ORIGINAL ARTICLE

Aspects of Plasma Television Supported Learning in Mathematics Classes in Selected Ethiopian High Schools

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Abstract

The purpose of this study was to examine the aspects of mathematics learning via Plasma TV based on the perceptions of students and teachers in Ethiopian high schools in selected four regional states. The design of the study was cross-sectional that used quantitative approach. A set of questionnaires was administered on high school mathematics teachers and students, and descriptive statistics was used to analyze the data.

The result of this study shows that students and teachers agreed in most of the merits and challenges of PTV lessons and activities. Both parties agreed that the lessons are well organized and well planned. Majority of them agreed that the plasma lesson motivates students to learn and encourages them to participate. One of the drawbacks both parties considered was that the time allotted to teachers to introduce and consolidate the lessons, and students to do class work and take notes was not enough. The major recommendations of this study are then to revise the overall PTV delivery system, emphasis on scheduling in such a way that mathematics teachers could have sufficient time and space to help students improve their problem solving skills and fill in the gaps that the technology cannot handle.

INTRODUCTION

Along with other societal sectors like political, economic and social changes, transformation of the education sector in Ethiopia was addressed that calls for system and curriculum change, introducing a new education and training policy in 1994 (TGE, 1994). The reform was made pedagogically to address the change of the age-old teacher centered approach into student centered method. These policy frameworks brought a reform to the teacher education sub-system by introducing teacher education system overhaul (TESO), the introduction of higher diploma program (HDP) and practicum that reinforced the active learning and student centered method introduced at the secondary education, and the technological input,

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the high school learning supported by plasma TV broadcasting system (MOE, 2003). These reforms revolutionized the roles and relationships among school actors more specifically Mathematics teachers and students. Mathematics teachers are therefore expected to play the major role of coaching in support of students' learning. In light of these developments, the introduction of direct satellite televised education program since 2004-2005 academic year in government secondary schools was perceived differently by various stakeholders in education.

Although ICT in Ethiopia is still in its infancy level, it has developed very fast in recent years. In part, this was due to the recognition of the importance of ICT in the development process worldwide. For this, the government has been undertaking several strategic policy initiatives that promote its development through the Public Sector Capacity Building Program (PSCAP) that represents an integrative national and sector-wide approach to capacity building. In this line, the Ethiopian government has made the development of information and communications technology (ICT) one of its strategic priorities. The policy framework stems from the recognition that ICT is the key driver and facilitator for transforming Ethiopia's predominantly subsistence-agriculture economy and society into information and knowledge-based economy and society by effectively integrating into the global economy. Overall, the vision of the national ICT policy was to transform Ethiopia from a poverty-stricken country into a middle-income economic society with a deep-rooted participatory democracy and good governance based on the mutual aspirations of its peoples. In order for Ethiopia to move into the knowledge and information age, and be integrated into the global economy, there is a need to vastly expand educational opportunities, modernize the educational system and improve its quality so that professional human power could easily be supplied.

Consequently, the country invested considerably on satellite television education programs to enhance its accessibility, quality and equity of education to the mass population. Such a huge investment p3was believed by the Ethiopian government to be relevant and mandatory due to the role ICT plays in national development in this time of globalization. In general adopting such technology alone can not contribute to development and requires the need for every actors to use it adequately for the purpose it was intended. Here, as major agents of learning, the commitment and conviction of teachers and students in implementing ICT supported learning is essential. In order for this innovation to serve its purposes, students and teachers need to understand and play their roles and responsibilities.

A number of justifications were forwarded by policymakers about the importance of ICT in education. Among others, educational technology enables the country's education system, aligns with international development, contributes to the nation demand for trained human power and creates communities that utilize modern system of information. Ethiopia started satellite television education program in mathematics, biology, chemistry, civics and Ethical Education, English and Physics in government secondary Schools during 2004/05 academic year with around 7000 plasma screens. To address existing quality and equity aspects and to resolve problems of limited access and use lessons from experiences of other nations, the Ministry of Education designed televised education program having 30 minute duration per class. Along with other sciences, satellite

television program in mathematics now being the given to secondary schools is based on national curriculum. The written scripts for the programs were made based on identifying content specification through consulting formal education flowcharts, syllabi and teaching learning materials from grades 9-12.

Like the other five programs, mathematics was designed to last for 30 minutes. It is transmitted based on broadcast time table in eight channels where the subject is repeated five times a day. Satellite television program broadcasting starts each day from 2:02 till 11:40 local time for a total of 9 hour and 38 minutes and with a total of 90 programs in week. These programs were also transmitted daily for evening students and on Saturday morning for grades 9 and 10 students.

Statement of the problem: The sudden appearance of plasma television within the national education debate and practice, coupled with the nature of its top-down decision (denying teacher autonomy in making decision as to when and how to teach) has cased anxiety among members of the teaching force. Together with the series of reform initiatives since the beginning of the millennium (performance based evaluation, the new management guideline etc.) within the general understanding held the government that schools and teacher failed to meet national priorities (MOI 2002a; MOE 2002b), the new scheme sent effective message to teachers that the use of technology was meant to replace them altogether. Even though the reaction of students, parents and teachers were well-felt, their voices in this regard were not well represented in a systematic educational enquiry.

Though teachers were left to implement the curriculum without sufficient support (for secondary teacher education reform was made after eight years of policy implementation, soon after everything was got worsened), they were blamed for implementation failure. To justify these claims and to establish the need for teacher education reform, the teaching force and existing teacher education programs, among other things, were criticized by policy makers for "lack of required competence, poor quality of teacher education programs, poor ethical conduct and professional commitment" (MOI 2002b; MOE 2002a).

The introduction of plasma television was related within this national scenario, but its sudden appearance in 2004/05 academic year, the overall rationale, the processes that led to its introduction etc., were largely absent within the government's policy documents. In general, the introduction of plasma television was justified by government in response to the critics largely on quality of secondary education. However George Piranian (1975) urges the mathematical community to strengthen its pedagogical effort, not by buying new gadgets, not by creating new committees of experts, but by the intensification of personal effort. Let each man assume the responsibility for teaching with greater vitality.

Due to the nature mathematical content that concentrates on abstract concepts and problem solving skills, it was believed that using televised programs as an input would enhances quality learning (Amare, 1998). Thus, using the technology would make it possible to design different effects, animations, graphics and pictures and could allow for designing individualized and group activities. This was why mathematics subject was given priority for using the technology as an input for designing quality television programs that will be accessible to all schools (Tekeste,1996).

