A Study of Classroom Amplification Systems in 21st Century Classrooms: An analysis of the impact of system usage on participating teachers and students

Submitted by

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Executive Summary

Classroom amplification technologies are designed to clarify and evenly distribute the teacher and student voices throughout the classroom. Built on the premise that improving communication improves learning, classroom amplification technologies seek to create acoustic environments where learners can more easily hear the teacher's and one another's voices making key concepts more easily understood by removing interference. High quality acoustics are even more important in 21st century classroom settings such as those promoted by the eMINTS (enhancing Missouri's Instructional Networked Teaching Strategies) National Center.

In eMINTS classroom high levels of technology use and the ambient noise associated with student conversations as they collaborate on project work often create additional sound intensity. If classroom amplification technologies can be used effectively to moderate the additional sound, problems such as student inattention, inability of students to hear teacher directives, and other circumstances that may negatively impact the effectiveness of the "high tech" instructional environment could be managed.

The technologies required for designation as an eMINTS classroom include:

- Interactive whiteboard and data projector
- Teacher laptop
- Student laptops at a ratio of at least one computer for every two students
- Digital camera
- Printer and scanner

eMINTS offers professional development programs designed to take advantage of technology by helping teachers learn to use technology in transformative ways, making instruction engaging for students and helping them understand complex concepts more deeply. The professional development programs provided to teachers in eMINTS classrooms are based on the eMINTS Instructional Model and its four components:

- High-quality lesson design
- Inquiry-based teaching
- Community of learners
- Technology-rich classrooms

A total of 34 teachers and 943 students in grades four through twelve from 13 schools in seven school districts (one in Alabama and six in Missouri) participated in a project to study the effect of bringing classroom amplification technologies to technology-rich eMINTS classrooms. All teachers involved in the study completed the eMINTS Comprehensive professional development program that includes:

- The full suite of hardware and software described above
- A rigorous and intensive face-to-face training program that includes the following:
    - 124 contact hours and 9-10 in-classroom coaching and mentoring sessions in Year 1
    - 90 contact hours and 9-10 in-classroom coaching and mentoring sessions in Year 2

Participating teachers and their students at the elementary level (grade 4), middle school level (grades 6-8), and high school level (grades 9-12) were divided into 3 study groups. Neither teachers nor students were made aware of the experimental group they were assigned to for the study:

1. Experimental Group #1 – classrooms receiving the "standard" low-volume amplification system. This group is referred to as "experimental standard" throughout the report.
2. Experimental Group #2 – classrooms receiving the "enhanced" amplification system with additional features. This group is referred to as "experimental enhanced" throughout the report.
3. Control Group – classrooms that did not receive any amplification systems and conducted "business as usual." This group is referred to as "control" throughout the report.

The following questions guided the overall study of the impact of classroom amplification technologies on teachers and students:

- **Question #1 (Student Academic Performance):** What instructional impact does the consistent use of classroom amplification technologies or enhanced classroom amplification technologies have on the academic performance of students in 21st century (technology-rich) eMINTS classrooms at the elementary, middle, and high school level student populations examined?

- **Question #2 (Student Behavior/Motivation):** What behavioral and/or motivational impacts does the consistent use of classroom amplification technologies or enhanced classroom amplification technologies have on the behavior and motivation of students who are taught in 21st century (technology-rich) eMINTS classrooms with classroom amplification technologies or enhanced classroom amplification technologies when compared to one another and to students of similar demographic backgrounds who are taught in classrooms not equipped with classroom amplification technologies at the elementary, middle, and high school level populations examined?

- **Question #3 (Teacher Instructional Change):** What differences are noted in teachers' instructional patterns in 21st century (technology-rich) eMINTS classrooms equipped with classroom amplification technologies or enhanced classroom amplification technologies at the elementary, middle, and high school levels as observed by trained observers using validated classroom observation instruments when compared with one another and to teachers' instructional patterns in classrooms not equipped with classroom amplification technologies in similar demographic settings?

Key findings from the study of the impact of classroom amplification technologies on teachers and students included:

- On surveys of usage, teachers in experimental (both standard and enhanced) groups indicated amplification technologies helped them to engage students and improve student attitudes toward school. Teachers in experimental classrooms reported using the other technologies available to them at higher rates than teachers in control classrooms.

- Students at all grade levels in experimental enhanced classrooms had higher survey rating averages than those in experimental standard classrooms
    - On items addressing the impact of using classroom amplification students "agreed" (with ratings of 3.7 or higher on a scale where "5" is strongly agree)
        - I can hear my teacher's voice from anywhere in the room.
        - My teacher uses the sound system in our classroom every day.
        - I hope that my classroom next year has a sound system.
        - It's easier for me to pay attention to my teacher.
        - I am learning more.
        - My teacher's instructions are clearer to me when he/she uses the system.
- Teachers in experimental (both standard and enhanced) classrooms at all grade levels reported fewer behavioral incidents than teachers in control classrooms. The incidence of behavioral problems decreased over the course of the school year while usage of the systems (both standard and enhanced) increased over time.
- In measuring reading performance across all grade levels, students in the experimental standard group outperformed students in the control group and the experimental enhanced group in the fall. However, all three groups showed a gain in the scale score means from fall 2010 to spring 2011. The largest gain was found in the experimental enhanced group and the smallest gain was found in the experimental standard group. Spring scores indicate a closing of the gap between the highest and lowest scale score means.

Overall, this study provides evidence that teachers and students at all grade levels found significant value in the use of classroom amplification technologies in their technology-rich classrooms, noting that the amplification technologies increased their abilities to understand instructions and to hear presentations. Teachers in classroom equipped with the amplification technologies reported that students with special education classifications, particularly Attention Deficit Disorder (ADD), Attention Deficit Hyperactivity Disorder (ADHD) and those with hearing impairments, along with students classified as English Language Learners (ELL) benefited the most from the use of the systems.

There is also evidence that classroom amplification technologies contribute to lower rates of student behavioral incidents, particularly when the usage rate of the systems increased over time. Academic performance in reading/language arts across all grade levels was higher in classrooms using the amplification technologies than in control classrooms without the technologies.

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Section I: Introduction

A quasi-experimental research study of the impact of classroom amplification technologies in 21st century classrooms was conducted by the eMINTS (enhancing Missouri's Instructional Networked Teaching Strategies) National Center at the University of Missouri beginning in fall 2010 and concluding in spring 2011. The study involved a thorough examination of the use of classroom amplification technologies (both standard and enhanced versions) in 34 technology-rich 21st century classrooms at 13 schools in seven school districts located in two states, Alabama and Missouri. One district was located in Alabama and the remaining six districts were located in Missouri.

For this study, a "21st century classroom" was defined as a classroom in which the teacher could be classified as an official eMINTS teacher. Teachers are considered to be official eMINTS teachers when they have satisfactorily completed the two-year eMINTS Comprehensive professional development program (eMINTS Comp PD) as provided by an eMINTS staff member or a certified eMINTS Instructional Specialist employed by an external organization, such as a school district. Teachers must also teach in a classroom with the prescribed suite of eMINTS equipment and software installed and fully functional. The designation begins when teachers are enrolled in eMINTS Comp PD and becomes finalized upon satisfactory completion of the program.

The eMINTS National Center is a professional development affiliate of the Partnership for 21st Century Skills, a national organization that advocates for 21st century skill readiness for every student. For more information see: http://www.p21.org/

All classrooms involved in the study were equipped with the technologies required for designation as an eMINTS classroom:

- Interactive whiteboard and data projector
- Teacher laptop
- Student laptops at a ratio of at least one computer for every two students
- Digital camera
- Printer and scanner

All teachers participating in the study successfully completed the two-year intensive eMINTS Comp PD program that focuses on using inquiry-based instruction supported by technology. The positive impact of the eMINTS Comp PD program has been recognized by the US Department of Education with the award of a Validation level grant in the competitive Investing in Innovation (i3) program. For more information see: http://www.emints.org

Section II: Methods

eMINTS National Center staff drew upon data obtained throughout the 2010-2011 school year. Data were obtained from teachers and students in both "experimental" classrooms (those with the amplification technologies – standard and enhanced) and "control" classrooms (those without the amplification technologies) at the elementary, middle, and high school levels. The terms "standard" and "enhanced" refer to the type of amplification technologies installed in the classrooms:

- ***Standard*** – a low-volume amplification system that improves clarity of speech and sound throughout the classroom. The system usually consists of a configurable microphone for the teacher, a base station receiver, and a combination of wall and ceiling speakers.
- ***Enhanced*** - a specific feature added to standard amplification systems that adjusts voice clarity to compensate for high background noise levels (e.g., during summer when air conditioning is used), special activities (e.g., a dictated spelling test), or to help students with special learning needs (e.g., English Language Learners). An example of such technology is the 'OptiVoice' feature used in some products by the manufacturer FrontRow.

Data were collected from multiple sources as detailed in Table 1. The relationship among the data and their association with either "experimental standard or experimental enhanced" or "control" classrooms was examined. Brief descriptions of the study participants and data sources, how they are defined and how the data were collected are provided in this section.

Table 1. Data sources

Source Type	Individuals Providing Data		Participating Study Group		
	Teachers	Students	Experimental (Standard)	Experimental (Enhanced)	Control
Survey	X	X	X	X	X
Behavior incidents log	X		X	X	X
System usage logs	X		X	X	
Classroom observations	X		X	X	
Focus groups	X		X	X	
Academic performance		X	X	X	X

Participants

A total of 34 teachers and 943 students in grades four through twelve from 13 schools in seven schools located in two different school districts participated in the project. Table 2 shows the number of students participating at each level: elementary, middle and high school.

Table 2. Total numbers of teachers and students by grade level.

GRADE LEVEL	NUMBER OF TEACHERS	NUMBER OF STUDENTS
Elementary School (Grade 4)	18	331
Middle School (Grades 6-8)	10	511
High School (Grades 9-12)	6	101
Total (Grades 4 – 12)	34	943

Students and teachers from both Missouri and Alabama were included in the elementary and middle school groups; however, only students and teachers from Missouri were included in the high school group. The eMINTS implementation in Alabama had not yet extended into high school grades and eMINTS classrooms were not available at the high school level in that state.

Demographic characteristics of the schools and districts involved in the project covered a wide range and included the following:

- The Alabama district is the sixth largest in the state with more than 27,000 students. The district has 46 different school campuses and covers a geographic area of nearly 1,600 square miles. Using US Census Bureau definitions, five of the schools in the district were classified as urban and two were rural.
- The Missouri districts represent all geographic quadrants of the state. One of the schools in the districts was classified as urban and five were rural.
- Overall, there were six urban schools and seven rural schools.

According to the US Census Bureau (2010),

> For the 2010 Census, an **urban** area will comprise a densely settled core of census tracts and/or census blocks that meet minimum population density requirements, along with adjacent territory containing non-residential urban land uses as well as territory with low population density included to link outlying densely settled territory with the densely settled core. To qualify as an urban area, the territory identified according to criteria must encompass at least 2,500 people, at least 1,500 of which reside outside institutional group quarters. "**Rural**" encompasses all population, housing, and territory not included within an urban area.

All but one of the Missouri school districts is classified as a "high need district." In Missouri, high-need eligibility adopts federal standards for poverty level and district-level data on percent of course taught by highly qualified teachers. Local school districts must meet both criteria to be considered high-need. Districts with 10,000 students or 20% of students living in poverty and with less than 100% of courses taught by highly qualified teachers are considered high-need.

The Alabama district included in the study involved schools with high levels (more than 50%) of students receiving assistance from the Free and Reduced Lunch Program; however, all teachers in the district were reported as being highly qualified.

Table 3 provides detailed demographic information about the participating districts and schools. It provides additional information about the total number of students in the districts and in the schools. The total number of students is more than the number of students participating in the study because of two possible situations:

- not all of the classrooms in the participating schools were classified as eMINTS classrooms; or,
- there were additional classrooms in the school that involved students in different grade levels than those included in the study.

Table 3. Participating district and school demographics.

STATE	DISTRICT AND SCHOOL	RURAL / URBAN	NUMBER OF STUDENTS	% ELIGIBLE FOR FRPL	NUMBER OF STUDY CLASSROOMS
ALABAMA	DISTRICT # 1		27,000	37.5%	10 total
	Middle School A	Urban	650	55.5%	2
	Middle School B	Rural	604	49.8%	1
	Middle School C	Urban	748	53.5%	1
	Elementary School A	Urban	783	39%	2
	Elementary School B	Urban	919	52.1%	2
	Elementary School C	Rural	230	43.7%	1
	Elementary School D	Urban	474	66.5%	1
MISSOURI	District #1		1,896	59.5%	6 total
	Elementary School E	Rural	401	41.7%	6
	District #2		1,600	71.7%	6 total
	Middle School D	Urban	740	70.7%	6
	District #3		711	71.2%	2 total
	High School A	Rural	320	69.8%	2
	District #4		428	48.9%	2 total
	High School B	Rural	229	44.6%	2
	District #5		228	40.8%	2 total
	High School C	Rural	115	66.5%	2
	District #6		1,906	51.1%	6 total
	Elementary School F	Rural	449	48.2%	6

The eMINTS Comp PD program had been fully delivered to all participating teachers in all seven school districts. In the eMINTS Comp PD program, teachers have the full suite of hardware and

software prescribed by eMINTS. They also complete a rigorous and intensive face-to-face professional development program that includes the following:

- 124 contact hours and 9-10 in-classroom coaching and mentoring sessions in Year 1
- 90 contact hours and 9-10 in-classroom coaching and mentoring sessions in Year 2

Formation of comparison groups

The formation of comparison groups within the study was completed using a simplified random assignment process. By the time the study was organized, students had already been assigned to teachers so it was not possible to randomly assign students to the various treatment conditions, experimental (standard and enhanced) or control. Since the selection of the participating teachers/classrooms in school districts could not be done using random selection techniques due to the requirement that the teachers/classrooms meet the criterion of being a 21st century (eMINTS) classroom, a random assignment process was used to approach conditions found in quasi-experimental designs.

Once districts were recruited into the study and district administrators agreed to participate in the activities involved in the study, teachers whose classrooms met the criterion of being a 21st century classroom were assigned numbers and all other identifying information except for grade and/or content area taught was stripped. An equal number of experimental classrooms (those with the amplification technologies) and control classrooms (those without the amplification technologies) were drawn. In cases where there were an inadequate number of teachers and students to constitute full experimental and control classrooms, teachers' class loads were divided into morning (a.m.) and afternoon (p.m.) groups. Thus, a teacher may have his/her morning classes designated as being in the experimental group and his/her afternoon classes designated as being in the control group.

The experimental classrooms were further stratified into those where the "standard" classroom amplification technologies were installed and those that were provided with the "enhanced" systems. Enhanced systems included a specific feature that adjusts voice clarity to compensate for high background noise levels (e.g., during summer when air conditioning is used), special activities (e.g., a dictated spelling test), or to help students with special learning needs (e.g., English Language Learners). Neither teachers nor students were made aware of which experimental group (standard or enhanced) they were assigned to for the study.

Participating teachers and their students at the elementary level (grade 4), middle school level (grades 6-8), and high school level (grades 9-12) were divided into 3 study groups:

1. Experimental Group #1 – classrooms receiving the "standard" low-volume amplification system. This group is referred to as "experimental standard" throughout the report.
2. Experimental Group #2 – classrooms receiving the "enhanced" amplification system with additional features. This group is referred to as "experimental enhanced" throughout the report.

3. Control Group – classrooms that did not receive any amplification systems and conducted "business as usual." This group is referred to as "control" throughout the report.

It must be emphasized that, because the overall school groups were not randomly assigned, students were not randomly assigned to teachers, and because there was a relatively small population in the analyses, the study did not allow for an experimental design. Conclusions drawn from the analyses involving the comparison groups are limited by these circumstances.

Basic demographic information was collected including teachers' experience, subjects and grade levels taught, and their familiarity with classroom amplification technologies prior to being selected to participate in the study. Table 4 summarizes the demographic make-up of participating teachers. See Appendix A for details regarding study group demographics.

As shown in Table 4, study groups were fairly even in terms of their grade spans and subjects, but they differ with regards to classroom amplification familiarity and teaching experience.

Table 4. Study group demographics

DEMOGRAPHIC	CONTROL GROUP	EXPERIMENTAL GROUP	EXPERIMENTAL SUB-GROUPS	
			STANDARD	ENHANCED
Grade span				
• Elementary	9	9	4	5
• Middle	6	6	3	3
• High	4	5	3	2
Total	**19**	**20**	**10**	**10**
Secondary content areas				
• Reading/language arts	6	5	4	1
• Mathematics	2	3	1	2
• Science	2	3	1	2
Total	**10**	**11**	**6**	**5**
Years Full-time Teacher				
• 1 to 5	3	6	3	3
• 6 to 10	8	9	3	6
• 11 to 20	5	2	1	1
• 21 to 29	3	3	3	0
Average	**11**	**10**	**13**	**7**
Familiarity with classroom amplification technologies				
• Very familiar	1	1	0	1
• Somewhat familiar	10	6	3	3
• Not at all familiar	8	13	7	6
Total	**19**	**20**	**10**	**10**

* Control group totals include the five secondary teachers with courses assigned to both control and experimental study groups.

