subtotal				296,594,800			4,007,000
Existing Recurrent Cost							
Broadcast Fee				9,500,000			
Supply of Audio Materials					2,294	300	688,200
Replacement of Radio / Audio Sets	Once in Three Years	15,667	500	783,500	765	2,000	1,630,000
Sub total				10,283,500			2,318,200
				306,878,300			6,325,200
Per Capita Cost				53.60			59.58
Total Annual Costs with Improvements							313,203,500

Annexure Table 3: Estimation of Annual Cost of Improvement and Change in the Delivery Models (for Options 3 and 4) (` Million)

2012–13 prices	Type of Cost	All Kannada- and Urdu-medium Schools with Radio			All Kannada- and Urdu-medium Schools with Audio		
		Physical	Unit Cost in `	Total in `	Physical	Unit Cost in `	Total in `
Supply of Radio Sets	Once in three years	16,432	500	821,600			
Supply of Multimedia Kits	Once in three years				16,432	2,000	3,2864,000
Broadcast Fee	All AIR stations for both Urdu and Kannada	2	9,500,000	19,000,000			
Supply of Audio Materials	annual				49,294	300	688,200
Subtotal				19,821,600			33,552,200
Total Cost of Improvement				296,594,800			4,007,000
Total				316,416,400			37,559,200
Per Capita Cost				55.27			353.8