This study, therefore, attempts to investigate the of aspects this newly implemented technology to support

educational system assumed as one of the recent innovations in Ethiopian secondary schools. The purpose of the study is to disclose the some of the issues surrounding the implementation of plasma television (PTV) program in mathematics subject in secondary grades, and to investigate the reactions of school level actors-students and teachers, and compare their reactions, commitments and readiness towards this program, and assess the merits and demerits of the new facility in line with the challenges to be resolved.

This study is assumed to be relevant to the preparation of learners for higher education and the curriculum development for secondary schools, including satellite plasma television broadcasting system which is a new trend in Ethiopia. As a result, the study is expected to improve the system of implementation through overcoming the challenges identified either through change in program planning and/or methodological modification in training high school teachers. It is also assumed to assist the policy makers indicating areas of improvement for future progress assisting them during revision. It may also provide feedback on the strengths and weaknesses of the program to the concerned bodies so that to be able to overcome the limitations and strengthen the advantages of satellite plasma television. Beyond all, the study may be important for another researcher, to conduct similar study.

RESEARCH METHODOLOGY

Research Design and Population: The design of this study was cross-sectional mainly following quantitative approach supported by qualitative through questionnaires focused on the current status of implantation of satellite plasma television broadcast in mathematics classes in selected secondary schools of four regional states of Ethiopia: Oromia, Amhara, Southern Nation & Nationality Peoples Regional States (SNNPR) and Tigray which were selected purposively for convenience of data collection and assumed relatively active regions. The study units were mainly teachers and students. In order to serve this purpose, different types of descriptive method were employed associating the experience and views of the two actors; students and teachers through comparison. Governmental secondary schools (grades 9-12) in the above four regional states were in the sample frame based on the 2004/2005 Ministry of Education academic document (MOE 2005).

Sampling Procedure and Sample Size: The population of this research includes all existing government secondary schools in the above four states. Purposive samples of five schools each from Amhara, SNNPR and Tigray Region Regional State and seven schools from Oromia Regional State, hence, a total of 22 secondary schools were selected as sample schools for this study. The sample size in each region varies due to the relative difference of their geographical extensions. These schools were selected purposively based on road accessibility, financially economical and rich in their experience, and extensive in their expansion and facilities.

Teachers and students who participated in this study were also sampled appropriately. All subject teachers (On average 5 teachers per school) of mathematics were involved. Systematic random sampling was used to choose 40 students per subject per grade within each school. Accordingly, 110 teachers were expected of whom 35 from Oromia and 25 each from the rest of the three regions. Similarly, 3520 students were expected from the four regions in which 1120 from Oromia and 800 each from the other three. From this sample size the survey respondents were 2860 students and 124 teachers (more than the expected),

who returned the questionnaire properly. Besides, some questionnaires were excluded from the analysis since they missed some of the key information.

Instrument Development and Administration: The instruments employed to gather necessary data for this study include questionnaire and documentation. Questionnaires were employed as the major instrument to collect data from teachers and students. Here, though observation would have been wise to use as one of the tools for data collection, it was not employed due to large number of classes which would be one limitation of the study. The instruments were tested in the local areas after three senior researchers critically commented upon them for further improvement, to improve the validity and reliability.

In general two sets of questionnaire were employed for students and teachers. The items in both questionnaires include background information, the range of instructional variables in terms of pre-broadcasting, during broadcasting and after broadcasting; having about 32 to 37 items with both open and closed ended questions.

Concerning data collection procedures, introductory sessions were given to the data collectors in each study area and the actual data collection took four months (January-April, 2008) which was supported by official letter from the College of Education of AAU. In general, about 2984 copies of the questionnaires were distributed to the 22 schools, for teachers and students identified through the sampling frames based on the consent of the respondents.

Method of Data Analysis: The analysis was mainly based on descriptive combining some positive parameters like strongly agree and agree on one hand and the negatives like strongly disagree and disagree on the other so that the aggregate could provide general picture of respondents' views. Closed ended items of the questionnaire were encoded using version 14 SPSS-PC software package and basic statistical methods were employed for analysis. T-test was used to see the agreement of the means based on the five Likert scale points strongly agree, agree, indifferent disagree and strongly disagree wherever it is relevant.

ANALYSIS AND DISCUSSION

Respondents' Background Information

In this study, a total of 2984 participants were involved, out of whom 2860 were students and the remaining 124 teachers. Of these, respondents, 2769 of them indicated their sex of which 63.2% were males and the rest, 36.8% females. Looking into the regional origins of student respondents 31.4 % were from Amhara, 30% from Oromia, 24.2 % from SNNPR and 14.4% from Tigray. Of the 2696 students who identified their age 74.4% were in the range of their proper school age (15-18) while 20.1% were over aged and 5.2% under aged. From 2859 students who responded for their grade levels, 25.5% were found in grade 9 while 26.4% in grade 10, 23.3% in 11^{th} grade and 24.8% in 12^{th} grade.

Among a total of 123 school teachers who indicated their sex, 95.9% were males while 4.1% were females. Majority of the mathematics teachers (62.3%) were young, their age ranging from 21 to 39. Of these 122 mathematics teachers, 37.7% of were of age below 30, 24.6% of age between 30 and 39 inclusive, 33.6% from 40 to 49 and the rest 4.1% were 50 and above years old. Among a total of 124 teachers who were involved in the study 24.2% were from Tigray, 32.3% from Amhara, 23.4% from Oromia and 20.2% from southern nations and Nationalities (SNNPR).

The academic qualifications of the majority of these mathematics teachers were at the level of first degree (86.8%) in which 11.6% were at diploma level and only 1.6% at second degree level. The teaching service of these teachers ranged from 1 to 35 years. The majority of the mathematics teachers (35.8%) served for 20 years and above, and 25.9% of them between 10 and 19 years; 18.3% from 5 to 9 followed by 20% for below 5 years. In addition, the majority of the teachers (63.7%) were teaching 10^{th} grades while 28.2% teaching in 12^{th} grades.

The working load of the teachers ran from 5 to 30 hours per week; the majority of them handling 20 hours (30.6%) and 25hrs (32.2%), only 9% in between. Apparently, teachers were asked to show experience of the average student number in their classes which ranged from 45 to 100 students per class. Many (46.3%) of the teachers were dealing with more than 70 students in a class and only 12.2% of them experienced a class size of 50 students and below.

***L*earning Activities During PTV Lessons**

In general, there are two widely used methods of presenting televised educational programs-as enrichment and as instructional. From these methods, the country adopted instructional or direct teaching approach in the new satellite programs. Enrichment model of media utilization was considered not responsive to the county's existing educational problems. It was assumed that enrichment does not give practical solution to existing problems like shortage of teachers, problem related to teachers teaching competence, shortage of teaching-learning materials and lack of awareness among teachers about the importance of ICT.