There was a slight difference in how familiar teachers were with amplification systems, prior to this study, with 11 (58%) of the control group teachers having some familiarity compared to seven (35%) of the experimental group teachers. While the average teaching experience of the experimental group as a whole is comparable to that of the control group, teachers in the standard amplification system study group had been teachers for 13 years compared to seven years for teachers in the enhanced amplification group. The demographics for each study group, however, are similar enough that the slight differences noted should not affect results.

Teacher survey

A survey focused on teachers was developed using items from surveys created for similar past projects and studies. Items specific to the use of classroom amplification technologies were added to the survey. The survey was field-tested with a small group of eMINTS staff members, all of whom had experience as classroom teachers. Clarifications and corrections were made to the survey prior to loading it into the SurveyMonkey program to format it as an online survey.

The purpose of the teacher survey was to collect data about the following:

- Teacher perceptions of student motivation and interest in school
- Teacher self-reports of instructional or teaching practice changes
- Teacher perceptions of the use of the classroom amplification technologies, the ease of adoption, and the effect of the classroom amplification technologies on their use of other 21st century technologies available in their classrooms

A comparison of pre-and post-survey items from the survey is useful in determining the extent to which teachers perceived that the classroom amplification technologies impacted student motivation and interest as well as capturing any self-reported changes in teaching practices.

The teacher survey was completed by all 34 teachers from the participating schools at the beginning of the study in October 2010 and by 30 teachers at the conclusion of the study in May 2011. The survey was completed by 100% of the participating teachers in fall 2010 and by 88% of the participating teachers in spring 2011.

Student survey

A survey focused on students was developed using items from surveys created for similar past projects and studies that had been field-tested with elementary, middle and high school-aged students. Items specific to the use of classroom amplification technologies were added to the survey. The survey was loaded into the SurveyMonkey program to format it as an online survey.

The purpose of the student survey was to collect data about the following:

- Student self-reports of their motivation and interest in school

- Student perceptions of the use of the classroom amplification technologies, the ease of using the microphone, and the effect of the classroom amplification technologies on their use of other 21st century technologies available in their classrooms

A comparison of responses to pre-and post-survey items is useful in determining the extent to which students perceived that the classroom amplification technologies impacted their motivation and interest in school as well as capturing any changes about how they interacted with other technologies in their classrooms.

In total, 1,145 student surveys were completed at the beginning of the study in October 2010 and 1,187 student surveys were completed at the conclusion of the study in May 2011. Students completed surveys in their classroom settings to ensure the highest possible completion rate. The number of completed surveys varies from the number of student participants due to several factors:

- Student mobility throughout the year,
- Students present or absent during one or both survey sessions, and
- Multiple entries by middle and high school students enrolled in multiple subject areas (in multiple participating classrooms).

While there was mobility of students in all of the schools and classrooms, none reported a mobility rate exceeding 20% which is below the average rate of 31% reported by Rumberger and Larson (1998). The reported mobility rate is not likely to have a significant effect on the student survey results due to the size of the groups in the study.

Behavior incident logs

A simple Excel spreadsheet was developed to track the number of behavior incidents that occurred in all study classrooms. Instructions to participating teachers for the completion of the log were: "*For every full week that school is in session, please record the total number of any behavioral incidents that occurred in your classroom requiring you to instigate your school's disciplinary procedures. Routine incidents such as isolated talking out need not be recorded. Record only incidents that required you to use your school's disciplinary procedures such as isolation, sending the student to the office, giving the student detention, etc.*"

The purpose of the behavior incident log was to collect data about the following:

- Trend lines for the number of teacher-reported student disciplinary incidents in their classroom
- Anecdotal reports about any student disciplinary incidents that teachers provided

Behavior logs were submitted by 100% of the teachers in the study. The number of weekly logs submitted by participating teachers ranged from 11 weeks to 31 weeks. The differences in the number of logs submitted were due to variations in school calendars, teacher absences due to

illness or other circumstances, and school closures due to inclement weather. There were also differences in the number of logs submitted by elementary and secondary teachers since elementary teachers had single data entries each week and secondary teachers entered data for each appropriate course or course section that they taught.

System usage logs

Another simple Excel spreadsheet was developed to track the usage of the classroom amplification technologies (both standard and enhanced) for experimental classrooms. Instructions to participating teachers for the completion of the log were: "*For every week that school is in session, please record the total approximate number of minutes you and/or your students used the amplification system."* Spaces were provided for teachers to record the date and class period. Class period information was recorded by middle and high school teachers only. The remaining columns included: number of minutes system in use, problems or issues with system, and new or different uses of the system.

The purpose of the system usage logs was to collect data about the following:

- Trend lines for the number of minutes teachers and students used the amplification technologies
- Any problems or issues noted with the amplification systems
- Anecdotal reports about new or different uses of the amplification systems that occurred

System usage logs were submitted by 100% of the teachers in the experimental group. The number of weekly logs submitted by participating teachers ranged from 11 to 31 weeks. Similar to the behavior logs, the differences in the number of usage logs submitted were due to variations in school calendars, number of middle and high school courses in the study, teacher absences due to illness or other circumstances, and school closures due to inclement weather.

Classroom observations

Observations of all experimental (standard and enhanced) classrooms were conducted at the beginning of the study in fall 2010 and at the conclusion of the study in spring 2011. The "Classroom Observation Instrument" used by the West Virginia Department of Education in their Teach 21 project was adapted for use in this study. Adaptations to the instrument included the addition of items specifically about the classroom amplification technologies and the revision of the list of technology tools to reflect the required suite of hardware and software required for eMINTS classrooms. The instrument was also revised to include a place where observers could note the approximate number of minutes that they observed tools and resources being used.

All individuals responsible for conducting observations were trained to ensure inter-rater reliability. Using standard processes, observers were provided with the instrument and a video-

tape of a classroom similar to those they would be observing for the study. Observers were asked to complete the observation instrument independently. A webinar with all observers was then held to compare responses and come to consensus on the scoring for each item on the instrument. A second video-tape was provided and observers again used the observation instrument to collect data from the classroom independently. Responses were compared and an inter-rated reliability score of .85 for consistency was obtained on a simple scale where "0" equals no agreement and "1.0" equals complete agreement.

The purpose of the classroom observations was to collect data about the following:

- The extent to which the systems were being used
- The interaction between the usage of the systems and other 21st century classroom technologies

A total of 35 classroom observations were completed during two periods of time in the study. The first set of observations was conducted beginning November 29, 2010 and concluding December 13, 2010 .The second set of observations was conducted beginning April 8, 2011 and concluding May 3, 2011.

Teacher focus groups

All teachers in experimental classrooms (standard and enhanced) were invited to participate in focus groups during the final weeks of the study. The timing of the focus group invitations coincided with the ending of the school year so that participants would have as much experience with the technologies as possible.

Focus group questions were developed using tested examples from previous technology-based projects and tested with program staff who made suggestions for clarity and revision. All staff involved in conducting focus groups were trained in standard methods for conducting focus groups to ensure consistency.

The focus groups were conducted using Voice over Internet Protocol (VoIP) web-conferencing software to minimize travel required for participants. Use of the web-conferencing software also allowed the sessions to be recorded for later transcription and analysis. The data from the focus groups were organized using NVivo9 software to determine and triangulate the various themes that emerged. An open coding process which allows the identification of the types of and the variety of themes that emerged related was used.

The purpose of the focus groups was to collect data about the following:

- Teacher perceptions of the use of the classroom amplification technologies, the ease of adoption, and the effect of the classroom amplification technologies on their use of other 21st century technologies available in their classrooms

- Specific features of the classroom amplification technologies that had an impact on their instruction and the performance of their students

In total, four focus groups were conducted involving all 20 participants assigned to the two experimental study groups. The first group was convened April 29, 2011 and the final group met May 11, 2011.

Student academic performance assessment

The final element in the study was to measure the impact of the technologies on student performance in reading/language arts and mathematics by comparing the performance of students in both the experimental (including standard and enhanced) and control groups over time. The Scantron Corporation Performance Series® assessments were selected for use in the study to provide a common measure since participants were from states that use two different assessment instruments for calculating student achievement. The Scantron Performance Series® was also designed for online delivery and offered a significant convenience and cost-savings alternative to paper and pencil assessments.

The Scantron Performance Series® is a standards-based adaptive measurement. The assessments adapt to each student's ability level. Depending on student responses, the assessment starts students with items that are on grade level. If students are unable to answer the items, the assessment moves them to progressively less difficult items until a success rate is achieved and then on to more difficult items until the student reaches a level where items are not being answered correctly. Adaptive measurements require fewer test items to arrive at equally accurate scores.

Scantron Performance Series® provides National Percentile Rankings (NPR) to show how students performed on the test compared to a national norm sample. Scantron Corporation has been able to leverage the extensive research done with other products to identify the critical learning objectives taught throughout the United States. Through the creation of a massive relational database of alignments for hundreds of standards documents, including state and national standards, and state and national high-stakes assessments, Scantron assessments have achieved a high degree of correlation to state and national standards (Scantron, 2010). The results obtained for the study therefore can be reliably viewed as demonstrating results that are applicable to students in multiple states beyond those included in the study.

Independent reviewers have noted that Scantron Performance Series® is useful for high-level, long-term measurement of gains, but not for short-term or curriculum assessments (Henington, 2006). Based on independent reviews, the type of assessments planned for the study, and consultations with practicing educators, the Scantron Performance Series® was selected for use in the study.

The purpose of the student academic performance assessment was to collect data about the following:

- Any differences in academic performance, specifically in reading/language arts and mathematics performance, based on study group assignment across a typical nine month school year.

Student identification files were loaded into the Scantron system by designated administrators from each participating school district. Project staff were provided with training by the Scantron Corporation about how to assist participating teachers in the administration of the assessments. Progress in completing the assessments was monitored and assistance was provided as needed to ensure that assessments were completed.

Students in elementary grades completed both the reading/language arts assessment and the mathematics assessment. Students in middle and high school grades completed the assessment for the class they were enrolled in by teacher. If their communication or language arts teacher was part of the study, they completed the reading/language arts assessment. If their mathematics teacher was part of the study, they completed the mathematics assessment. Some students in middle and high school grades completed both the reading/language arts and the mathematics assessments while others completed only one of the assessments due to their assignment to teachers who were not participating in the study for one subject or the other.

Students in the study were tested in fall 2010 and spring 2011 using a pre- and post-test methodology. Results from the two assessments were analyzed, disaggregated by group, and compared using analyses available through the Scantron Corporation online administration service.

Section III: Analyses

Teacher survey

Analyses of the data collected from teacher surveys was completed using standard calculations of mean scores to arrive at averages for each of the items on the survey. The responses from the fall and spring administrations were aggregated at the item level and then disaggregated by study group. Appendices B and C summarize the teacher responses for the fall and spring surveys, respectively.

The results from both survey administrations were compared and analyzed for pre- and post-study differences. All 34 teachers completed the October 2010 survey and 30 teachers completed the survey in May 2011. The four teachers not completing the spring survey did not significantly impact one study group over another. Table 5 summarizes basic teacher demographics for the fall and spring survey administrations.

Table 5. Teachers completing fall and spring teacher surveys

DEMOGRAPHIC	TOTALS		CONTROL GROUP		EXPERIMENTAL SUBGROUPS			
					STANDARD		ENHANCED	
	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING
Grade span								
• Elementary	18	15	9	7	4	3	5	5
• Middle	10	9	4	4	3	3	3	2
• High	6	6	1	1	3	3	2	2
Total	**34**	**30**	**14**	**12**	**10**	**9**	**10**	**9**
Secondary content areas								
• Reading/language arts	8	8	3	3	4	4	1	1
• Mathematics	4	4	1	1	1	1	2	2
• Science	4	3	1	1	1	1	2	1
Total	**16**	**15**	**5**	**5**	**6**	**6**	**5**	**4**

Table 6 details pre- and post-survey item rating averages. For each item, an overall rating average was calculated based on the number of response choices. An item with six response choices, for example, has a six-point rating average scale where “1” indicates the least favorable response (such as “Never”), and “6“ represents the most favorable response (such as “Almost all day”). This table summarizes the fall and spring responses by comparing the rating averages across study groups and across grade spans. Fall and spring rating averages are listed in black font; the highest rating average (fall or spring) derived for each item is highlighted in bold. Positive fall to spring differences are noted in green font and negative fall to spring differences are noted in red font; any difference (positive or negative) of 0.4 or higher is highlighted in bold. Overall grade span rating averages are in Italics.

In most cases the item averages increased from fall to spring, and in many cases the averages indicated favorable responses (4.0 and above on a 6-point scale, for example) during both survey administrations.

- Teachers in experimental classrooms (both standard and enhanced) had higher rating averages than teachers in the control classrooms for a vast majority of the items.
- Teachers, in general, reported using inquiry techniques about half of the time, with the most frequent use noted by teachers in the experimental enhanced group in the spring.
- All teachers reported high use of classroom technologies (particularly interactive whiteboards and computers), using the technologies more frequently than their students.
- Teachers and students in the experimental classrooms (both standard and enhanced) were reported using their technologies more frequently than teachers and students in the control classrooms.
- In general, teachers reported favorable student learner characteristics, with higher rating averages noted in the spring than in the fall.
- Except for one group at the high school level, teachers in experimental classrooms (both standard and enhanced) reported an increase in item rating averages from fall to spring with regards to project impact. Teachers indicated that the amplification technologies helped them to engage students and improve student attitudes toward school.
- When rating the impact of using classroom amplification technologies, elementary teachers had the highest rating averages, followed by middle school teachers, then high school teachers. Overall, teachers with standard systems had slightly higher rating averages than teachers with enhanced systems.

Table 6. Pre- and post- teacher survey item rating averages

TEACHER USAGE SURVEY ITEM	CONTROL			STANDARD			ENHANCED		
	PRE	POST	DIFF	PRE	POST	DIFF	PRE	POST	DIFF
Teacher use of inquiry techniques	Rating Average Range of 1-6, No Usage to Nearly Every Day								
Overall frequency of use	2.9	2.7	-0.2	3.5	3.2	-0.3	3.8	**4.3**	**+0.5**
• *Elementary use of inquiry*	*3.1*	*2.3*	***-0.8***	*4.3*	*3.7*	***-0.6***	*3.6*	***4.4***	***+0.8***
• *Middle*	*3.0*	*3.5*	***+0.5***	*3.0*	*3.3*	*+0.3*	***4.7***	*4.0*	***-0.7***
• *High*	*1.0*	*2.0*	***+1.0***	*3.0*	*3.0*	-	*3.0*	***4.5***	***+1.5***
Teacher use of classroom technology	Rating Average Range of 1-6, No Usage to Nearly Every Day								
Amplification technologies				3.7	4.8	**+1.1**	4.8	**5.1**	+0.3
Special amplification technologies				**1.1**	0.4	**-0.7**	0.4	**1.1**	**+0.7**
Interactive whiteboard	4.5	5.4	**+0.9**	4.8	5.0	+0.2	5.0	**5.7**	**+0.7**
Computers	4.1	4.5	**+0.4**	4.5	**5.0**	**+0.5**	**5.0**	4.1	**-0.9**
Internet sites	3.6	3.9	+0.3	4.0	**4.6**	**+0.6**	**4.6**	4.1	**-0.5**
• *Elementary use of technologies*	*2.8*	*2.9*	*+0.1*	*4.2*	***4.3***	*+0.1*	*4.0*	*4.2*	***+0.7***
• *Middle*	*3.0*	*2.8*	*-0.2*	*3.1*	*4.0*	***+0.9***	***4.3***	*3.6*	***-0.7***
• *High*	*3.2*	*3.0*	*-0.2*	*3.4*	*3.6*	*+0.2*	***4.3***	*4.0*	*-0.3*