The satellite educational television program that was introduced quite recently attempted to address existing limitations and facilitate students understanding of concepts through the use of pictures and graphics. It presents formulae and complex principles through animation techniques. It also helps students and address problem of equity and delivery of the subject to all students in urban and rural areas. It further contributes to cover course materials that were not, most often, completed by the teacher within the academic year. The relevance of ICT for Ethiopia's attempt to provide access to education was recognized that it contributes significantly to enhance teachers teaching competence by introducing them to a continuous and sustained manner with new information and methods of teaching. Due to the close link between pedagogy and developments in science and technology, transitions were made from verbal teaching to the use of textbooks, then use of radio and television. Today, it is possible to provide education through satellite educational television programs and using the computers and the internet. Nevertheless, until the introduction of this plasma TV teaching, teachers in Ethiopia, until quite recently, used to provide their lessons without any assistance; teachers perform the teaching learning process without the help of technological teaching aids.

Still, other advantages of this technology to schools include the ability of the technology to make available relevant educational information to all learners in equitable and speedy way; its ability to minimize the impact of lack of educational facilities and teaching aids between secondary schools in urban and rural communities enabling students to find other sources of information besides the classroom teacher and above all provides common and standardized educational experiences to all students. also provides support to most existing teachers who teaches beyond their levels of training.

Thus, school teachers, teacher educators and teacher education institutions were

blamed requiring the need to fix through prescribing wholesale re-visitation of teacher education called TESO (Teacher Education System Overhaul) and through the introduction of plasma television (MOE, 2003). Thus, by introducing televised instruction, the teaching force was disempowered through the provision of teacher proof lessons. Teachers' complete control over their classroom was systematically taken by the new media and their role was assumed down-graded to only caregiver (supervising students behavior and manipulating the TV monitor), while the televised teacher teaches.

Coming to the study as explained in the discussion of respondents' background information, teachers' profile indicated that the majority of the sampled teachers had appropriate qualifications and experience, though most of them teach in overcrowded settings. With this general background information of respondents, the paper then treats some aspects of the pre-broadcasting, broadcasting and post broadcasting phases of plasma lessons. Under these sections, participants were asked about their opinion and the extent of implementation of some of the salient features of the broadcasting phases.

Aspects Before Plasma TV Lessons

Teaching and learning process is generally dependent on adequate planning, otherwise it fails to attain its purpose. In order to conduct the relevant tasks; teachers need to prepare their educational plan in advance. Thus, they are expected to know in advance the topic of their daily lesson, prepare daily lesson plan, make preparations adequately by consulting the portion in the textbook which that day program emphasizes, arrange the inputs identified in the teachers' guide and inform students in advance of the educational materials and facilities required during the broadcasting of programs. Finally, they are expected to make a brief introduction about the daily televised lesson by concentrating on the title, specific objectives and content of the program.

Though what students are supposed to do in each program lesson was identified in the student-guide, due to financial reasons, these guides are not available in schools. To minimize these effects, teachers were expected to inform students what they should do/bring for the next lesson until such times come where all schools are connected through internet and the students may access the database and prepare accordingly by using computers.

Before the broadcast, students are expected to prepare by reading those relevant pages from their textbooks plus other references and come with some understanding of the topic of the daily lesson. They are also expected to bring their notebooks, pens, and pencils and depending on the topic under considerations they should bring rulers, calculators, compasses, protractors and other facilities pertinent to the subject mathematics. Students are also expected to listen attentively and reflect when appropriate to their teacher's introductory explanations and execute what they are expected to do.

One of the serious critics made to the plasma technology, based on the existing literature, was related to the sharing of roles and responsibility and the division of instructional time between classroom and televised teachers. When the technology appeared for the first time in the 2004/05 academic year, 30 out of 40 minutes of instructional time was assigned for the televised teachers by leaving only 10 minutes for classroom teachers. Thus, actual lesson presentation was left for the televised teacher all the way from the first lesson up to the end of the year. On the

other hand, classroom teachers use ten minutes each for introducing and summarizing the lesson before and after the broadcasting (five minutes each).

The instructional innovation was not whole-heartedly welcome by school communities. According to Temtim (2007) due to teachers' early resistance to the innovation, since the second semester of 2004/05 academic year, some nominal adjustment was made to the share of instructional time assigned for classroom teachers by adding two minutes and by reshuffling the relative share of instructional time between introduction and summary of the lesson. Thus, overall instructional time was pushed by adding two more minutes (to become 42 minutes) and classroom teachers were expected to use only two minutes for introducing the coming lesson and the remaining ten minutes for summarizing the televised lesson which is mostly wasted during shifting from section to section. According to P.R. Halmos (1980), as teachers, in classrooms, we will emphasize problems more and more, and that we will train our students to be better problem-posers and problem solvers than we are.

Out of 2768 student respondents, the majority (70.7%) evaluated the frequency of the mathematics teachers' punctuality always (31.4%) and most of the time (39.3%).

Students were asked to reveal their experiences about the minutes the school teachers have had for the introduction, before the TV lesson start. For this issue, 2333 students responded and as a result, the majority (83%) said at most 5 minutes, while (45%) said exactly5 minutes while 38.1% below 5) in which 18.6% said zero and 15.3% said only 2 minutes. In this line, 80.9% of the teachers said that at most 2 minutes were given for this session while 13.9 % of them said that they have 5 minutes.

Following the above issue, students were asked to evaluate the time given for introduction by using the parameters; "very good", "good", "satisfactory", "low" and "very low". Out of the 2757 who responded to this issue saying low (27.7%) and very low (25%) which was 52.7% below satisfactory in aggregate. As a result, 66.2% of teachers said that the time given for introduction is inadequate. Furthermore, majority of student respondents (47.2%) revealed that their teachers introduce the lesson always (20.7%) or most of the time (26.5%) with in this short period of time.

In addition, the majority of those students who said the introduction time given to the school teacher was low suggested that10 minutes (31.7%) would be sufficient while 18.8% said 15 minutes. In general, 68.9% of the students suggested the introduction time to be ranged from 10 to 20 minutes which could be questionable for a period of 42 minutes. Though the time given was not sufficient, 47.3% of the students said that their teachers introduce the lesson clearly rating good whereas 27.3% rated weak. In this same issue, many of the teachers (81%) who indicated the time given for the introduction is poor further suggested from 5 to 10 minutes in which the highest was for 5 minutes (55.7%) and then 10 minutes (21.5%).

On the other hand, 57.4% of the teachers did not have the teachers guide for PTV lesson so that they could be prepared before hand, where as 81.7% did have the objectives of the program to be aired next class. Besides, 44.7% of the teachers did often tell their students about the next lesson at the rate of always (20.3%) and most of the time (24.4%). Majority of the teachers (40.7%) used to do this activity some times. A great deal of teachers (76.7%) confirmed that the students own text books at individual basis.

Nevertheless, 54.5% of the teachers said that the books did not reach the students as soon as the first class begins and 95.7% of them also said that the books reach the students within a month or two. Regarding, these ups and downs, 83.7% of the teachers complained that students did not usually bring the texts to classes which affected the introduction as well as the activity sessions of the lesson.

Aspects During PTV Lessons

In general, the MOE/EMA believes that satellite television program was designed to help classroom teachers. Even though the technology accomplishes tasks that cannot be performed by the teacher, they are expected to guide, identify and give support to students, take note of issues that are difficult to them and also consult students while they solve exercises suggested by televised teachers. It was further argued that if the teacher makes adequate preparation in advance; respond to students to the questions posed by televised teacher and makes sure that all tasks given to students are dully exercised; he/she could address all possible limitations of the technology.

As a result, during broadcasting, teachers are expected to have their textbook with them so that if broadcast failure happens, they should take over the teaching learning process. The teacher is expected to follow and provide help to students. Teachers should entertain students' questions, give comment, take note of those issues that they believed require further explanation and do not interfere while the televised teacher is conducting lesson.

Similarly, students are not expected to write all the materials that appear on the screen since the televised program closely follows what are in the students' textbooks. Instead, they should read and take short notes of the issues that they believe require further discussion or explanation after transmission is over. To this end, students are expected to follow attentively the program, present to classroom teachers their answers to questions posed by the televised teacher and do classroom tasks and take notes of the core issues of the lessons.

Careful planning is absolutely essential for effective teaching. It helps produce well-organized classes, purposeful class atmosphere and reduce the likelihood of disciplinary problems (Callahan & Clark 1982). As teachers in mathematics classrooms, we emphasize problems more and more, and P.R. Halmos (1980) states that we will train our students to be better problem-posers and problem solvers than we are**.**

According to some studies, for example Kassahun & Zelalem (2006), the innovation does not consider individual differences, learning pace of students and their language ability which contradicts with the fact that the best way for an individual to learn is to rediscover by himself (P.R.Halmos, 1994). Thus, another way of uncovering the responsiveness of the plasma lesson was by asking participants to some of the issues of planning and extent to which attention was paid to them. Thus aspects of lesson organization, needs of students and teachers, relevance of the content and tasks of the lessons etc were considered for examination (P.R.Halmos, 1975). The table below presents aspects of plasma lesson organization and the response made by the participants, in line with the perception of the two parties, students and teachers.

Table 1: Aspects of Lesson Planning of Plasma Lessons, as Reported by Students and Teachers

No	*Aspects of lesson planning*	*Agree (%)*		*Disagree (%)*		Total No.		P-values
		Stud	Teach	Stud	Teach	stud	teach	
1	It revises the previous lesson	62.1	88.4	37.9	11.6	2630	121	0.987
2	It clearly states daily instructional objectives	85.2	81.8	14.8	18.2	2629	121	0.9001
3	It clearly states the content of daily lesson	83.7	93.4	16.3	9.6	2619	122	0.980
4	The lessons are well paced/speed	52.9	79.1	47.1	20.9	2614	120	0.871
5	The lessons are well organized	81.2	88.6	18.8	11.4	2632	122	0.912
6	The lessons are well planned	77.0	89.1	23.0	10.9	2582	120	0.911

As shown in Table 1, in all aspects of lesson organization, the plasma program was found to be superior since the majority of both respondents rated them positively (more than 80% in many cases). In most of the cases, the proportion of teachers who agreed with the lesson organization issue was found to be greater than that of students. The majority of the respondents agreed with the fact that clearly stating the objectives and contents of the lesson. Moreover, the plasma lessons were found to be well-planned and well-organized. The variables with the highest percentage of students who disagreed (47.1%) were whether the plasma lessons were well paced during presentations showing students had difficulties in coping against the speed of the TV presentation. In addition, 37.9% of the students disagreed that the plasma revises the previous lesson which serves as a bridge to understand the new lesson. The P-values based on the t-test show that there is no any significance judgment difference between the two groups at $P<0.05$.

This apparent fact seems sensible: based on the experience of these researchers as teacher educators with experience in school practicum, not due to their omissions in the plasma lessons as such but due to the way the program was implemented. Presently, plasma lessons are no more sources of inspiration to students as too often stated in official rhetoric. The majority of students just exhausted with the mandatory six to seven lessons a day with inanimate teacher who does not sense and respond to their problem of language and pace of instruction.

Success of the teaching learning process depends largely on how it fit the students' abilities, needs, aptitude, interest and goals (Callahan & Clark 1982). Students who are well motivated to learn usually learn best if lessons are reasonably well designed. On the other hand, if students' attitude towards school and school learning is antagonistic, teachers' effort alone is not likely to be fruitful (Ibid: 128). In addition to these psychological findings, there are also researches done results by communication experts who uphold the important role the audience have in determining the effect of communication (Amare 1998; Ali 2005).

A single fact that all earlier studies on the subject unanimously agreed on was the fast pace of plasma instruction (Gary 2005; Ali 2005; Getnet 2006; Temtim 2007;

Kassahun & Zelalem , 2006). For example; Gary writes: "… every thing about the program is too fast. Students cannot take in what presenters are saying; there is not enough time to complete the exercise or to copy the notes given on the screen". In this study, 79.1% of the teachers agreed that plasma lessons have appropriate pace (Table 1). In spite of accumulated research findings that state otherwise, such a high positive response rate can probably be attributed to the way the item was stated in the questionnaire for it does not clearly specify in terms of students capability because, on the other hand, students are complaining about it. Though schools have now three years experience since the inception of the broadcast, still 47.1% of the students believed that the pace of plasma instruction was not appropriate to their level (Table-1).

To evaluate plasma lessons with respect to their ability to address students' need like access to quality education, its consideration for the special needs of students with visual and hearing impairment and the pace of instruction were identified. Table 2, conveys some of the variable related to students to which research participants were asked to indicate their degree of agreement and/ or disagreement.