Student use of classroom technology	Rating Average Range of 1-6, No Usage to Nearly Every Day								
Amplification technologies				2.2	3.1	**+0.9**	2.6	**4.0**	**+1.4**
Special amplification technologies				0.9	0.6	-0.3	**1.3**	0.9	-0.4
Interactive whiteboard	**4.5**	4.3	-0.2	3.9	4.1	+0.2	4.2	4.2	--
Computers	4.1	4.2	+0.1	4.0	**4.6**	**+0.6**	3.9	4.2	+0.3
Internet sites	3.6	4.1	**+0.5**	3.6	**4.2**	**+0.6**	3.9	3.6	-0.3
• *Elementary use of technologies*	*2.5*	*2.7*	*+0.2*	*3.2*	***3.8***	***+0.6***	*3.2*	*3.7*	***+0.5***
• *Middle*	*2.8*	*2.5*	*-0.3*	*2.7*	***3.2***	***+0.5***	*3.1*	*3.0*	*-0.1*
• *High*	*2.0*	*2.0*	--	*2.9*	*2.9*	--	***3.1***	*3.0*	*-0.1*
Student characteristics	Rating Average Range of 1-5, Much Less to Much More								
Overall, my students…									
are active learners	3.4	3.2	-0.2	3.7	**4.0**	+0.3	3.9	**4.0**	+0.1
engage in cooperative learning	3.3	3.2	-0.1	3.5	**3.9**	**+0.4**	3.5	3.7	+0.2
have improved achievement	3.2	3.4	+0.2	3.3	**4.0**	**+0.7**	3.5	3.8	+0.3
enjoy lessons	3.2	3.4	+0.2	3.7	**4.1**	**+0.4**	3.9	4.0	+0.1
are interested in their school work	3.2	3.3	+0.1	3.7	**3.9**	+0.2	3.7	3.6	-0.1
view school as important, useful for the future	3.2	3.3	+0.1	3.0	**3.8**	**+0.8**	3.4	3.4	--
feel capable in their school work	3.2	3.3	+0.1	3.4	**3.8**	**+0.4**	3.4	3.6	+0.2
are interested in going to college	3.2	3.0	-0.2	3.1	**3.6**	**+0.5**	3.5	3.2	-0.3
put effort into learning school work	3.2	3.1	-0.1	3.4	**3.7**	+0.3	3.5	3.6	+0.1
plan to take advanced course in the future	3.0	2.9	-0.1	3.0	**3.7**	**+0.7**	3.2	3.5	+0.3
• *Elementary characteristics*	*3.1*	*3.2*	*+0.1*	*3.5*	***4.7***	***+1.2***	*3.7*	*3.7*	--
• *Middle*	***3.6***	*3.2*	***-0.4***	*3.3*	*3.4*	*+0.1*	*3.4*	*3.5*	*+0.1*
• *High*	*3.0*	*3.0*	--	*3.4*	*3.4*	--	*3.5*	***3.6***	*+0.1*
Amplification technology impact	Rating Average Range of 1-5, Much Less to Much More								
Extent use has helped to…									
engage students in lessons				4.2	**4.4**	+0.2	4.1	4.3	+0.2
improve students' attitudes toward school				3.7	**4.1**	**+0.4**	3.6	3.9	+0.3
• *Elementary impact*				4.3	**5.0**	**+0.7**	4.1	4.1	--
• *Middle*				3.8	**4.3**	**+0.5**	3.5	**4.3**	**+0.8**
• *High*				3.7	3.5	-0.2	3.8	**4.0**	+0.2

One survey item asked teachers whether use of other technology had increased as a result of participating in the project and allowed space for teacher comments. In spring 2011, 13 teachers indicated that their use of other technology had increased, and many provided comments. Following is a sample of comments provided during the May 2011 survey administration. Interestingly, several of the teachers used this space to comment specifically on their use of the classroom amplification systems rather than on "other" technology. A complete account of teacher comments can be found in Appendices B and C summarizing the fall and spring administrations of the teacher survey.

STANDARD AMPLIFICATION SYSTEM TEACHER COMMENTS:

Because I have been eMINTS trained, I was already using other technology. The amplification devices just enhanced the instruction and made it easier to teach.

I have allowed the students to use the computers for smaller projects more often. We might design a poster with smart notebook (sic) or create a graphic organizer. Then the students present their projects with the SmartBoard (sic) and the microphone. The kids share so much more when holding the microphone.

When I have students working on computers, it is much easier to get all of their attention.

It is easier to communicate during group projects involving wikis.

I feel that the classroom amplification has allowed my students to really hear comments made by myself and their peers more so than in the past. It has also increased the level of attention and decreased the of level off-task conversations.

ENHANCED AMPLIFICATION SYSTEM TEACHER COMMENTS:

Active participation has been near perfection since using the amplification system and negative behavior and inattentive behavior has dissolved.

The amplification technology has significantly improved my ability to use the SmartBoard (sic) and computers. When I explain concepts at the board, every student can hear me, even when I am turned sideways to write. I can step away from the board to explain what is being presented, allowing more students to use the board. Students use the microphone when they present PowerPoints, drawings, etc. to the class. Having a microphone has made it easier to help the students use their laptops, because I can turn it on and give specific directions regarding computer tasks or assignments as I am walking around the room. Instant feedback to the entire class is very helpful, especially when I am trouble-shooting problems or identifying and explaining how to improve what they are working on.

Student survey

Analyses of the data collected from student surveys was completed using standard calculations of mean scores to arrive at averages for each of the items on the survey. The responses from the fall and spring survey administrations were aggregated at the item level and then disaggregated by study group. Appendices D and E summarize the student responses for the fall and spring surveys, respectively.

The results from both administrations were compared and analyzed for pre- and post-study differences. Students completed a total of 1,145 student motivation and usage surveys in October 2010 and 1,145 surveys in May 2011. These numbers are duplicated counts of students since a majority of secondary students had more than one teacher who participated in the study and thus had an opportunity to complete the survey more than one time per survey administration period. Table 7 summarizes basic student demographics for the fall and spring survey administrations. Overall, the survey totals remain fairly consistent from fall to spring. It is interesting to note, however, that while there were more middle and high school surveys completed in the spring, there were fewer elementary surveys completed in the spring.

Table 7. Students completing fall and spring student surveys

DEMOGRAPHIC	TOTALS		CONTROL GROUP		EXPERIMENTAL SUBGROUPS			
					STANDARD		ENHANCED	
	FALL	SPRING	FALL	SPRING	FALL	SPRING	FALL	SPRING
Grade span								
• Elementary	440	389	217	194	90	75	133	120
• Middle	569	630	225	285	218	251	126	94
• High	136	168	9	6	65	107	62	55
Total	**1145**	**1187**	**451**	**485**	**373**	**433**	**321**	**269**

Table 8 details pre- and post-survey item rating averages. For each item, an overall rating average was calculated based on the number of response choices. An item with five response choices, for example, has a five-point rating average scale where “1” indicates the least favorable response (such as “Strongly Disagree”), and “5“represents the most favorable response (such as “Strongly Agree”). This table summarizes the fall and spring responses by comparing the rating averages across study groups and across grade spans. Fall and spring rating averages are listed in black font; the highest rating average (fall or spring) derived for each item is highlighted in bold. Positive fall to spring differences are noted in green font and negative fall to spring differences are noted in red font; any difference (positive or negative) of 0.4 or higher is highlighted in bold. [Note that some of the items are negative in nature and a fall-to-spring decrease would indicate improvement.] For items related specifically to the impact of amplification technologies, the higher rating ascribed to either standard or enhanced experimental groups are noted in bold. Overall grade span rating averages are in italics.

A comparison of the fall and spring responses indicates mixed results. In many cases the spring item rating averages were lower than the fall rating averages. On the other hand, the differences were slight and the spring item averages still rated favorable to highly favorable (at or above 3.7 on a 5.0 scale). Students in all study groups provided essentially the same responses for items related to school motivation, effort, self-concept, school enjoyment, school value/importance, and teacher encouragement. However, middle school students in the experimental enhanced classrooms showed a half-point (0.55) increase in their self-concept, while high school students in the control classrooms had an overall decrease (0.5 points).

Students responded to the items surveying the impact of using classroom amplification technologies in the spring only. Elementary students had the highest rating averages, followed by middle school students, then high school students – similar to the teacher survey findings. Overall, students in experimental enhanced classrooms had higher rating averages than those in experimental standard classrooms – opposite of the teacher findings. Not surprising is that the item, "I can hear my teacher's voice from anywhere in the room", received the most favorable responses, averaging above 4.0 points in each experimental group. The ten survey items related specifically to the impact of amplification technologies indicated that nine of those ten items were rated higher by students in enhanced experimental classrooms than by students in standard experimental classrooms. The tenth item related to the impact of amplification technologies was rated exactly the same by students in both experimental groups.

Table 8. Pre- and post- student survey item rating averages

STUDENT MOTIVATION AND USAGE SURVEY ITEM	CONTROL			STANDARD			ENHANCED		
	PRE	POST	DIFF	PRE	POST	DIFF	PRE	POST	DIFF
Class is motivating In this school…	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
we do a lot of fun activities	**3.83**	3.70	-0.13	3.70	3.56	-0.14	3.79	3.80	+0.01
we cover interesting topics	**3.86**	3.73	-0.13	3.92	3.79	-0.13	4.15	**4.17**	+0.02
my teacher makes good plans for us	4.11	3.96	-0.15	4.22	4.10	-0.12	**4.25**	4.23	-0.02
we learn about important things	**4.36**	4.29	-0.07	2.93	3.05	+0.12	2.71	2.60	-0.11
I usually dislike lessons	2.58	2.77	-0.21	3.34	3.21	+0.13	**3.55**	3.47	+0.08
most lessons are fun	**3.66**	3.38	-0.28	3.70	3.56	-0.24	3.79	3.80	+0.01
• *Elementary*	*3.82*	*3.83*	*+0.01*	*3.91*	***4.04***	*+0.13*	*3.97*	*3.94*	*-0.03*
• *Middle*	*3.65*	*3.51*	*-0.14*	*3.59*	*3.42*	*-0.17*	*3.66*	***3.71***	*+0.05*
• *High*	***3.74***	*3.51*	*-0.23*	*3.30*	*3.47*	*+0.17*	*3.30*	*3.32*	*+0.02*
Effort	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
I always try hard, no matter how difficult the work	**4.39**	4.31	-0.08	4.31	4.19	-0.23	4.28	4.19	-0.23
I try hard to do well	**4.56**	4.48	-0.08	4.50	4.35	-0.23	4.52	4.35	-0.23
When I fail, it makes me try that much harder	4.36	**4.37**	+0.01	4.30	4.31	+0.01	4.31	4.31	--
• *Elementary*	*4.55*	*4.58*	*+0.03*	*4.52*	***4.69***	*+0.17*	*4.57*	*4.63*	*+0.06*
• *Middle*	*4.34*	*4.26*	*-0.08*	***4.41***	*4.22*	*-0.19*	*4.37*	*4.36*	*-0.01*
• *High*	*4.19*	***4.39***	*+0.20*	*4.02*	*4.04*	*+0.01*	*3.94*	*3.94*	--
Self-concept	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
I am sure that I can learn in school	**4.62**	4.59	-0.03	4.60	4.52	-0.08	4.55	4.61	+0.06
I can get good grades	4.46	4.46	--	**4.49**	4.42	-0.07	4.48	4.45	-0.03
I don't think I could do advanced school work	**2.73**	2.59	+0.14	2.71	2.57	+0.14	2.61	2.54	+0.07
I am sure of myself when I do school work	4.06	4.08	+0.02	3.96	4.02	+0.06	**4.10**	4.03	-0.07

STUDENT MOTIVATION AND USAGE SURVEY ITEM	CONTROL			STANDARD			ENHANCED		
	PRE	POST	DIFF	PRE	POST	DIFF	PRE	POST	DIFF
I think I could handle more difficult school work	3.26	3.21	-0.05	3.23	3.38	+0.16	3.30	**3.43**	+0.13
I'm not good at school	1.88	1.84	+0.04	1.84	**2.00**	-0.16	1.85	1.87	-0.02
I am sure that I can learn in school	**4.62**	4.59	-0.03	4.60	4.52	-0.08	4.55	4.61	+0.06
• *Elementary*	***3.54***	*3.50*	*-0.04*	*3.46*	*3.53*	*+0.07*	***3.54***	*3.51*	*-0.03*
• *Middle*	*3.45*	*3.44*	*-0.01*	*3.49*	*3.47*	*-0.02*	*3.04*	***3.59***	*+0.55*
• *High*	***3.69***	*3.19*	*-0.50*	*3.42*	*3.51*	*+0.09*	*3.45*	*3.37*	*-0.08*
Enjoyment of school	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
School is dull and boring	2.40	2.67	-0.27	2.72	**2.98**	-0.26	2.54	2.57	-0.03
I have good feelings toward school	**3.79**	3.62	-0.17	3.57	3.46	-0.11	3.68	3.67	-0.01
I really like school	**3.65**	3.40	-0.25	3.37	3.27	-0.10	3.54	3.52	-0.02
I get bored watching programs about school on TV	2.99	3.17	-0.18	**3.38**	3.36	+0.02	3.06	3.16	-0.10
I would like to be given a book or learning games as presents	**3.20**	2.81	**-0.39**	2.78	2.59	-0.19	3.03	2.87	-0.16
I would like to do school work at home	**2.36**	2.19	-0.17	2.00	2.21	+0.21	2.29	2.34	+0.05
• *Elementary*	***3.20***	*3.10*	*-0.10*	*3.14*	*3.05*	*-0.09*	*3.18*	*3.16*	*-0.02*
• *Middle*	*2.93*	*2.89*	*-0.04*	*2.91*	***2.96***	*+0.02*	*2.93*	***2.96***	*+0.03*
• *High*	*3.15*	***3.31***	*+0.16*	*2.92*	*2.96*	*+0.04*	*2.86*	*2.92*	*+0.06*
Value/importance	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
I don't expect to use that much of what I learned in school when I get out of school	**2.53**	2.27	+0.26	2.37	2.46	-0.09	2.36	2.28	+0.08
School will not be important to me in my life's work	1.84	1.74	+0.10	1.83	**2.13**	**-0.30**	1.97	1.91	+0.08
Coming to school is a waste of time	1.78	1.87	-0.08	1.90	**2.02**	-0.12	1.91	1.84	+0.07
What I have learning at school will help me earn a living	**4.48**	4.47	-0.01	4.40	4.22	-0.18	4.43	4.26	-0.17
Doing well in school is not important for my future	1.95	1.84	+0.11	1.90	**2.13**	-0.23	1.97	1.95	+0.02
I will use what I learned in school in many ways as an adult	4.37	4.36	-0.01	4.31	4.12	-0.19	**4.38**	4.23	-0.16
• *Elementary*	*2.81*	*2.72*	*-0.09*	*2.78*	*2.72*	*-0.06*	***2.83***	*2.66*	*-0.17*
• *Middle*	*2.83*	*2.78*	*-0.05*	*2.78*	***2.89***	*+0.11*	*2.79*	*2.83*	*+0.04*
• *High*	***3.17***	*2.83*	***-0.34***	*2.80*	*2.83*	*+0.03*	*2.94*	*2.77*	*-0.17*
Teacher encouragement	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
My teachers…									
Encourage me to study more	4.03	**4.09**	+0.06	3.91	3.86	-0.05	**4.09**	4.04	-0.05
Think advanced school work will be a waste of time for me	2.01	1.92	-0.09	2.04	**2.20**	+0.16	1.98	2.04	+0.06
Want me to learn as much as I can	**4.63**	4.54	-0.09	4.47	4.33	-0.14	4.55	4.53	-0.02

STUDENT MOTIVATION AND USAGE SURVEY ITEM	CONTROL			STANDARD			ENHANCED		
	PRE	POST	DIFF	PRE	POST	DIFF	PRE	POST	DIFF
My teachers… Would not take me seriously if I told them I was interested in going to college	1.98	1.83	-0.16	1.92	**2.07**	+0.15	2.03	1.88	-0.15
… Have made me feel I have the ability to go on in school	4.25	**4.32**	+0.07	4.23	4.12	-0.11	**4.32**	4.31	-0.01
… Think I'm the kind of person who could do well in school	4.27	4.25	-0.02	4.24	4.18	-0.06	**4.36**	4.29	-0.07
• *Elementary effort*	*3.55*	*3.53*	*-0.00*	*3.62*	*3.61*	*-0.01*	***3.68***	*3.60*	*-0.08*
• *Middle*	*3.51*	*3.47*	*-0.04*	*3.45*	*3.45*	--	*3.54*	***3.58***	*+0.04*
• *High*	***3.59***	*3.44*	*-0.14*	*3.32*	*3.34*	*+0.02*	*3.31*	*3.37*	*+0.06*
Amplification technology impact *	Rating Average Range of 1-5, Strongly Disagree to Strongly Agree								
My teacher uses the sound system in our classroom every day					3.66			**3.87**	
I can hear my teacher better in this classroom than in other classrooms that do not have this system					3.60			**3.70**	
I can hear my teacher's voice from anywhere in the room					4.02			**4.20**	
My teacher's instructions are clearer to me when he/she uses the system					3.70			**3.74**	
I like to use the microphone					3.25			**3.55**	
I am learning more					3.65			**3.81**	
It's easier for me to pay attention to my teacher					3.65			**3.85**	
My teacher does not talk as loudly when she uses the sound system					3.18			**3.43**	
It seems the other students are paying attention to the teacher and each other when we use the system					3.46			**3.73**	
I hope that my classroom next year has a sound system					3.69			**3.89**	
• *Elementary*					***4.48***			*4.24*	
• *Middle*					*3.45*			***3.79***	
• *High*					*3.01*			***3.23***	

*Students in the control group did not complete the amplification technology impact items during either survey administration period. Students in the experimental groups (standard and enhanced) did not complete the amplification technology impact items in the fall 2010 administration, only in the spring 2011 administration.