Table 2: Consideration of Students Need Conveyed by the Plasma Lesson, as Reported by the Two Groups

No	*Aspects of students need*	*Agree (%)*		*Disagree (%)*		*Total No.*		**P-values**
		Stud	**Teach**	**Stud**	**Teach**	**Stud**	**Teach**	
1	It motivates students to learn	66.4	70.3	33.6	29.7	2585	121	0.904
2	It encourages students to participate	69.5	63.9	30.5	36.1	2542	122	0.921
3	It clearly communicates to the students	70.5	60.5	29.5	39.5	2619	119	0.002
4	It has no place for visually impaired students	37.5	81.0	62.5	19.0	2669	116	0.000
5	It has no place for hearing impaired students	56.1	79.2	43.9	20.8	2567	115	0.000
6	It gives chance for students to discuss in groups	36.0	38.9	64.0	61.1	2628	123	0.174

As shown in Table 2, above, the ability of plasma lessons in motivating and giving equal access to quality education to all students by encouraging them and providing clear instruction were positively rated (more than 60%) by both students and teachers respondents. Regarding giving chances to students for group discussion during PTV lessons was rated low by both students (36.0%) and teachers (38.9%). It was acknowledged that the variety of information, visual and audio experiences; often beyond the capacity of the classroom teacher to assemble, sustain students' attention and motivation. The P-values of the t-test here also show that there is no significant difference in most of items but

numbers 3 and 5 are quite the opposite which needs further investigation.

The responsiveness of plasma lessons to students with special needs, presents different stances. Plasma lessons provide both sound and vision; hence, marginalizes students with both hearing, and sight impairments. Large proportion of teachers did not believe the fact that visually impaired students were significantly hindered by the technology. For example, 56.1% of the students and about 79.2% of the teachers believed that the technology had no place for the hearing impaired students. Though with varied magnitude both groups believed that the technology had limitation for hearing impaired students. The authoritative statement in government rhetoric seemed to be based on policymakers perspectives and not of school actors (especially that of teachers) since the innovation tends to serve more of the governments concerns (Brook 2006).

Subject contents are the substance of teaching. Teachers are expected to select those contents that are important to students. Moreover, P. R. Halmos (1994) stated that the most effective way to teach mathematics is by problem solving to keep challenging students with problems that are barely within their reach. Such principle implies that thorough coverage of the most important and useful contents was more desirable than covering everything superficial. They advised the need for content not as an end but rather as a means to knowledge and learning that was not available for use or not of much value.

Table 3: Relevance of Plasma Lesson Content and Tasks, as Reported by Both Groups

No	*Issues of content and tasks*	*Agree (%)*		*Disagree (%)*		*Total No.*		P-value
		Stud	**Teach**	**Stud**	**Teach**	**Stud**	**Teach**	
1	The depth of the content is up to the level of students	63.2	70.0	36.8	30.0	2836	120	0.904
2	The content contains the most important points to be covered	81.9	90.2	18.1	9.8	2619	122	0.851
3	It gives appropriate class work	72.2	82.1	27.8	17.9	2554	119	0.044
4	It gives feed back to class work	65.9	78.7	34.1	21.3	2628	122	0.249
5	It gives appropriate homework	76.9	56.9	23.1	43.1	2577	123	0.000
6	It gives feedback to homework	49.9	42.2	50.1	57.8	2555	121	0.123

As shown in Table 3, students and teachers were asked to rate the scope and depth of the plasma lesson content. Concerning the depth of the plasma lesson content, about 63.2% of the students and 70.0% of the teachers agreed that the scope and the content were appropriate. Similarly, the content covered by plasma lesson was agreed as relevant by significant majority (81.9% and 90.2%) of the students and teachers respectively.

About 65.9% of the students and 78.7% of the teachers agreed that feedback was given on class tasks. Students were occasionally asked to carryout tasks framed between 20 to 40 seconds, the immediate feedback given after the time set discouraged them

from attempting the task. According to Kassahun and Zelalem (2006), most students do not cope with the plasma teacher and are not able to finish the tasks on time. After all, it does not matter if students attempt to carry out the tasks or not; the answers will appear on the screen at the end of the allotted time. Feedback to home work was only agreed by 49.9% of the students and 42.2% of the teachers. Again, the P-values agreed with the rates of judgments except item number 5 showing significance difference while both agreed by the rate of 50% generalization.

Though the relevance of school curriculum had long been the focus of considerable debate, it was now used to give credibility to the plasma lesson. The ministry further argued that it followed exactly what was identified in the national curriculum, though it was labeled as 'vastly overcrowded' (Tewodros 2006; 68). The plasma presents 'rich content but it is not selective (Tewodros 2006: 69). The appropriateness of the class work tasks of the plasma lesson was also agreed by both research participants (72.2% students and 82.1% teachers). In general, more percentage of students (76.9%) seem to agree with the appropriateness of giving home work, but on the other hand, almost half of the teachers disagreed with the appropriateness of the home works given to students. Moreover, both students and teachers agreed that PTV uses in most cases self assessment method where as it does not encourage students to discuss in groups and help each other.

Based on available finding, there is different interpretations of such mainstream perspective, one seemingly concerns for policymakers was related to content coverage. Before the introduction of plasma lessons, it was argued that most teachers did not manage to finish the content of their subjects, for most part due to the wide scope of secondary school curriculum. Thus, when content coverage was singled out without referring to other important competing outcomes which professional educators' weigh was indeed a success that 81.9% agreed by the students and 90.2% by their teachers.

One may also need to ask a similar question to understand fully how plasma lessons manage to finish a nationally prescribed curriculum to which it was impossible to some classroom teachers. Was there anything meaningful done to reduce the scope of existing national curriculum which taught only what seemed to be relevant? Based on existing findings, this concern of policymakers was addressed through the elevation of content coverage at the expense of students' understanding and their meaningful participation. The various instructional strategies employed in the plasma mode of instruction to attain such purpose were used at the expense of students direct needs. These include the too fast pace of instruction which too little time given to student's participation, absence of the time for student's problem and no feedback from the plasma teacher.

Table 4, outlined some of the participatory possibilities rendered inherent in the nature of the technology and major policy rhetoric were outlined to which research participants were asked to rate these delivery items based on their level of agreement and/ or disagreement.

Table 4: The Nature of the Televised Program Delivery System, as Reported by Respondents

No	*Aspects of plasma lesson*	*Agree (%)*		*Disagree (%)*		*Total No.*		P-values
		Stud	**Teach**	**Stud**	**Teach**	**stud**	**teach**	
1	It cannot replay back	54.6	83.6	45.4	16.4	2538	116	0.000
2	It gives enough time to do the given class work	36.0	33.6	64.0	66.4	2633	122	0.000
3	It gives enough time to copy notes	55.2	9.8	44.8	90.2	2613	123	0.000
4	It makes students to have equal access to quality education	72.3	86.9	27.7	13.1	2599	122	0.000
5	In considers individual differences	75.3	28.7	24.7	71.3	2621	122	0.000
6	Tracking while the lesson is on progress	70.3	69.5	29.7	30.5	2594	115	0.023
7	The lesson presented in the neighboring class disturb while the class in progress	39.0	29.3	61.0	60.7	2631	123	0.178
8	It utilizes a variety of teaching aids	78.6	87.4	21.4	12.6	2644	119	0.911

As shown in Table 4, the PTV system was revealed deficient and in-appropriate like it cannot replay when the needs arise to clarify things: agreed by students at the rate of 54.6% and teachers at the rate of 83.6%. The ability of the technology in providing a variety of teaching aid was agreed by 78.6% of the students and 87.4% of the teachers. Though classroom tasks and content of the plasma lessons were considered relevant, the adequacy of the time given for class work and taking notes were disagreed by most participants. About 64.0% of the students and 66.4% of the teachers felt that the time set for class work was not appropriate. Usually, the allotted time for doing exercises was not sufficient, to which students had to risk understanding of the question for writing it. Understanding of the problem was relegated to secondary status. Furthermore, time assigned to copy notes from the plasma display was rated as not enough by 90.2% of the teachers while on the contrary almost half of the students (55.2%) agreed that the plasma gives enough time to copy notes. The two parties also differed in their opinions regarding the aspects of PTV lesson considering individual differences which was disagreed by the teachers at higher rates (71.3%) while the students opinions were the opposite in these issue with the agreement rated 75.3% (Table-4). Similarly, the test supports many of the items like numbers, 3, 6, 7, and 8 except the rest where the mean for Likert scales does not help here.

The Ministry's rhetoric also includes the benefits of the technology to classroom teachers. One of the salient argument set forward was related to lack of adequate quantity of component teaching methods. As Dugdale (2003) states that the teacher's skill in integrating technology into the mathematics curriculum according to sound pedagogical principles is essential to get

the needed support of a technology for the proper implementation.

In addition to the existence of un-qualified teachers, most of those who are currently teaching are beyond their capacity. Thus, plasma lessons provide best teachers that helps school teachers to learn not only the language, but also the method about teaching. Table-5 outlines some of such claims to which both students and teachers were asked to indicate their level of agreement.

Table 5: Considerations of the Technology to the Need of Teachers, as Reported by Students and Teachers

No	*Aspects of teachers*	*Agree (%)*		*Disagree (%)*		*Total No.*		P-values
		Stud	**Teach**	**Stud**	**Teach**	**Stud**	**Teach**	
1	Teachers have good opportunity to learn teaching techniques from plasma lessons	27.2	82.9	72.8	17.1	2623	123	0.000
2	It gives enough time to classroom teachers to help students to do class work	72.0	27.7	28.0	72.3	2654	123	0.000
3	It solves the problem of qualified teachers	58.4	64.4	41.6	35.6	2544	118	0.495
4	It decreases teachers creativity	46.6	56.6	53.4	43.4	2608	120	0.008
5	It reduce teachers workload	50.7	63.4	49.3	36.6	2615	123	0.007

According to this study, the PTV teachers were elevated as qualified and experienced in the ministry rhetoric, though observation by a number of researchers revealed the opposite. For example, Tekeste (2006) labeled them as 'readers' and not teachers. More probably, they were recruited for their language proficiency, hence, instead of teaching they read out the lesson to the detriment of the students. This was why, although 82.9% of the teacher agreed that the plasma lesson gave them opportunity to learn various teaching methods, about 72.8% of the students disagreed. The majority of the students believed the new innovation do not have much worth to teach teachers about methodology.

Since the actual teaching was made by the plasma TV teacher, classroom teachers were expected to play the role of facilitation. The ministry guideline also identified a number of specific roles for teachers to play while plasma lessons were in progress. While assigning task, the TV teachers also instruct classroom teachers to check, correct or guide and the time left for this was judged inadequate by 72.3% the teachers and 28% the students.

On the other hand, only 58.4% of the students and 64.4% of the teachers agreed with the statement that the plasma lessons will solve shortage of qualified teachers. Since the lion's share of instructional time was given to the technology, about 50.7% of the students and 63.4% of the teachers agreed that it decreased teachers' work load. The technology deprived teachers of making instructional decisions which they used to have (Ali 2005; Brook 2006; Getnet 2008). The cumulative effect of this was gradual distancing them from their profession and with the resultant atrophy of

their intellectual capability. This fact was further reinforced for about 46.6% of the student and 56.6% of the teacher believed that the technology would decrease teachers' creativity.

Audiovisual instructional materials are appropriate for they facilitate teaching learning process, though they could not substitute classroom teachers. They do make learning more interesting and vivid by appealing to students' attention and promoting motivation and retention. Audiovisual materials are well recognized in the teaching learning processes for they maximize learning due to the multiple avenues of sensations they render for the learners. Though they are generally taken important, selection should be made based on their some criteria. Students were asked to indicate their agreement to such quality of audio visual provisions rendered by the plasma TV.

In addition, all the motion experiences in question were agreed by research respondents that, the ability of plasma lesson in providing visual information that is difficult to convey in words was agreed by 77.4% of the students and 89.3% of the teachers. Lastly, before the lesson was over, the plasma TV class was rated positively (80.2% and 81.3% by students and teachers respectively) in summarizing the daily lesson.

Table-6: Quality of Visual Experiences Attributed by the Plasma TV

No.	*Aspects teachers*	*Agree (%)*		*Disagree (%)*		*Total No.*		*P-values*
		Stud	**Teach**	**Stud**	**Teach**	**stud**	**teach**	
1	Uses relative sizes of font to give emphasis to important ideas	80.8	98.4	19.2	1.6	2640	124	0.907
2	Uses upper and lower case letter to make reading easy and fast	75.5	96.0	24.5	4.0	2644	123	0.902
3	Uses bold text to emphasize information	85.8	94.0	14.2	6.0	2656	117	0.899
4	Text and images stand apart from the background and be easily seen	84.8	94.3	15.2	5.7	2641	123	0.987
5	Uses bright or different sizes for emphasis which catch up the attention of the viewer	84.6	96.0	15.4	4.0	2649	123	0.911
6	Text and colored backgrounds (or backgrounds images) contrast to ensure legibility	82.2	81.0	17.8	19.0	2612	121	0.311
7	It does not use complicated background that make the next difficult to read	77.3	87.1	22.7	12.9	2588	121	0.115

As shown in Table 6, the plasma lesson uses relative size and bold fonts for giving emphasis to important ideas; facilitates easy and fast reading of texts by using upper and lower case letters. Similarly, the appropriateness of colours used by the plasma lessons was judged by the research participants. Thus, the majority of the respondents agreed that to maximize attention, and visibility and legibility of information, the plasma lesson uses bright colors, contrasts color between text/ image background, the rates varied from at least 75% where many of them between 80^{th} and 90^{th} percent ranges.