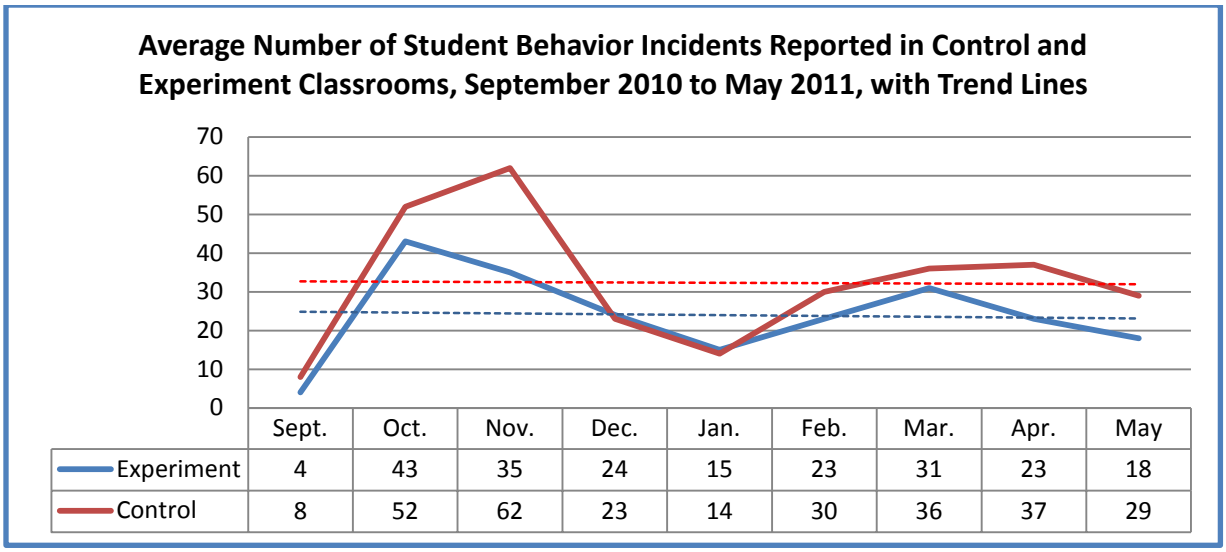
Behavior log

For each week that school was in session, participating teachers (both control and experimental) recorded the number of times there were behavioral incidents in their study

group classrooms. The logs were reviewed to determine the number of incidents that would necessitate a teacher to enforce school disciplinary procedures (such as isolation, sending a student to the office, giving a student detention, etc.) and exclude data related to minor or routine behavior issues (such as isolated talking out in class). The resulting numbers of student incidents were then calculated by week, month and study group, and analyzed to determine whether use of classroom amplification technologies has any relationship to student behavior.

In total, teachers reported 502 student behavior incidents in the study group classrooms, ranging from 0 to 64 incidents and averaging 13 incidents per teacher. Figure 1 illustrates the average number of student incidents reported by teachers in the control and total experimental groups during each month of the study. As seen in Figure 1, teachers in the experimental classrooms reported fewer incidents than teachers in the control classrooms. The trend lines indicate a general decrease in student behavior reports during the school year in both control and experimental classrooms.

Figure 1. Student behavior incidents reported per month



	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Experiment	4	43	35	24	15	23	31	23	18
Control	8	52	62	23	14	30	36	37	29

Table 9 summarizes student behavior incidents reported by study group and grade span. Note that the secondary grade span was aggregated because of the small numbers of middle and high school teachers and students. The elementary and secondary split shows comparable numbers of teachers and classrooms in each study group. Teachers in the experimental standard study group most often reported fewer issues with student behavior than teachers in the other study groups. Elementary and middle school teachers in both experimental groups (standard and enhanced) reported fewer incidents than in control classrooms. In the control group, elementary teachers had the highest number student behavioral incidents, more than twice the number noted for middle school teachers and nearly six times more than the high school teachers. The results were mixed with regards to high school student behaviors, with fewer incidents reported in control classrooms and a wide discrepancy noted in the two experimental groups.

Table 9. Student behavior incidents by grade span

GRADE SPAN	CONTROL GROUP			EXPERIMENTAL GROUP			EXPERIMENTAL SUBGROUPS					
							STANDARD			ENHANCED		
	INCIDENT REPORTS	NUMBER TEACHERS	*AVG.*	INCIDENT REPORTS	NUMBER TEACHERS	*AVG.*	INCIDENT REPORTS	NUMBER TEACHERS	*AVG.*	INCIDENT REPORTS	NUMBER TEACHERS	*AVG.*
Elementary	205	9	*23*	57	9	*6*	16	4	*4*	41	5	*8*
Secondary	72	10	*7*	161	11	*15*	28	6	*5*	140	5	*28*
• Middle	59	6	*10*	28	6	*6*	11	3	*4*	24	3	*8*
• High	13	4	*3*	133	5	*27*	17	3	*6*	116	2	*58*
Total	277	19	*15*	218	20	*11*	44	10	*4*	181	10	*18*

Data were also examined to determine student behavior patterns, if any, across the study groups based on the content taught in secondary classrooms. Incident rates for the content areas were calculated based on the total number of courses or sections taught within each subject area. The data analysis, as detailed in Table 10 did not show any discernible patterns.

Table 10. Student behavior incidents by content area

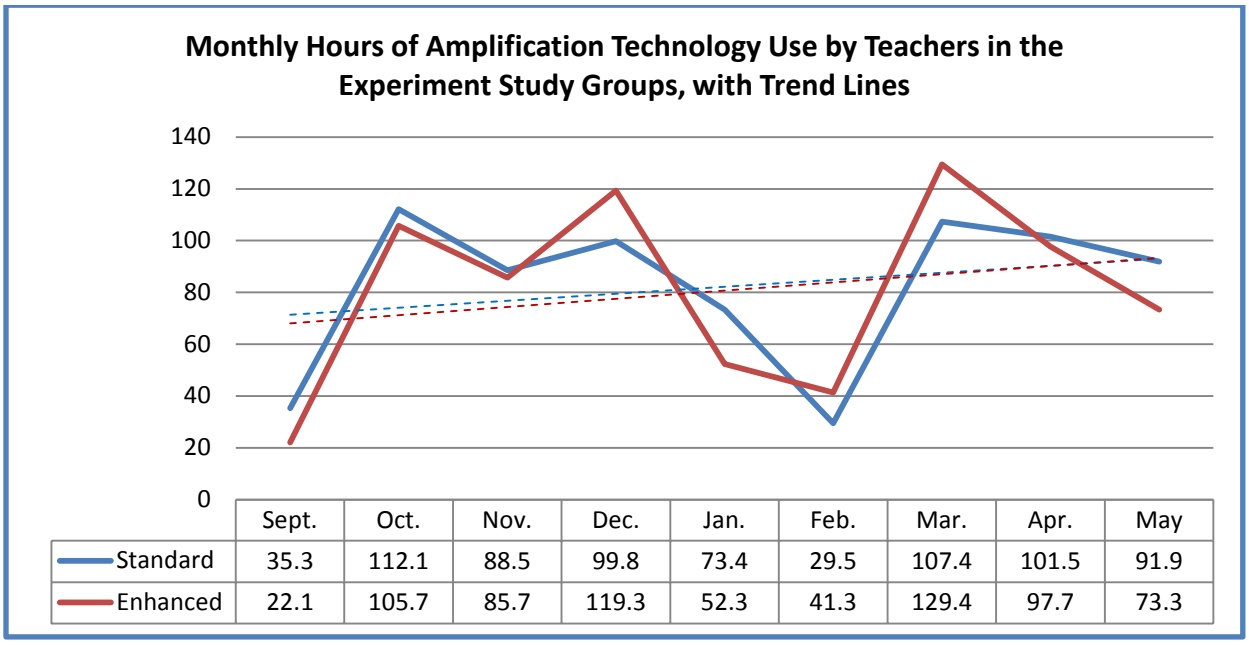
CONTENT AREA	CONTROL GROUP			EXPERIMENTAL GROUP			EXPERIMENTAL SUBGROUPS					
							STANDARD			ENHANCED		
	INCIDENT REPORTS	NUMBER COURSES	*AVG.*	INCIDENT REPORTS	NUMBER COURSES	*AVG.*	INCIDENT REPORTS	NUMBER COURSES	*AVG.*	INCIDENT REPORTS	NUMBER COURSES	*AVG.*
Reading/ language arts	60	23	*3*	18	18	*1*	18	12	*2*	0	6	*0*
Mathematics	2	3	*1*	82	11	*7*	6	3	*2*	76	8	*10*
Science	10	9	*1*	68	11	*6*	4	5	*1*	64	6	*11*

System usage log

For each week that school was in session, participating teachers in the experimental enhanced and experimental standard classrooms recorded the number of minutes they used their classroom amplification systems. The numbers of minutes were analyzed by week, month and amplification type, and analyzed for usage patterns. In total, teachers reported using classroom amplification systems 275,754 minutes throughout the year. The typical teacher logged 21 weeks of usage data over the course of 8 months (October through May), averaging over 11 hours of use per week.

Figure 2 illustrates teacher use for each month of the project by amplification type. The trend lines indicate that overall usage patterns were similar for the two experimental groups and that teacher usage increased during the school year. There was a rapid increase in use in October, another peak in December, and the highest level of usage was reached in March. The decreases likely reflect seasonal holidays, inclement weather in January and February, end-of-year testing, and varying school year-end dates.

Figure 2. Hours of classroom amplification use reported by month



	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May
Standard	35.3	112.1	88.5	99.8	73.4	29.5	107.4	101.5	91.9
Enhanced	22.1	105.7	85.7	119.3	52.3	41.3	129.4	97.7	73.3

Table 11 details amplification system usage by amplification study group and grade span. Again note that the secondary grade span includes both middle and high school grades because of the small numbers of middle and high school teachers and students. The elementary and secondary grade span split results in comparable numbers of teachers/classrooms in each experimental study group. These data indicate elementary teachers had the highest system usage rates, followed by middle school teachers and then high school teachers. On average, elementary teachers used their amplification systems over 18 hours per month, while middle school teachers totaled over seven hours and high school teachers, only three hours.

These data would seem to align with the teacher surveys, where elementary teachers rated the impact of using classroom amplification the highest, followed by middle school teachers and high school teachers. It should also be noted that that five of the 16 middle and high school teachers had half of their courses assigned to the control group and half assigned to an experimental group, reducing the total number of hours of possible amplification usage. It is possible that middle and high school teachers who had half of their courses assigned the control group and half to an experimental group would have potentially doubled the amount of system usage recorded had they been able to use the systems in all of their course sections. Several teachers from this group indicated in written comments on the teacher survey and in focus group responses that they were looking forward to being able to use the system in all of their course sections during the 2011-2012 school year.

Table 11. Hours of amplification system use by grade span

GRADE SPAN	EXPERIMENTAL GROUP			EXPERIMENTAL SUBGROUPS					
				STANDARD			ENHANCED		
	NUMBER TEACHERS	TOTAL MINUTES	*AVG. HOURS PER WEEK*	NUMBER TEACHERS	TOTAL MINUTES	*AVG. HOURS PER WEEK*	NUMBER TEACHERS	TOTAL MINUTES	*AVG. HOURS PER WEEK*
Elementary	9	199433	*18.5*	4	97888	*21.3*	5	4857	*16.2*
Secondary	11	76321	*5.5*	6	2709	*3.6*	5	911	*1.7*
• Middle		52996	*7.5*	3	45311	*12.6*	3	7685	*2.4*
• High		23325	*3.1*	3	9640	*2.5*	2	13685	*4.0*
Total	20	275754	*11.3*	10	15284	*13.0*	10	12292	*9.6*
Range	*0.9 to 33.4 hours per week*			*0.9 to 33.4 hours per week*			*1.2 to 24.5 hours per week*		

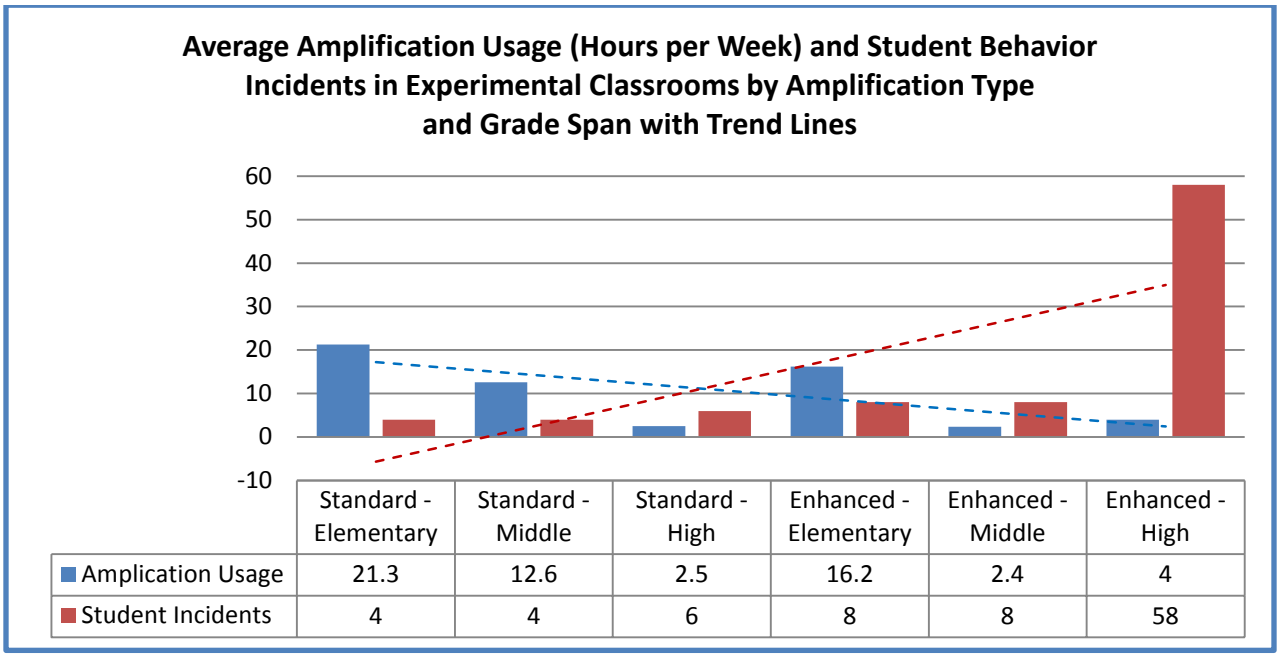
Teacher usage data were also examined to determine if any distinct patterns existed across the study groups based on the content taught in secondary classrooms. Data detailed in Table 12 suggest that there is no pattern for one amplification type over the other; however reading/language arts teachers generally reported usage rates twice that of mathematics teachers and nearly thrice that of science teachers when experimental standard and experimental enhanced system groups are combined. Since listening and being able to hear well enough to discriminate very minor differences in sound are critical in reading/language arts instruction and skill acquisition, the data substantiate teacher use of the systems in that content area.

Table 12. Hours of amplification systems use by content area

GRADE SPAN	EXPERIMENTAL GROUP			EXPERIMENTAL SUBGROUPS					
				STANDARD			ENHANCED		
	NUMBER TEACHERS	TOTAL MINUTES	*AVG. HOURS PER WEEK*	NUMBER TEACHERS	TOTAL MINUTES	*AVG. HOURS PER WEEK*	NUMBER TEACHERS	TOTAL MINUTES	*AVG. HOURS PER WEEK*
Reading/ language arts	5	51492	*8.5*	4	50292	*10.3*	1	1200	*1.2*
Mathematics	3	11475	*3.2*	1	3005	*2.3*	2	9065	*3.7*
Science	3	12759	*2.8*	1	1654	*1.8*	2	11105	*3.4*

Figure 3 indicates that issues with student behaviors decreased as usage of classroom amplification systems (both standard and enhanced) increased. Teacher responses to survey items and in the focus groups confirmed the hypothesis that content areas most directly tied to being able to hear and differentiate sounds are the areas most likely to benefit from the application of amplification technologies.