Table 7: Quality of Auditor Experience Rendered by the Plasma TV Lessons as Reported by Student and Teachers

No	*Aspects teachers*	*Agree (%)*		*Disagree (%)*		*Total No.*		*P-values*
		Stud	**Teach**	**Stud**	**Teach**	**Stud**	**Teach**	
1	It is audible for students sitting at the back	90.1	94.3	9.9	5.7	2585	123	*0.109*
2	It is easy for students to understand the pronunciation	68.0	67.2	32.0	32.8	2585	122	0.286
3	It is easy for students to understand the meaning	42.1	59.6	57.9	40.4	2518	124	0.000
4	It has good quality sound that can pay the attention of students	70.6	89.5	29.4	10.5	2608	124	0.040

As shown in Table 7, the general nature of the sound produced by the plasma TV (its audibility and quality) was to some extent agreed by the participants, where as the language aspect was not. More than 90% of the respondents agreed that lessons were audible even to students who sit at the back. Quite similarly, 70.6% of the students and 89.6% of the teachers agreed with that the quality of the sound was good.

On the other hand, the pronunciations of plasma presenters and students' understanding were somehow accepted by majority of the respondents. For instance, only 68% and 67.2% of the students and teachers respectively agreed that students easily understand the pronunciation of lesson presenters. What seemed worrying as attested in various studies, was the problem of understanding as a result of the combined effort of pace and high language demand of the lesson. Participants were asked whether understanding the vocabulary was easy to which about 57.9% of students disagreed.

Table 8: Quality of Video Experience Rendered by the Plasma TV Lessons as Reported by Students and Teachers

No	*Aspects teachers*	*Agree (%)*		*Disagree (%)*		*Total No.*		*p-values*
		Stud	**Teach**	**Stud**	**Teach**	**Stud**	**Teach**	
1	Provide visual access to experiments that would be difficult for the students to get in their schools	71.0	87.6	29.0	12.4	2596	113	0.000
2	Present visual information that is difficult to convey in words	77.4	89.3	22.6	10.7	2596	121	0.000
3	Present visual information which are related to the lives of the learners	67.9	84.4	32.1	15.6	2565	122	0.001
4	Present visual information in appropriate sequence	74.6	87.7	25.4	12.3	2547	122	0.017
5	The visual information are presented only when they are needed	76.5	88.5	23.5	11.5	2579	122	0.057

In general, the P-values of tables 5 to 8 could be interpreted similarly with the above tables that many of the items agreement have no significant difference in which the otherwise shall need further investigations.

As shown in Table 8, all the motion experiences identified above were agreed by research respondents. For example, the ability of plasma lessons to providing visual information that is difficult to convey in words was agreed by 77.4 and 89.3 percent of the students and the teachers respectively. In general, plasma lessons present visual information in appropriate sequences. Lastly, before the lesson was over the plasma rated positively (80.2% and 81.3% by students and teachers respectively) that it summarizes the daily lesson.

One can use multiple and appropriate assessment methods to make learning fruitful. In this regard, students and teachers were asked to rank the evaluation methods mostly used during the learning activities in Mathematics class. Accordingly, self-assessment was ranked first at the rate of 10.9% by the students and 25.8% by the teachers which was not significant related to the ranks beyond that. The remaining assessment styles like group discussion, reflection and peer assessment were far below 5% by the rating of both parties. Tables-9 shows the ranks on different assessment methods employed by the plasma TV.

Table9: Ranks of Assessment Rendered by the Plasma TV Lessons as Reported by Students and Teachers.

Assessment methods	Rank	Students	Teachers
Self assessment	First	312(10.9)	32(25.8)
	Second	223(7.8)	22(17.7)
	Third	183(6.4)	13(10.5)
	Fourth – Seventh	291(10.2)	16(12.9)
	Missing	1851(64.7)	41(33.1)
	Total	**2860(100)**	**124(100)**
Peer assessment	First	67(2.3)	4(3.2)
	Second	161(5.6)	12(9.7)
	Third	251(8.8)	19(15.3)
	Fourth – Seventh	520(18.2)	39(31.5)
	Missing	1861(65.1)	50(40.3)
	Total	**2860(100)**	**124(100)**
Group discussion	First	154(5.4)	6(4.8)
	Second	215(7.5)	16(12.9)
	Third	153(5.3)	10(8.1)
	Fourth – Seventh	450(15.7)	42(33.9)
	Missing	1888(66.1)	50(40.3)
	Total	**2860(100)**	**124(100)**
Reflection on certain points	First	87(3.0)	6(4.8)
	Second	108(3.8)	14(11.3)
	Third	110(3.8)	10(8.1)
	Fourth – Seventh	424(21.9)	44(35.5)
	Missing	1931(67.5)	50(40.3)
	Total	2860(100)	124(100)
Others	First	18(0.8)	0(0.0)
	Second	28(1.0)	1(0.8)
	Third	32(1.1)	1(0.8)
	Fourth – Seventh	461(12.5)	44(35.5)
	Missing	2421(84.6)	78(62.9)
	Total	**2860(100)**	**124(100)**

After the Broadcast of the PTV lessons

When the broadcast is over, teachers are generally expected to give overall summary of the program, concentrate on those issues he/she identified during broadcasting that requires further explanation and address any other queries from the students. Teachers need to identify and discuss issues of the lesson that may present challenge to students. Finally, the teacher was expected to introduce the title and content of the next televised program and attend to students concerns on the program.

Students are also expected to consolidate what they have learned attending closely the classroom teachers' explanation on the summary of the lesson. They further are expected to ask any questions pertaining to difficult issues they experienced during the broadcast and strengthen their notes by relating what they write during the

broadcast from their textbook and other reference materials. Finally, they need to perform homework and projects suggested by the televised teacher and show their results to the classroom teacher.

According to the query on how the teachers consolidated and summarized the PTV lessons at the end, the majority of the students (57.4 %) agreed that the time given to classroom teachers for making summary of the lesson was low. The relatively extended time given for teachers' summary was judged as low probably due to the emphasis of plasma lessons on the principles of content coverage. The relatively larger portion covered by each plasma lessons during those thirty minutes might contribute to difficulty for teachers summary of the lessons within ten minutes (Kassahun & Zelalem, 2006).