Figure 3. Relationship between usage and student behavior incidents



	Standard - Elementary	Standard - Middle	Standard - High	Enhanced - Elementary	Enhanced - Middle	Enhanced - High
Amplication Usage	21.3	12.6	2.5	16.2	2.4	4
Student Incidents	4	4	6	8	8	58

Classroom observations

Experimental classrooms (both standard and enhanced) were observed in fall 2010 and spring 2011 to determine what impact classroom amplification had on teaching and learning practices. Observations were conducted by trained personnel, eMINTS instructional specialists (eIS), using a standard checklist. All 20 experimental classrooms were observed in the fall and 15 classrooms in the spring. In total, eIS observed 17 classrooms with 343 students using standard amplification and 18 classrooms with 314 students using enhanced amplification systems. Reading/language arts was being taught in 22 of the classrooms (63%), followed by science in 8 (23%) rooms and mathematics in 5 (20%) of the observed classrooms. The predominant setting was elementary (15 classrooms), followed by middle school (12) and high school (8). In all classrooms the amplification systems were in working order; however, one teacher noted in the spring observation that the student microphone was not always working reliably. A call was made to the company providing the equipment and the microphone was replaced.

The observation checklist used was comprehensive, observing elements such as classroom setting/facility, student seating and grouping arrangements, class environment, use of 21st century tools, instructional resources, content focus and method of delivery, teacher behavior, student behavior and attitude, instructional and questioning strategies, classroom management, and development of higher order thinking skills. Data from the checklists were aggregated and analyzed for differences between fall and spring observations and between classes using standard and enhanced classroom amplification systems. Copies of the aggregated summaries for the fall and spring observations are provided in Appendix F.

Table 13 presents selected items from the checklist where differences were noted from fall to spring [the first three data columns] or between experimental standard or experimental enhanced classrooms [the three data columns to the right]. Checklist items with averages at or above 80% are indicated in bold print. Fall to spring differences of at least 12% are noted by directional arrows (up or down) and color (green or red font). Experimental standard and experimental enhanced differences are also coded by arrow and color. Bold print indicates any difference of 20% or higher.

Since all classrooms were staffed with trained eMINTS teachers, the typical classroom involved the teacher guiding instruction and helping students clarify their learning, and involved the students interacting with one another. Students were also major users of instructional resources and technologies – regardless of whether the classroom was observed in the fall or spring or was equipped with standard or enhanced amplification systems. On average, teachers were noted using classroom amplification for 30 minutes or longer while students were noted using the technology 18 minutes or longer.

- Use of amplification and other classroom technologies was slightly lower in the spring than in the fall.
- Teachers and students in the experimental enhanced group were noted using systems for slightly longer periods of time than that found in the experimental standard study group.
- Student seating in pairs or small groups was found more frequently in the spring and in experimental enhanced classrooms.
- Students were the main users of instructional materials in experimental standard classrooms, while teachers and students shared use of instructional materials in experimental enhanced classrooms.
- While focus on problem-solving decreased from fall to spring, use of real-world context increased from fall to spring; the highest use of real-world context was found in experimental standard classrooms.
- Spring increases were also noted for teachers' use of moving around and questioning students to monitor learning and the use of manipulatives or technology.
- Spring increases were also noted in students sharing their solutions/processes with other students, defending their solutions/processes, and communicating mathematics ideas. Students in experimental enhanced classrooms were more likely to share solutions and communicate mathematics concepts, while students in experimental standard classrooms were more frequently seen defending their solutions/processes.
- Teacher use of a number of effective instructional strategies and strategies to develop higher-order thinking increased from fall to spring. Use of these instructional strategies and a number of effective questioning strategies were noted more frequently in experimental enhanced classrooms.

Table 13. Classroom observation results

	FALL TO SPRING DIFFERENCES			CAP SYSTEM DIFFERENCES		
	FALL (N=20)	SPRING (N=15)	CHANGE	STANDARD (N=17)	ENHANCED (N=18)	DIFFERENCE
Classroom Setting / Facility						
CAP system in working order	20 / **100%**	15 / **100%**		17 / **100%**	18 / **100%**	
• Teacher use – avg. time *(minutes)*	**100%** – *36"*	**100%** – *30"*	↓ 6 min.	**100%** – *33"*	**100%** – *34"*	E>S 1 min.
• Students' use and average time	11 / 55% – *22"*	8 / 53% – *18"*	↓ 4 min.	8 / 47% – *19"*	11 / 61% – *21"*	E>S 2 min.
Student Seating						
Total - average configurations	34 – 1.7	30 = 2.0	↑	29 – 1.7	35 – 1.9	E>S
Rows / Pairs / Small Groups	9 / 10 / 7	6 / 12 / 8	↑ Pairs/ small groups	11 / 10 / 4	4 / 12 / 11	E>S Pairs/ small groups
Class Environment						
Core curriculum materials	19 / **95%**	14 / **93%**		15 / **88%**	18 /**100%**	E>S 12%
Content area displays	17 / **85%**	10 / 67%	↓ 18%	13 / 76%	14 / 78%	
Student work displayed	17 / **85%**	12 / **80%**		14 / **82%**	15 / **83%**	
Hands-on resources	13 / 65%	10 / 67%		11 / 65%	15 / **83%**	E E>S 18%
Mathematics-Science materials	6 / 30%	8 / 53%	↑ **23%**	4 / 24%	10 / 56%	**E>S 32%**
21st Century tools						
Total - average equipment in room	55 – 2.8	54 – 3.6	↑	53 – 3.1	56 – 3.1	E>S
Interactive whiteboard use-time	18 / **90%** – *29"*	13 / **87%** – *25"*	↓ 4 min.	13 / **87%** – *28"*	18/**100%** – *27"*	S>E 1 min.
Teacher computer use-time	14 / 70% – *20"*	10 / 67% – *15"*	↓ 5 min.	12 / 75% – *20"*	12 / 67% – *17"*	S>E 3 min.
Student computer use-time	10 / 50% – *31"*	10 / 67% – *25"*	↓ 6 min.	9 / 60% – *31"*	11 / 61% – *26"*	S>E 5 min.
• Total – average per room	281 / **1.3**	187 / **1.5**		260 – **1.3**	208 – **1.5**	
• Elementary/Middle/High ratios	1.6 / 1.3 / 1.1	1.6 / 1.4 / 0.5		1.6 / 1.5 / 0.8	1.7 / 1.2 / 0.7	
Instructional Resources						
Total - average resources used	54 – 2.7	52 – 2.9	↑	43 – 2.5	52 – 2.9	E>S
Other print (not text)	15 / 75%	9 / 60%	↓ 15%	9 / 60%	15 / **83%**	**E>S 23%**
Internet	11 / 55%	10 / 67%	↑ 12%	10 / 67%	11 / 78%	
Software	5 / 25%	6 / 40%	↑ 15%	5 / 33%	6 / 33%	
Content – users of instructional materials and method of delivering the content						
Both teacher and student users	12 / 60%	9 / 60%		8 / 53%	13 / 72%	**E>S 29%**
Mainly student users	7 / 35%	6 / 40%		9 / 60%	4 / 22%	**S>E 38%**
Problem-based learning	14 / 70%	9 / 60%		12 /75%	11 / 61%	S>E 14%
Focus on problem solving	12 / 60%	3 / 20%	**↓ 40%**	7 / 47%	8 / 46%	
Real-world context	10 / 50%	11 / 73%	**↑ 23%**	11 / 73%	10 / 56%	S>E 17%
Lecture	5 / 25%	7 / 47%	**↓ 22%**	5 / 33%	7 / 39%	
Grouping Arrangements						
Total – average configurations	46 – 2.3	32 – 2.1		38 – 2.2	40 – 2.2	
Whole group	15 / 75%	9 / 60%	↓ 15%	12 / 71%	12 / 67%	
Small groups: same task	11 / 55%	9 / 60%		9 / 53%	11 / 61%	
Individuals: same task	12 / 60%	12 / **80%**	**↑ 20%**	13 / 76%	11 / 61%	S>E 15%
Appropriate for content / activity	18 / **90%**	13 / **87%**		15 / **88%**	16 / **89%**	
Teacher and Student Behavior						
Teacher total – average behaviors	68 – 3.4	63 – 4.2		62 – 3.6	69 – 3.8	
• Monitor, question	14 / 70%	15 /**100%**	**↑ 30%**	15 / **88%**	16 / **89%**	
• Encourage multiple solutions	11 / 55%	9 / 60%		10 / 59%	10 / 56%	
• Use manipulatives / technology	10 / 50%	11 / 73%	**↑ 23%**	10 / 59%	11 / 61%	
• Lead discussion / journaling	14 / 70%	11 / 73%		11 / 65%	14 / 78%	E>S 13%

	FALL TO SPRING DIFFERENCES			CAP SYSTEM DIFFERENCES		
	FALL (N=20)	SPRING (N=15)	CHANGE	STANDARD (N=17)	ENHANCED (N=18)	DIFFERENCE
• Promote student inquiry	8 / 40%	8 / 53%	↑ 13%	8 / 47%	8 / 46%	
Student total – average behaviors	40 – 2.0	31 – 2.1		37 – 2.2	34 – 1.9	
• Interact w/others	18 / **90%**	14 / **87%**		15 / **88%**	16 / **89%**	
• Work in groups / teams	9 / 45%	5 / 33%	↓ 12%	7 / 41%	7 / 39%	
21st Century Information and Communication Skills						
Total – average skills	37 – 1.9	33 – 2.2		31 – 1.8	39 – 2.2	
Help clarify one another's learning	19 / **95%**	13 / **87%**		15 / **88%**	17 / **94%**	
Share solutions / processes	8 / 40%	12 / **80%**	**↑ 40%**	8 / 47%	12 / 67%	**E>S 20%**
Communicate mathematics ideas	7 / 35%	2 / 13%	**↓ 22%**	3 / 18%	6 / 33%	E>S 15%
Defend solutions/ processes	3 / 75%	6 / 40%	**↓ 35%**	5 / 29%	4 / 22%	
Instructional Strategies						
Total – average strategies	55 – 2.8	52 – 3.5		46 – 2.7	61 – 3.4	
Connecting prior knowledge	17 / **85%**	14 / **93%**		14 / **82%**	17 / **94%**	E>S 12%
Differentiating instruction	7 / 35%	9 / 60%	**↑ 25%**	7 / 41%	9 / 50%	
Teacher modeling	8 / 40%	10 / 67%	**↑ 22%**	9 / 53%	12 / 67%	E>S 14%
Collaborative grouping	12 / 60%	8 / 53%		8 / 47%	12 / 67%	**E>S 30%**
Opportunity to justify solutions	7 / 35%	8 / 53%	↑ 18%	5 / 29%	10 / 56%	**E>S 27%**
Varied assessments	4 / 20%	5 / 33%	↑ 13%	5 / 29%	4 / 22%	
Questioning Strategies						
Use of wait time	19 / **95%**	13 / **87%**		15 / **88%**	17 / **94%**	
Higher-order questions	11 / 55%	7 / 47%		7 / 41%	11 / 61%	**E>S 20%**
Ensuring all students can respond	11 / 55%	7 / 47%		10 / 59%	8 / 46%	S>E 13%
Probing follow-up questions	15 / 75%	9 / 60%	↓ 15%	11 / 65%	13 / 72%	
Students can ask other students	19 / **95%**	12 / **80%**	↓ 15%	13 / 76%	18 /**100%**	**E>S 24%**
Teacher praise: specific	11 / 55%	11 / 73%	↑ 18%	11 / 65%	11 / 61%	
Teacher praise: general	15 / 75%	10 / 67%		12 / 71%	13 / 72%	
Questions to check understanding	18 / **80%**	13 / **87%**		15 / **88%**	16 / **89%**	
Student Involvement						
Interested / engaged / on task	18 / **90%**	14 / **93%**		16 **/ 94%**	16 / **89%**	
Taking initiative	12 / 60%	10 / 67%		11 / 75%	11 / 61%	S>E 14%
Development of Higher Order Thinking Skills						
Total – average skills	87 – 4.4	85 – 5.7		74 – 4.4	98 – 5.4	
Making observations	10 / 50%	11 / 73%	**↑ 23%**	9 / 53%	12 / 67%	
Reciting / recalling facts	14 / 70%	10 / 67%		13 / 76%	11 / 61%	S>E 15%
Classifying	1 / 5%	3 / 20%	↑ 15%	1 / 6%	3 / 17%	
Estimating	2 / 10%	2 / 13%		0 / 0%	4 / 22%	**E>S 22%**
Collecting / recording data	3 / 15%	4 / 27%	↑ 12%	4 / 24%	3 / 17%	
Comparing / contrasting	7 / 35%	7 / 47%	↑ 12%	6 / 35%	8 / 46%	
Drawing conclusions	12 / 60%	12 / **80%**	**↑ 20%**	11 / 65%	13 / 72%	
Interpreting / analyzing data	2 / 10%	5 / 33%	**↑ 23%**	3 / 18%	4 / 22%	
Predicting	4 / 20%	8 / 53%	**↑ 33%**	5 / 29%	7 / 39%	
Creating / formulating	5 / 25%	2 / 13%		2 / 12%	5 / 28%	E ↑ 16%
Justifying solutions / strategies	6 / 30%	7 / 47%	↑ 17%	4 / 24%	9 / 50%	**E ↑ 26%**
Learner Attitudes/ Attributes						
Total – average student attributes	112 – 5.6	92 – 6.3		95 – 5.6	109 – 6.1	
Dependent on others	12 / 60%	4 / 27%	**↓ 33%**	6 / 35%	10 / 56%	**E ↑ 21%**
Cooperation	19 / **95%**	11 / 73%	**↓ 22%**	14 / **82%**	16 / **89%**	

	FALL TO SPRING DIFFERENCES			CAP SYSTEM DIFFERENCES		
	FALL (N=20)	SPRING (N=15)	CHANGE	STANDARD (N=17)	ENHANCED (N=18)	DIFFERENCE
Responsibility	17 / **85%**	13 / **87%**		15 / **88%**	15 **/ 83%**	
Confidence	13 / 65%	12 / **80%**	↑ 15%	13 / 76%	12 / 67%	
Enthusiasm	14 / 70%	10 / 67%		10 / 59%	14 / 78%	E ↑ 19%
Objectivity	3 / 15%	6 / 40%	**↑ 25%**	5 / 29%	4 / 22%	
Critical thinking	4 / 20%	6 / 40%	**↑ 20%**	4 / 24%	6 / 33%	
Self-directed	8 / 40%	10 / 67%	**↑ 27%**	9 / 53%	9 / 50%	
Curiosity	9 / 45%	8 / 53%		7 / 41%	10 / 56%	E ↑ 15%

Observers on occasion provided additional comments. While some comments simply summarized what was observed, the following comments provide additional insight regarding teacher use of amplification systems and how usage benefited students.

FALL OBSERVATION COMMENTS - STANDARD AMPLIFICATION SYSTEM CLASSROOMS:

This class has a high percentage of ELL students, with an ELL teacher in the classroom who commented about what a difference the amplification has made in student concentration and helping the ELL students.

Teacher commented "kids seem to volunteer to answer and speak more often when the student microphone is utilized. Students seem to listen better in the classroom with the sound system than they do in other places in the school (such as the computer lab)." Teacher wishes there were 2 microphones.

Teacher commented on wearing the neck microphone home one day.

Teacher commented "students seem to listen better this year."

FALL OBSERVATION COMMENTS - ENHANCED AMPLIFICATION SYSTEM CLASSROOMS:

Teacher claims that hearing impaired student is doing well with the sound system and that "if we aren't using the student microphones, I have less volunteers during sharing and reporting times", "the student microphone encourages kids to read aloud…"

Observer noted being distracted because of sound, but the teacher and students seem to have adjusted – wondered whether room needed two wireless collection devices in the ceiling.

Teacher reported "my voice feels much better this year."

SPRING OBSERVATION COMMENTS – STANDARD AMPLIFICATION SYSTEM CLASSROOMS:

Students were to use the microphone, but it didn't work. Teacher commented "sometimes the student microphone works; sometimes it doesn't. Today it didn't work."

SPRING OBSERVATION COMMENTS - ENHANCED AMPLIFICATION SYSTEM CLASSROOMS:

Teacher used her microphone to lead discussion and to assist students and used background "jazz" music via ceiling speakers while students recorded in journals. Students used microphone to share responses and ideas, passing the microphone from one student to another, without prompting, as if routine.

Teacher commented "I don't think I can go back to teaching without the microphone. I accidentally wore it home one day and left it at my house. I started the morning and had to have my husband go by the house and bring me my microphone."

Observer noted static with both the teacher and student microphones when they are not directly facing receiver… but teacher and students seem to be accustomed to this and students have learned to hold the microphone at the very bottom in order for the signal to work.

Teacher repeated students' answers using the system… turned the volume up when it was necessary to get whole class attention.

Teacher focus groups

Teachers in experimental classrooms (standard and enhanced) were invited to participate in focus groups during the final weeks of the study. A total of four groups were convened in late April and May 2011 via web-conferencing: three groups of Missouri teachers and one group of Alabama teachers. All 20 experimental group teachers participated. Trained personnel facilitated the focus groups, following a set sequence of questions addressing installation, professional development, and use of classroom amplification systems. The sessions were recorded (via the web-conferencing tool), transcripted, and analyzed using the NVivo9 software. Below is a summary of the emerging themes presented by teachers. See Appendix G for a more detailed account of teacher responses.

When asked about the installation of the technologies, all 20 teachers reported that the initial installations went without problems. Nearly half of the teachers reported that that the equipment installation was complete before they started the school year. Follow-up questioning revealed teachers had some initial challenges in becoming familiar with and accustomed to using the systems, working around locations in the room where teacher and student microphones might experience feedback (high pitched sound) or interference (dead spots), most of which were easily overcome or minimized. Follow-up questioning also revealed limitations with having only one student microphone: four teachers spoke of the time spent

passing the microphone from one student to the next (especially in large classrooms in terms of size and/or student enrollment); two elementary teachers commented how students began to compete for microphone access/use.

In response to the question concerning the effectiveness of the training or professional development teachers received in learning to use the technologies, over half of the teacher felt they received enough information on basic use of the equipment. Just under half of the teachers spoke of receiving basic information from the installers and/or installation manuals; half also spoke of receiving additional information and/or technical assistance during visits from their eMINTS instructional specialists (eIS). But while teachers felt they had enough information on how to turn on and use the equipment, over a third of the teachers expressed interest or need in learning more about how to integrate the technologies in their instructional activities.

The largest amount of time was spent discussing students' reactions to using the amplification technologies. There was a fairly even split, with seven teachers saying their students "loved" using the systems and seven teachers saying their students were reluctant to use the student microphones. While no teacher commented on students having a negative reaction to teacher use of the technology, 17 teachers spoke of certain groups of students who had issues with using the student microphones – most generally, secondary students, "shyer" students, and students with lower reading ability that were reluctant to use the microphone during oral reading sessions.

Teachers also spent a good amount of time discussing students most likely to benefit from the use of classroom amplification technologies: hearing-impaired students, students with attention or hyperactivity issues, ELL students, and other special needs students. Teachers commented on a number of features they liked best, with almost half discussing how the systems helped distribute their voice evenly, reaching students in all corners of the room and helping keep them engaged and on-task. Teachers also discussed the ease in using the necklace to wear the teacher microphone and how using the systems helped reduce wear and tear on their voices. The teachers mentioned a variety of activities where students used the microphone for oral readings, presentations, whole class questions and answers; some teachers spoke of using the technologies for classroom management and to help amplify audio through their interactive whiteboard (classroom videos and online video streaming).

Following is a sampling of teacher comments that best illustrate the recurring themes.

TEACHER FOCUS GROUP COMMENTS - STANDARD AMPLIFICATION SYSTEM CLASSROOMS:

[Elementary Teachers]

I have to say I loved my microphone. It was a great classroom management tool: all you had to do was speak up a little bit and [students] would get quiet. So I would have to say that would be the best feature for me.

I do definitely think it's been a very positive experience, that it's been very beneficial. I'm not going to lie, I was a bit skeptical at the beginning of the year because I thought, 'oh my goodness, I'm going to have to wear this microphone, what's it going to look like, how's it going to be, how are the kids going to respond?' But I was convinced after the first week of school. I don't know if I could live without it now! I've gotten so used to it. I love the amplification, love the fact that all the kids can hear at the same time, hearing the same thing, love that the kids love to use the microphone when it's working. So I have to say I'm so excited that we were chosen to get it. I know a lot of the other grade levels are jealous that they don't have it.

I think it really helped keep the attention and focus on some of my special education kids [class within a class] who were normally off task or wouldn't focus, because a couple of them were the ones who always wanted to be with or use the microphone.

The teacher microphone was very comfortable. And I thought it was a great classroom management tool, as well. The kids reacted very positively to it.

I have several students who [have attention deficit disorder], and I just noticed that their active participation improved; it was through the roof with paying attention, on task, participating.

I think my ADD and ADHD students they benefitted the most from this [experience]. I think all students did, but if I had to pick one group that benefited the most, I would say this group.

[Middle School Teachers]

I can say I'm really excited about being able to use the system all day long next year instead of just half the day. [Teacher was assigned to both control and experimental groups.]

I think my special education boys probably benefitted a lot... I had one in particular who told the school psychologist that he really liked the system because he could actually hear what was going on in the classroom better.

Students would immediately perk up and start to listen when they heard [my voice] coming from every direction when I was speaking. This was helpful when I had my regular class and my ELL [English Language Learner] class.

[High School Teachers]

The speakers were very excellent quality. When we would be playing SMART Board games, it was very clear and easy for kids to pay attention [and] not to tune out because of a low-end speaker system.

I was a little skeptical about using the system because my room was very small, thinking 'well, why do I need a microphone in a small room, they can hear me already.' But when I started to get sick, that's when I really appreciated it. Even in a small room, if you have to raise your voice that really strains, and the microphone was great for that. So I think even in small rooms you could make a case that it's still more useful than not having it.

I was a little apprehensive at the beginning of the year, but having the microphone has been wonderful and I'm very glad that I was chosen to be a part of this study. I enjoy using [the system] and being able just to talk in my normal voice and have everyone hear me just as well as if I was talking as loudly as I could.

I think all my students benefitted from the technology in the classroom. It immediately gets their attention, my voice is everywhere, and everybody can clearly hear everything that's being explained and talked about. Some of the features I liked best were having the mute button and being able to go from a classroom conversation to a personal conversation was very nice.

TEACHER FOCUS GROUP COMMENTS - ENHANCED AMPLIFICATION SYSTEM CLASSROOMS:

[Elementary Teachers]

I really like the fact that we could wear the teacher microphone around our neck and was very comfortable. A lot of times we forgot they were there… At the beginning of the year, [I received] some weird looks and questions about what it was, and I still get questions from teachers and parents and visitors of the school; but it's been a very positive experience and I'm so glad that we got chosen to take part in this study.

Having the microphone hooked in to our SMART Board was awesome... any videos we watched were fed through the speakers, and it was great.

We have some very jealous teachers in our building who definitely would love to have one of these systems and have even asked our administrators if it would be possible to get one.

I think it was great this year. I had 25 students and they were a very chatty class, and the microphone has helped so much. I don't think if I hadn't had it I would have lasted!

[Middle School Teachers]

I have a student who is hearing impaired [and the school] actually changed his schedule so he could be in my experimental class. I think he really benefitted from the program. He tends to show through his behavior when he's not hearing directions or hearing certain things that he should, and I noticed a difference when I started in my classroom… It was a positive improvement.

In my classroom, the students who benefitted the most might have been the people with more soft-spoken voices who'd been reluctant to read-aloud before… it was just easier to hear them and they were less reluctant to read to the class, which was nice.

[High School Teachers]

My room is a very large room. It was very, very nice to have the microphone because I could be anywhere in the room and the students could hear me at any time… I think overall the reaction to these microphones was very positive and I would honestly like to see microphones in a lot more classrooms. I think that a lot of teachers would benefit from them…

I have one class that had some difficulties staying focused. A lot of guys in that class like to joke around and there would be mornings where we would use the microphone to read problems aloud, and it actually seemed to help the mood. They were more alert, more involved than they might have been…

As a mathematics teacher, always turning my back to the students to work out a problem; it was pretty obvious even from the beginning that they could hear me just as quickly. It helped quite a bit that they never lost what I was saying.

Thank you. I've not been a part of a study like this in my nine years of teaching, and I'm actually very interested to see what you all find out about this kind of thing. I think it will benefit all the classrooms.

Student academic performance assessment

Students in participating classrooms took Scantron Corporation Performance Series® reading and mathematics assessments in fall 2010 and spring 2011. Students in elementary classrooms completed both the reading assessment and the mathematics assessment. Students in middle and high school grades completed the assessment most appropriate for the class in which they were enrolled. Students enrolled in a participating reading/language arts course took the reading/language arts assessment. If they also were in a participating mathematics course, they also took the mathematics assessment. Results from the assessments were analyzed using a pre- and post-test methodology. Results were organized by subject, student group, and grade level (where appropriate), using analyses available through the Scantron Corporation online administration service.

Table 14 provides an overall summary of the reading and mathematics assessment results. The table is arranged by assessment area and study group; results are detailed based on student counts (the number of students who completed a test within a given subject area), fall and spring scale score means (the arithmetic mean of the overall scaled score for that group of interest), and standard error for each mean scaled score (calculated by taking the standard deviation of the group and dividing it by the square root of the student count in that group). For

all assessments and subgroups, the spring scale score mean was higher than the fall scale score mean, indicating performance gains. Note that a gain is considered significant if it is greater than the standard error of the mean scale score difference in absolute value.

Table 14. Reading/language arts and mathematics performance gains (fall 2010 to spring 2011) by study group

		Fall 2010		Spring 2011		Gain	
STUDY GROUP	STUDENT COUNT	MEAN SCORE	STANDARD ERROR	MEAN SCORE	STANDARD ERROR	MEAN SCORE DIFFERENCE	STANDARD ERROR
READING SCALE SCORES							
Control Reading	355	2709	16	2769	15	+60	9
Experimental Reading							
• Standard Amplification	247	2748	19	2796	18	+48	12
• Enhanced Amplification	110	2638	25	2735	25	+97	16
Control Mathematics	130	2653	26	2723	23	+70	15
Experimental Mathematics							
• Standard Amplification	49	2515	38	2670	36	+155	26
• Enhanced Amplification	81	2588	30	2691	30	+103	18
MATHEMATICS SCALE SCORES							
Control Mathematics	166	2490	19	2593	19	+103	9
Experimental Mathematics							
• Standard Amplification	92	2528	27	2601	24	+73	18
• Enhanced Amplification	103	2509	26	2588	26	+79	13
Control Reading	147	2397	17	2511	18	+114	9
Experimental Reading							
• Standard Amplification	82	2452	28	2580	25	+128	13
• Enhanced Amplification	96	2414	19	2499	20	+85	14

Figure 4 depicts the fall to spring gains on the Reading Performance Series assessment, comparing the results of students in the reading/language arts control group and the two reading/language arts experimental groups (standard and enhanced). Students in the experimental standard group outperformed students in the control group and the experimental enhanced group in the fall. All three groups showed a gain in the scale score means from fall 2010 to spring 2011, with the largest gain found in the experimental enhanced group and the smallest gain found in the experimental standard group. Spring scores indicate a closing of the gap between the highest and lowest scale score means.

Figure 4. Reading/language arts performance gains by study group

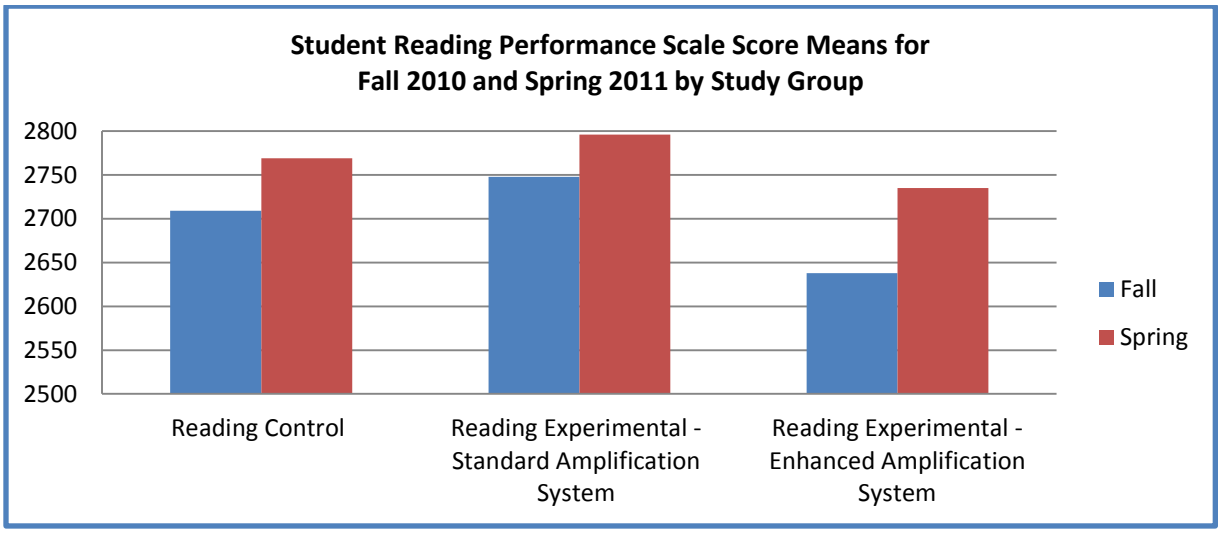
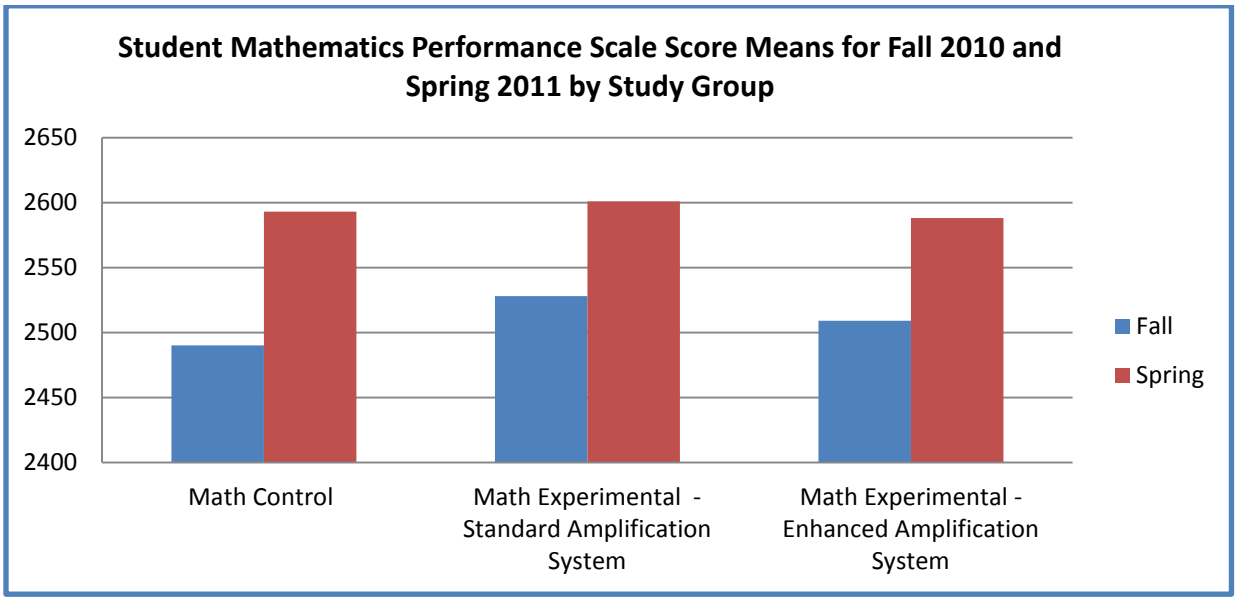


Figure 5 depicts the fall to spring gains on the Mathematics Performance Series assessment, comparing the results of students in the mathematics control group and the two mathematics experimental groups. As seen here, students in the experimental standard group outperformed students in the control group and the experimental enhanced group in the fall. All three groups showed a gain in the scale score means from fall 2010 to spring 2011, with the largest gain found in the control group and the smallest gain found in the experimental standard group. Spring scores indicate a closing of the gap between the highest and lowest scale score mean.

Figure 5. Mathematics performance gains by study group



Tables 15 and 16 provide summaries of the reading/language arts and the mathematics Performance Series scores by grade level or course level where appropriate. These tables show the uneven student counts across subjects, study groups, and grade levels that may account for the lack of differences among groups. Note that only those cells with an N greater than 20 are included. The tables also detail the Item Pool (the collection of Performance Series items aligned to state specific standards and grade levels) and Standard Item Pool Scores (SIP). SIP is based on the scaled score and represents the percentage of test questions that students would be expected to answer correctly if they were to see the entire item pool for that grade and topic area. Scantron indicates that SIP may be used as one part of a comprehensive review process and should not be examined as a single summative score. As seen in Table 15, only grades 4 and 8 had sufficient student counts across all reading/language study groups. Table 16 indicates fewer student counts across the mathematics study groups.