Though the time given for summarizing was rated low, teachers' interest to give summary at the end was rated satisfactory by 74% of students. Similarly, 73.7% of the students responded that the way teachers made summary at the end is satisfactory even many of them rated good. Moreover, students were asked to estimate the time given to teachers for consolidation, and 60% of the students said 10 minutes which is the highest and 28% of them said 5 minutes which is the next highest. In general, 90.2% of them suggested a consolidating time ranging between 5 and 10 minutes. Since the majority were not satisfied with the above time ranging from 5 to 10 minutes, they were asked to suggest a change of time. Accordingly, 84% of them suggested the time to range from 10 to 20 minutes, specially, 16% of them for 10 minutes, 30% for 15 minutes and 38% for 20 minutes.

Major Challenges Noted

In general, those problems encountered since the introduction of televised instruction could be classified into two: problems encountered as a result of broadcasting the program (problems inherent within the program) and problems encountered as a result of lack of the feeling of ownership and responsibility among the users of the program. A study made by MOE/EMA to identify the implementation of the technology includes problems related to the use of the technology and adequate handling of the satellite facilities.

Some of the problems were related to contents of the subject. These problems were related to inappropriate contents encountered in existing programs, mismatch between subject content with students ability and problem of sequencing of course contents. Some other problems related to program presentation were speedy pace of presentation and shortage of time for the assigned tasks. Shortage of time given to classroom teachers before and after transmission contributed significantly for teachers to make inadequate support to students' learning. Similarly during transmission, inadequate time was assigned for taking notes, doing exercises and respond into questions. As a result, it worked against the expected student-centered method of teaching introduced as part of pedagogical reforms.

Problems related to program broadcasting are attributed to technical and natural causes. Technical problems were associated with channel confusions, maintaining the various facilities, malfunction of VSAT and plasma TV by thunder and heavy windy rain resulting power interruption.

Supportive materials (teacher and student guides and broadcast schedule) were not available to schools before the commencement of the academic year whereas the ministry at the beginning thought that modules would be distributed to all government schools so that they copy

the CD and distribute to students and teachers. Whereas in reality, schools did not have the facility to duplicate the modules and distribute them in time. Similarly, student textbooks did not only arrive late but also were not distributed on a one-to-one basis. This definitely contributed negatively to teachers and students failure to make preparations before the broadcast.

Lack of ownership and accountability was also a very crucial concern that it appears that there is role confusion and responsiveness among the various institutions involved in the implementation of the program. In general, lack of ownership and feeling of responsibility among various actors responsible for implementing ICT resulted in role and role relationship confusion. This will result in lack of responsible agency for technical maintenance and trouble shooting.

Looking into administrative problems, inadequate training was given to education professionals (teachers, directors and supervisors) at the grass root level about program preparation, presentation, and handling and using the innovation. There is lack of full participation of the school leadership for they did not arrange conditions for those teachers who received training to train others.

Due to lack of adequate activities directed towards creating awareness, a number of perception problems are encountered. These include the different practice called for the innovation, the technology was seen as alien and tendency for "fear of new thing", considering the satellite program was meant for replacing teachers.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion: Even though the innovation was introduced to the secondary schools four years back, significant percent of both respondents did not know the exact share of time given to school teachers for making introduction and summary of lessons. It could be possible to argue that given the key role of introduction and the limited time set for teachers to do so, lack of knowledge of teachers share in this regard would have implication for their extent of use of this time and ultimately for the quality of the lesson understood by students. In other words, the time assigned for classroom teachers pre-broadcasting session was inadequate, and it did not consider the range of introductory events that could happen during instruction. As a result significant percent of teachers did not make use of their time, were not punctual and could not make appropriate introduction. Significant percent of respondents argued that the time share for introduction should be elevated from the current two minutes to the range between 5-10 minutes.

In general, plasma lessons were found to be well-planned and well-organized. Nearly, all the introductory variables were supported except questioning the appropriateness of their pace of instruction. Most of the variables identified in relation to students' needs were agreed except for students with special needs. Due to the variety of information, plasma lessons were found to be motivating. Generally, they communicate information directly to students and other forms of knowledge construction like group discussion was totally absent; the content covered by the plasma lesson was relevant and did attend to secondary students' level of understanding. Similarly, class work and homework tasks were appropriate even

though the feedback was found to be insufficient.

Regarding the nature of the technology itself, along with the problem of pace, the inability of the plasma lessons to replay and their variance to individual difference were some of the critical issues that need attention. In general, even though plasma lessons use a variety of teaching aids, the time assigned for pre-broadcasting, class work and copying notes was not considered appropriate. This fact indicates that even after three years of implementing the innovation, significant number of participants lack knowledge about the time share. This may have serious implication; especially for teachers, for it affects their level of use of the time and ultimately contributes to the difficulty of understanding the lesson by students.

From the comparison of the perceptions of the two parties under study, we can generalize that mathematics students and teachers have more or less similar attitudes and perceptions about the PTV implementation. In addition, though it has relatively significant changes and improvements in the delivery system, it would be very difficult to say that the PTV lessons are totally friendly to both parties due to the very little role given to the actual teachers with respect to time, speed and space. Moreover, we can agree that there is of course conceptual change in injecting ICT support to the conventional learning situations, in which the technology is currently dominating everybody's life. It supports the learning of mathematics in controlling the timely content coverage, and provides experimental demonstrations, additional teaching materials and attributes of presentations. This offects exceptional challenges that are beyond the PTV delivery system like conducting tutorial sessions for mathematics classes which are unique characters for the subject.

Recommendations: The major recommendations of this study are then:
When plasma is used well in mathematics classes, it can have positive effects on students' attitude toward learning through attracting their attentions, building confidence in their abilities to do mathematics, engagement with the subject matter, and mathematical achievement and conceptual understanding. Therefore, careful attention to teacher preparation and development as well as curriculum revision are needed to support effective use of technology in all grades of mathematics class.

Assign time to make tutorials and weekly consolidation of the PTV sessions so that students improve their problem solving skills and have chances of face to face contact with their teachers.

We can say it is not too late that time should be given to redesign the teaching methodology going on in TEI's (Teacher Educational Institutes, including the universities) when training the high school teachers so that they can use the technology to support their teaching and learning.

ACKNOWLEDGEMENTS
We are grateful to SIDA-SAREC for fully supporting the fund to complete the study via Addis Ababa University, College of Education, and our sponsors and facilitators all the way throughout. We would also like to extend our thanks to Akalewold Eshete and Addis Simachew for allowing us to use the part of data collected in team, and teachers and school authorities who participated in the study and gave us their assistants during the data collection.

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