Table15. Summary reading/language arts scores by grade or course level

GROUP	GRADE	ITEM POOL GRADE OR COURSE	STUDENT COUNT	MEAN SCALE SCORE	STANDARD ERROR OF MEAN SCORE	Overall SIP (%)	Vocabulary SIP (%)	Fiction SIP (%)	Nonfiction SIP (%)	Long Passage SIP (%)
Reading/ Language arts Control Group	Overall		431	2761						
	4	4	173	2643	22	79	85	80	72	77
	6	6	30	2759	54	72	74	73	65	74
	7	7	78	2805	26	65	64	68	58	67
	8	8	132	2851	23	61	57	65	58	63
Reading/ Language arts Experimental Group	Overall		355	2757						
	4	4	157	2657	23	80	86	81	74	78
	7	7	55	2759	33	60	60	64	53	63
	8	8	115	2822	27	58	54	62	55	60
	9	9	28	3048	41	75	64	77	70	82
• Standard Amplification	Overall		303	2769						
	4	4	84	2620	31	78	84	78	70	76
	7	7	82	2752	27	59	59	63	52	62
	8	8	101	2820	31	58	54	62	55	60
	9	9	33	3025	36	73	62	75	67	80
• Enhanced Amplification	Overall		160	2681						
	4	4	107	2628	30	78	84	79	71	76
	8	8	53	2788	28	54	51	58	51	56

Table 16. Summary mathematics scores by grade or course level

GROUP	GRADE	ITEM POOL GRADE OR COURSE	STUDENT COUNT	MEAN SCALE SCORE	STANDARD ERROR OF MEAN SCORE	Overall SIP (%)	Number & Operations SIP (%)	Algebra SIP (%)	Geometry SIP (%)	Measurement SIP (%)	Data Analysis & Probability SIP (%)
Mathematics Control Group	Overall		213	2596							
	4	4	112	2485	17	68	73	71	60	65	66
	7	7	72	2682	28	48	49	40	56	45	48
Mathematics Experimental Group	Overall		298	2607							
	4	4	122	2497	15	69	74	72	61	66	67
	7	7	67	2704	24	50	52	43	58	48	50
	8	8	32	2709	35	45	50	35	41		41
	9	9-12	56	2713	37	45	54	34	33	32	36
• Standard Amplification	Overall		110	2583							
	4	4	65	2491	19	69	73	72	61	66	67
	9	9-12	42	2730	39	47	56	36	34	33	38
• Enhanced Amplification	Overall		178	2540							
	4	4	87	2427	23	63	68	66	55	61	61
	6	6	27	2402	28	24	24	17	35	25	22
	7	7	29	2720	24	52	53	44	59	49	52

Section IV: Findings

This study provides evidence that teachers and students at all grade levels found significant value in the use of classroom amplification technologies. Teachers and students reported that the technologies increased their abilities to understand critical spoken communications in the classroom. Since the students involved in the study were primarily from high needs districts, the positive impacts reported may be important elements in strategies for closing the achievement gap for students at risk for school failure due to poverty.

Each of the study questions outlined in the methods section of this report was examined in light of the data collected and analyzed.

Student Academic Performance

Question #1 (Student Academic Performance): What instructional impact does the consistent use of classroom amplification technologies or enhanced classroom amplification technologies have on the academic performance of students in 21st century (technology-rich) eMINTS classrooms at the elementary, middle, and high school level student populations examined?

Performance on reading/language arts assessments showed that students across all grade levels in the experimental standard group outperformed students in the control group and the experimental enhanced group in the fall. However, all three groups showed a gain in the scale score means from fall 2010 to spring 2011. The largest gain was found in the experimental enhanced group and a smaller gain was found in the experimental standard group. Spring scores indicate a closing of the gap between the highest and lowest scale score means.

Teachers in reading/language arts classrooms reported higher levels of actual system usage (both standard and enhanced) than teachers in other content areas. Since listening and being able to hear well enough to discriminate very minor differences in sound are critical in reading/language arts instruction and skill acquisition, these findings support the use of classroom amplification technologies in all classrooms but especially those in which students may need additional support to improve their reading and language arts performance.

Anecdotal reports, focus groups, and observations completed during the study also found that students with special learning needs and those that are English Language Learners (ELL) benefit from the additional support that classroom amplification technologies provide. While the numbers of students with special needs and ELL students were not large enough to permit disaggregation of assessment results, trends noted for those students suggest that classroom amplification technologies can be key elements in strategies used to improve performance and close the achievement gap such students often experience in reading/language arts. As one teacher noted: “I have several students who [have attention deficit disorder], and I just noticed that their active participation improved; it was through the roof with paying attention, on task, participating…I think my ADD and ADHD students they benefitted the most from this

[experience]. I think all students did, but if I had to pick one group that benefited the most, I would say this group."

Overall, student performance in reading/language arts showed the strongest gains for experimental groups (both standard and enhanced) at grade 4 followed by middle school grades and then high school. These findings suggest that classroom amplification technologies may be most effective when used at earlier grade levels as students are developing their reading/language arts skills and hearing or listening is a more important feature in instruction.

Student performance in mathematics showed increases from fall to spring in all three groups, experimental standard, experimental enhanced, and control; however, there was not a significant difference when experimental groups were compared with one another or with the control group.

Student Behavior/Motivation

Question #2 (Student Behavior/Motivation): What behavioral and/or motivational impacts does the consistent use of classroom amplification technologies or enhanced classroom amplification technologies have on the behavior and motivation of students who are taught in 21st century (technology-rich) eMINTS classrooms with classroom amplification technologies or enhanced classroom amplification technologies when compared to one another and to students of similar demographic backgrounds who are taught in classrooms not equipped with classroom amplification technologies at the elementary, middle, and high school level populations examined?

Teachers across all grade levels in both experimental groups (standard and enhanced) indicated amplification technologies helped them to engage students and improve student attitudes toward school. Elementary teachers had the highest rating averages, followed by middle school teachers, then high school teachers. Overall, teachers with standard systems had slightly higher rating averages than teachers with enhanced systems. The comment of one teacher summed up the experiences reported by many: "Active participation has been near perfection since using the amplification system and negative behavior and inattentive behavior has dissolved."

Teachers in experimental classrooms (both standard and enhanced) reported fewer behavioral incidents than teachers in control classrooms with the number of incidents decreasing over the course of the year as their usage of the amplification systems increased over time. These findings suggest that teachers who use classroom amplification technologies can expect to see higher levels of student engagement and participation in classroom activities with a corresponding decrease in behavioral incidents requiring intervention.

On survey items related to motivation, effort, self-concept, teacher encouragement, enjoyment of school, and perceptions as to the value of school, students in experimental groups (both standard and enhanced) showed a higher number of positive gains from fall to spring in their responses than students in control classrooms.

Overall, on surveys about the impact of classroom amplification technologies on their motivation and learning, students in experimental enhanced had higher rating averages than those in experimental standard classrooms. The item, "I can hear my teacher's voice from anywhere in the room," received the most favorable responses from students across all grade levels in both experimental groups. The item rating averaged 4.2 points on a scale where "5" is the highest rating possible. The ten survey items related specifically to the impact of amplification technologies were:

- My teacher uses the sound system in our classroom every day
- I can hear my teacher better in this classroom than in other classrooms that do not have this system
- I can hear my teacher's voice from anywhere in the room
- My teacher's instructions are clearer to me when he/she uses the system
- I like to use the microphone
- I am learning more
- It's easier for me to pay attention to my teacher
- My teacher does not talk as loudly when she uses the sound system
- It seems the other students are paying attention to the teacher and each other when we use the system
- I hope that my classroom next year has a sound system

The item "I hope that my classroom next year has a sound system," received the highest rating for any survey item by elementary students in both experimental groups. These findings suggest that students themselves also perceived differences in their motivation and interest in school when they were placed in classrooms with amplification technologies.

Teacher Instructional Practice Change

Question #3 (Teacher Instructional Change): What differences are noted in teachers' instructional patterns in 21st century (technology-rich) eMINTS classrooms equipped with classroom amplification technologies or enhanced classroom amplification technologies at the elementary, middle, and high school levels as observed by trained observers using validated classroom observation instruments when compared with one another and to teachers' instructional patterns in classrooms not equipped with classroom amplification technologies in similar demographic settings?

Classroom observations and teacher self-report through surveys showed an increase in the use of other classroom technologies, particularly by students, and an increase in the use of instructional strategies that are linked to 21st century skill development (collaboration, problem-solving, and application to real-world contexts) in classrooms equipped with classroom amplification technologies. Teachers and students in the experimental classrooms (both standard and enhanced) reported using their technologies more frequently than teachers and students in the control classrooms. As one teacher noted: "The amplification technology has significantly improved my ability to use the SmartBoard (sic) and computers. When I explain

concepts at the board, every student can hear me, even when I am turned sideways to write. I can step away from the board to explain what is being presented, allowing more students to use the board."

With many school districts investing in classroom technology, the addition of amplification technologies may significantly leverage such investments allowing teachers and students to use technology resources more efficiently, more frequently, and with greater ease for learning.

With an increasing emphasis on developing students' abilities to apply what they are learning to real-world situations, classroom amplification technologies can also give teachers the confidence to more easily manage instructional strategies that permit students to work in small groups, collaborate on projects, and share solutions.

Next Steps

A number of next steps follow logically from this study. Since one of the limitations of the study was the number of students included, particularly at the high school level, a next step would be to conduct a similar study with larger numbers of high school students. If technology-rich "eMINTS" classrooms are not available, perhaps other versions of technology-rich classrooms such as those employing one-to-one laptop or other computing devices could be used. This would be an important means of verifying the effectiveness of classroom amplification technologies with students whose voices and activity levels are pitched differently than students at lower grade levels.

Preliminary evidence from this study suggests that one of the most powerful effects of the use of classroom amplification technologies may be found with students who have special learning needs or are English Language Learners (ELL). Specific studies with larger numbers of students in these particular groups would allow for more analysis of results and the disaggregation needed to support the initial positive results detected for these groups of students.

Another logical step would be to seek funding for a randomized control trial to measure the impact of classroom amplification technologies on students and teachers. As mentioned earlier in the report, one of the limitations of this study was the selection and placement of teachers and students in the study groups. A randomized control trial would provide a stronger, causal case for the impact of the amplification technologies should similar results be found. The instruments used in this study could serve as the basis for the development of even more sensitive measures for the detection of differences between and among groups.

This study provides initial evidence that classroom amplification technologies can have a positive impact on student achievement, on student motivation and interest, and on teacher instructional practices in 21st century classrooms. Further research will increase understanding about how the technologies can best be used in conjunction with instructional technologies to create the best outcomes for students.

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APPENDIX A

Classroom Amplification Project: Study Group Demographics

Grade Spans, Full-time Teaching Experience, Subject Areas, Classes/Courses, Student Incident Reports, Prior Familiarity of Classroom Amplification, and Usage Logs

GRADE SPAN	YEARS TEACHING		CORE CONTENT AREAS	NUMBER COURSES		STUDENT INCIDENTS		AMPLIFICATION TECHNOLOGIES FAMILIARITY	CLASSROOM AMPLIFICATION USAGE							
									MONTHS		WEEKS		MINUTES		HOURS / WEEK	
	RANGE	AVG.		RANGE	AVG.	RANGE	AVG.		RANGE	AVG.	RANGE	AVG.	RANGE	AVG.	RANGE	AVG.
CONTROL GROUP PARTICIPANTS (N = 19)																
Elementary (N = 9)	4-22	11	All = 9	4-8	6	2-64	23	Very = 1 Some = 5 None = 3								
Secondary (N = 10)	6-16	10	Com. Arts = 6 Math = 2 Science = 2	1-7	4	0-21	7	Very = 0 Some = 5 None = 5								
Average		***11***		***1-8***	***5***	***0-64***	***15***	***Yes = 58%***								
EXPERIMENT GROUP PARTICIPANTS – STANDARD CLASSROOM AMPLIFICATION SUBGROUP (N = 10)																
Elementary (N = 4)	4-26	11	All = 4	4-8	6	0-12	4	Very = 0 Some = 1 None = 3	6-9	8	18-22	20	12270 to 28580	24472	12.3 to 25.1	21.3
Secondary (N = 6)	1-29	15	Com. Arts = 4 Math = 1 Science = 1	1-6	3	3-7	5	Very = 0 Some = 2 None = 4	7-9	8	15-26	21	1385 To 40127	9159	0.9 To 33.4	7.5
Average		***13***			***4***		***4***	***Yes = 30%***		***8***		***21***		***15284***		***13.0***
EXPERIMENT GROUP PARTICIPANTS – ENHANCED CLASSROOM AMPLIFICATION SUBGROUP (N = 10)																
Elementary (N = 5)	2-8	6	All = 5	4-8	7	0-30	8	Very = 1 Some = 1 None = 3	7-9	8	18- 26	22	10860 To 29425	2309	7.2 To 24.5	16.2
Secondary (N = 5)	5-15	9	Com. Arts = 1 Math = 2 Science = 2	2-6	4	0-61	28	Very = 0 Some = 2 None = 3	6-9	8	11-31	22	1200 To 7140	4274	1.2 To 4.4	3.0
Average		***7***			***5***		***18***	***Yes = 40%***		***8***		***22***		***12292***		***9.6***
ALL PARTICIPANTS (N = 39)																
Average		***10***			***5***		***13***	***Yes = 46%***		***8***		***21***		***13788***		***11.3***

APPENDIX B

Classroom Amplification Project - Teacher Usage Survey
Fall 2010 Summary

RESPONDENTS (N=34)

The Classroom Amplification Project (CAP) assigned 34 teachers to participate in one of three study groups: control, experimental standard classroom amplification, and experimental enhanced amplification. Because of the smaller number of secondary participants, five teachers had half of their courses assigned as control and half as experimental. Teachers completed an online survey in fall 2010 and again in spring 2011 to examine perceptions regarding the impact of using, or not using, amplification technologies. This report summarizes the findings from the fall 2010 administration.

Years Employed as Full-Time Teacher

YEARS TEACHING	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
1 to 2	2	0 *(+1)*	2	1	1
3 to 5	6	2	4	2	2
6 to 10	14	5 *(+2)*	9	3	6
11 to 20	7	5 *(+1)*	2	1	1
21 to 30	5	2 *(+1)*	3	3	0
Total	34 *(+5)*	14 *(+5)*	20	10	10

**For the purposes of this report, the five control-experiment teachers are reported in both groups with regards to demographic information only. Their responses to project-related survey items are reported with their respective experiment groups and not included in the control group statistics.*

Grades Levels Taught

GRADES	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
Elementary	18	9	9	4	5
Middle	10	4 *(+2)*	6	3	3
High	6	1 *(+3)*	5	3	2
Total	34 *(+5)*	14 *(+5)*	20	10	10

SECONDARY TEACHER DEMOGRAPHICS (N=16)

Subjects Areas of Focus

SUBJECT AREA	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
English/language arts	8	3 *(+3)*	5	4	1
Mathematics	4	1 *(+1)*	3	1	2
Science	4	1 *(+1)*	3	1	2
Total	16 *(+5)*	5 *(+5)*	11	6	5

Note: No teacher reported a course as advanced.

Number Semesters Teaching this Course, Including this Semester

SEMESTERS	NUMBER	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
1 to 5	4	1 *(+1)*	3	2	1
6 to 10	1	1 *(+0)*	0	0	0
11 to 20	8	2 *(+3)*	6	3	3
21 or more	3	1 *(+1)*	2	1	1
Total	16	5 *(+5)*	11	6	5

Note: One teacher reported not teaching a course previous to this year.

ELEMENTARY TEACHER DEMOGRAPHICS (N=18)

Subject Areas Taught

SUBJECT AREA	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL	EXPERIMENT	STANDARD	ENHANCED
All four core content areas	18	9	9	4	5

Number Years Teaching this Content at this Grade Level

SUBJECT AREA	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL	EXPERIMENT	STANDARD	ENHANCED
1 to 5	7	3	4	2	2
6 to 10	8	4	4	1	3
11 or more	3	2	1	1	0
Total	18	9	9	4	5

Note: One teacher reported not teaching at this grade level previous to this year.

CLASSROOM PRACTICES – ALL RESPONDENTS (N=34)

Familiarity with Classroom Amplification Technologies Prior to Study

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Very familiar	2	1	1	0	1
Somewhat familiar	13	7	6	3	3
Not at all familiar	19	6	13	7	6
Total	34	14	20	10	10

Use of Inquiry Techniques

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Almost every day	6	1	5	2	3
At least 75% of the time	11	3	8	4	4
About half the time	6	3	3	2	1
It depends on the content I am teaching	10	7	3	1	2
Seldom	1	0	1	1	0
Never	0	0	0	0	0
Total	34	14	20	10	10

Overall Inquiry Use Rating Averages* By Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Inquiry use	3.3	2.9	3.7	3.5	3.8

[Range of 1-6, From No Usage to Nearly Every Day]

** Item rating averages are calculated based on the number of response choices. An item with six response choices, for example, has a 6.0 rating average scale where 1 indicates the least favorable response (such as "Never") and 6 represents the most favorable response (such as "Almost all day").*

Teacher Use of Technologies in the Classroom

	ALMOST ALL DAY LONG	AT LEAST 75% OF THE TIME	ABOUT HALF THE TIME	DEPENDS ON THE CONTENT	SELDOM	NEVER	N/A – DO NOT HAVE
Amplification technologies	5	5	5	1	0	4	14
Special amplification technologies	0	2	1	0	3	6	22
Interactive whiteboard	15	14	4	1	0	0	0
Computers	6	11	12	5	0	0	0
Internet sites	4	7	11	11	1	0	0

Overall Rating Averages by Study Group

Teacher technology use	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Amplification			4.1	3.7	4.8
Special amplification			1.3	1.1	0.4
Interactive whiteboard	5.3	5.4	5.2	4.8	5.0
Computers	4.5	4.5	4.6	4.5	5.0
Internet sites	4.1	3.9	4.2	4.0	4.6

[Range of 1-6, from Never to Almost All Day]

Student Use of Technologies in the Classroom

	ALMOST ALL DAY LONG	AT LEAST 75% OF THE TIME	ABOUT HALF THE TIME	DEPENDS ON THE CONTENT	SELDOM	NEVER	N/A – DO NOT HAVE
Amplification technologies	0	0	1	1	3	5	14
Special amplification technologies	0	0	2	1	2	7	22
Interactive whiteboard	4	10	11	8	1	0	0
Computers	0	14	9	9	2	0	0
Internet sites	0	7	12	13	2	0	0

Overall Rating Averages by Study Group

Student technology use	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Amplification			2.4	2.2	2.6
Special amplification			1.1	0.9	1.3
Interactive whiteboard	4.2	4.5	4.1	3.9	4.2
Computers	4.0	4.1	4.0	4.0	3.9
Internet sites	3.7	3.6	3.8	3.6	3.9

Classroom changes as a result of participating in the study

Overall, my students…	MUCH MORE	SOMEWHAT MORE	ABOUT THE SAME	SOMEWHAT LESS	MUCH LESS
• are active learners	3	15	15	0	0
• engage in cooperative learning	2	10	21	0	0
• have improved achievement	1	8	24	0	0
• enjoy lessons	2	15	16	0	0
• are interested in their school work	1	18	14	0	0
• view school as important, useful for their future	2	3	28	0	0
• feel capable in their school work	2	7	24	0	0
• are interested in going to college	1	8	26	0	0
• put effort into learning their school work	1	9	22	0	0
• plan to take advanced courses in the future	0	2	31	0	0

Overall classroom change rating averages by study group

Student characteristics	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
active learners	3.6	3.4	3.8	3.7	3.9
engage in cooperative learning	3.4	3.3	3.5	3.5	3.5
have improved achievement	3.3	3.2	3.4	3.3	3.5
enjoy lessons	3.6	3.2	3.8	3.7	3.9
interested in school work	3.5	3.2	3.7	3.7	3.7
view school as important	3.2	3.2	3.2	3.0	3.4
feel capable in school	3.3	3.2	3.4	3.4	3.4
interested in college	3.2	3.2	3.3	3.1	3.5
put effort into school work	3.3	3.2	3.5	3.4	3.5
plan to take advanced courses	3.1	3.0	3.1	3.0	3.2

Other Technologies used in the Classroom (in addition to eMINTS equipment, including interactive whiteboard, computers, digital camera, scanner, and printer):

Document camera (2), Graphing Calculator (1) and Student Response system (1)

EFFECTIVENESS OF AMPLIFICATION TECHNOLOGIES IN THE CLASSROOM –
TEACHERS IN EXPERIMENTAL GROUPS (N=20)

Use of Other Technology Has Increased Because of Project Participation

Yes = 12 No = 8

Teacher comments:

- *The benefit of being present and soft spoken, able to be heard and all of the previously mentioned saves valuable time-not having to repeat or ask a student to repeat*
- *We use the student microphone for different projects.*
- *It improves student focus*
- *I believe the amplification technology works very well in conjunction with my interactive whiteboard and steps up my use of it*
- *I have been using the other technologies for over a year and a half. Use of those technologies has not changed at this point*

- *I don't have to raise my voice as much to get attention*
- *It has allowed students to share their ideas & be heard by all students. Can't wait to incorporate the amp system into later lessons*
- *Students are more focused on me when I am delivering instruction. The use of the student microphone allows students to present information from cooperative activities such as PowerPoints more effectively*
- *I believe the use of the amplification technology helps students express themselves verbally in front of the entire class*
- It's too soon to tell <or> I haven't yet begun to use the amplification equipment [N=5]

Need to Repeat Directions to Students Prior to Using Classroom Amplification Technologies

	STANDARD	ENHANCED
Never	0	0
Seldom	0	1
About half of the time	4	2
At least 75% of the time	5	2
Every time class met	1	5
Total	10	10

Overall Rating Averages by Amplification Type

	STANDARD	ENHANCED
Repeating directions	2.3	1.9

[Range of 1-5, from Every Class to Never]

Impact of Amplification Technologies

Use of amplification technologies helps…	MUCH MORE	SOMEWHAT MORE	ABOUT THE SAME	SOMEWHAT LESS	MUCH LESS
• better equip teachers to engage students in lessons	4	14	2	0	0
• improve student attitudes towards school	2	8	10	0	0

Overall Rating Averages by Amplification Type

Amplification impact	STANDARD	ENHANCED
engages students	4.2	4.1
improves student attitudes	3.7	3.6

[Range of 1-5, from Much Less to Much More]

Support Received During the Study

	ADEQUATE	SOMEWHAT ADEQUATE	SOMEWHAT INADEQUATE	INADEQUATE	NO RESPONSE
Technological support	15	4	0	0	1
Teaching support	15	4	0	0	1
Curricular support	15	4	0	0	1
Administrative support	15	4	0	0	1

Overall Rating Averages by Amplification Type

Support satisfaction	STANDARD	ENHANCED
Technological	3.9	3.7
Teaching	3.8	3.8
Curricular	3.8	3.8
Administrative	3.8	3.8

[Range of 1-4, from Inadequate to Adequate]

Impact on Parental Involvement in Student Learning

	STANDARD	ENHANCED
Parents are much more involved	0	0
Parents are somewhat more involved	2	1
No change – about the same as before	7	9
Parents are somewhat less involved	0	0
Parents are much less involved	0	0
No response	1	NA
Total	10	10

Overall Rating Averages by Amplification Type

	STANDARD	ENHANCED
Parental involvement	3.2	3.1

[Range of 1-5, Much Less to Much More]

Frequency of Sharing Information from Classroom Amplification Technologies Training with Other Non-Participating Educators

	STANDARD	ENHANCED
Frequently	4	2
Occasionally	3	5
Rarely	2	3
Never	0	0
No response	1	NA
Total	10	10

Overall Rating Averages by Amplification Type

	STANDARD	ENHANCED
Information sharing	3.2	2.9

[Range of 1-4, from Never to Frequently]

APPENDIX C

Classroom Amplification Project - Teacher Usage Survey
Spring 2011 Summary

RESPONDENTS (N=30)

The Classroom Amplification Project (CAP) assigned 34 teachers to participate in one of three study groups: control, experimental standard classroom amplification, and experimental enhanced amplification. Because of the smaller number of secondary participants, five teachers had half of their courses assigned as control and half as experimental. Teachers completed an online survey in fall 2010 and again in spring 2011 to examine perceptions regarding the impact of using, or not using, amplification technologies in their classrooms. This report summarizes findings from the spring administration.

Years Employed as Full-Time Teacher

YEARS TEACHING	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
1 to 2	1	0 *(+1)*	1	1	0
3 to 5	4	1	3	2	1
6 to 10	14	5 *(+1)*	9	2	7
11 to 20	6	4 *(+1)*	2	1	1
21 to 30	5	2 *(+1)*	3	3	0
Total	30 *(+5)*	12 *(+4)*	18	9	9

** For purposes of this report, the five control-experimental teachers are reported in both groups with regards to demographic information only. Their responses to project-related survey items are reported with their respective experimental groups and not included in the control group statistics.*

Grades Levels Taught

GRADES	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
Elementary	15	7	8	3	5
Middle	9	4 *(+1)*	5	3	2
High	6	1 *(+3)*	5	3	2
Total	30 *(+5)*	12 *(+4)*	18	9	9

SECONDARY TEACHER DEMOGRAPHICS (N=15)

Subjects Areas of Focus

SUBJECT AREA	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
English/language arts	8	3 *(+3)*	5	4	1
Mathematics	4	1 *(+1)*	3	1	2
Science	3	1	2	1	1
Total	30 *(+5)*	5 *(+4)*	10	6	4

Note: No teacher reported a course as advanced.

Number Semesters Teaching this Course, Including this Semester

SEMESTERS	NUMBER	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL*	EXPERIMENT	STANDARD	ENHANCED
1 to 5	3	2 *(+1)*	1	1	0
6 to 10	2	1	1	0	1
11 to 20	7	1 *(+3)*	6	4	2
21 or more	3	1	2	1	1
Total	15	5 *(+4)*	10	6	4

Note: One teacher reported not teaching a course previous to this year.

ELEMENTARY TEACHER DEMOGRAPHICS (N=15)

Subject Areas Taught

SUBJECT AREA	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL	EXPERIMENT	STANDARD	ENHANCED
All four core content areas	15	7	8	3	5

Number Years Teaching this Content at this Grade Level

SUBJECT AREA	TOTAL	GROUP ASSIGNMENT		AMPLIFICATION TYPE	
		CONTROL	EXPERIMENT	STANDARD	ENHANCED
1 to 5	6	2	4	2	2
6 to 10	6	3	3	0	3
11 or more	3	2	1	1	0
Total	15	7	8	3	5

Note: One teacher reported not teaching at this grade level previous to this year.

CLASSROOM PRACTICES – ALL RESPONDENTS (N=30)

Familiarity with Classroom Amplification Technologies Prior to Study

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Very familiar	0	0	0	0	0
Somewhat familiar	5	2	3	1	2
Not at all familiar	25	10	15	8	7
Total	30	12	18	9	9

Use of Inquiry Techniques

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Almost every day	6	1	5	1	4
At least 75% of the time	9	2	7	3	4
About half the time	6	3	3	2	1
It depends on the content I am teaching	7	4	3	3	0
Seldom	2	2	0	0	0
Never	0	0	0	0	0
Total	30	12	18	9	9

Overall Inquiry Use Rating Averages* By Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
	3.3	2.7	3.8	3.2	4.3

[Range of 1-6, From No Usage to Nearly Every Day]

**Item rating averages are calculated based on the number of response choices. Items with six response choices have a 6.0 rating average scale where "1" indicates the least favorable response and "6" represents the most favorable response.*

Teacher Use of Technologies in the Classroom

	ALMOST ALL DAY LONG	AT LEAST 75% OF THE TIME	ABOUT HALF THE TIME	DEPENDS ON THE CONTENT	SELDOM	NEVER	N/A – DO NOT HAVE
Amplification technologies	7	6	2	3	0	0	12
Special amplification technologies	0	1	1	1	0	3	24
Interactive whiteboard	14	10	4	2	0	0	0
Computers	9	8	8	4	1	0	0
Internet sites	5	8	9	8	0	0	0

Overall Rating Averages by Study Group

Teacher technology use	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Amplification			4.9	4.8	5.1
Special amplification			0.8	0.4	1.1
Interactive whiteboard	5.2	5.0	5.3	5.0	5.7
Computers	4.7	4.8	4.6	5.0	4.1
Internet sites	4.3	4.3	4.3	4.6	4.1

[Range of 1-6, from Never to Almost All Day]

Student Use of Technologies in the Classroom

	ALMOST ALL DAY LONG	AT LEAST 75% OF THE TIME	ABOUT HALF THE TIME	DEPENDS ON THE CONTENT	SELDOM	NEVER	N/A – DO NOT HAVE
Amplification technologies	3	0	3	10	2	0	12
Special amplification technologies	0	0	1	2	0	3	24
Interactive whiteboard	5	7	9	7	2	0	0
Computers	3	10	11	5	1	0	0
Internet sites	2	6	13	7	2	0	0

Overall Rating Averages by Study Group

Student technology use	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Amplification			3.6	3.1	4.0
Special amplification			0.7	0.6	0.9
Interactive whiteboard	4.2	4.3	4.2	4.1	4.2
Computers	4.3	4.2	4.4	4.6	4.2
Internet sites	4.0	4.1	3.9	4.2	3.6

[Range of 1-6, from Never to Almost All Day]

Classroom changes as a result of participating in the study

Overall, my students…	MUCH MORE	SOMEWHAT MORE	ABOUT THE SAME	SOMEWHAT LESS	MUCH LESS
• are active learners	5	10	15	0	0
• engage in cooperative learning	4	8	18	0	0
• have improved achievement	3	15	12	0	0
• enjoy lessons	7	10	13	0	0
• are interested in their school work	4	9	17	0	0
• view school as important, useful for their future	3	8	19	0	0
• feel capable in their school work	2	12	16	0	0
• are interested in going to college	2	3	25	0	0
• put effort into learning their school work	2	8	20	0	0
• plan to take advanced courses in the future	2	5	22	0	0

Overall classroom change rating averages by study group

Student characteristics	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
active learners	3.7	3.2	4.0	4.0	4.0
engage in cooperative learning	3.5	3.2	3.8	3.9	3.7
have improved achievement	3.7	3.4	3.9	4.0	3.8
enjoy lessons	3.8	3.4	4.1	4.1	4.0
interested in school work	3.6	3.3	3.7	3.9	3.6
view school as important	3.5	3.3	3.6	3.8	3.4
feel capable in school	3.5	3.3	3.7	3.8	3.6
interested in college	3.2	3.0	3.4	3.6	3.2
put effort into school work	3.4	3.1	3.6	3.7	3.6
plan to take advanced courses	3.3	2.9	3.5	3.7	3.5

[Range of 1-5, from Much Less to Much More]

Other Technologies used in the Classroom (in addition to eMINTS equipment, including interactive whiteboard, computers, digital camera, scanner, and printer):
Document camera (3), Graphing Calculator (1) and Student Response system (1)

EFFECTIVENESS OF AMPLIFICATION TECHNOLOGIES IN THE CLASSROOM –
TEACHERS IN EXPERIMENTAL GROUPS (N=18)

Use of Other Technology Has Increased Because of Project Participation

Yes = 13 No = 5

Teacher comments: Standard amplification systems

- *Yes, because I had never had the amplification technology*
- *Because I have been eMINTS trained, I was already using other technology. The amplification devices just enhanced the instruction and made it easier to teach.*
- *I have allowed the students to use the computers for smaller projects more often. We might design a poster with smart notebook or create a graphic organizer. Then the students present their projects with the SmartBoard and the microphone. The kids share so much more when holding the microphone*
- *When I have students working on computers, it is much easier to get all of their attention*
- *It is easier to communicate during group projects involving wikis*

- *I feel that the classroom amplification has allowed my students to really hear comments made by myself and their peers more so than in the past. It has also increase the level of attention and decreased the level off-task conversations*
- *I believe the difference has been in the number of times I have had to repeat things to my students. We have used the technology for several years*
- *I have used the student microphone to get better (more evenly distributed) sound when listening to pre-recorded stories and books*

Teacher comments: Enhanced amplification systems

- *Active participation has been near perfection since using the amplification system and negative behavior and inattentive behavior has dissolved*
- *We use the microphone to share more in discussions during class time*
- *I don't think it has made other technologies more useful... they seem independent of each other*
- *The amplification technology has significantly improved my ability to use the SmartBoard and computers. When I explain concepts at the board, every student can hear me, even when I am turned sideways to write. I can step away from the board to explain what is being presented, allowing more students to use the board. Students use the microphone when they present PowerPoints, drawings, etc. to the class. Having a microphone has made it easier to help the students use their laptops, because I can turn it on and give specific directions regarding computer tasks or assignments as I am walking around the room. Instant feedback to the entire class is very helpful, especially when I am trouble-shooting problems or identifying and explaining how to improve what they are working on.*
- *Students are better able to hear and understand guidelines and expectations to complete an activity whether it be on the computer, using a graphing calculator or using other manipulatives.*

Need to Repeat Directions to Students Prior to Using Classroom Amplification Technologies

	STANDARD	ENHANCED
Never	0	0
Seldom	0	1
About half of the time	3	4
At least 75% of the time	4	1
Every time class met	2	3
Total	9	9

Overall Rating Averages by Amplification Type

	STANDARD	ENHANCED
Repeating directions	2.1	2.1

[Range of 1-5, from Every Class to Never]

Impact of Amplification Technologies

Use of amplification technologies helps…	MUCH MORE	SOMEWHAT MORE	ABOUT THE SAME	SOMEWHAT LESS	MUCH LESS
• equip teachers to engage students in lessons	9	7	2	0	0
• improve student attitudes towards school	3	12	3	0	0

Overall Rating Averages by Amplification Type

Amplification impact	STANDARD	ENHANCED
engages students	4.4	4.3
improves student attitudes	4.1	3.9

[Range of 1-5, from Much Less to Much More]

Support Received During the Study

	ADEQUATE	SOMEWHAT ADEQUATE	SOMEWHAT INADEQUATE	INADEQUATE
Technological support	15	3	0	0
Teaching support	12	5	1	0
Curricular support	11	6	1	0
Administrative support	13	4	1	0

Overall Rating Averages by Amplification Type

Support satisfaction	STANDARD	ENHANCED
Technological	4.0	3.7
Teaching	3.8	3.4
Curricular	3.8	3.4
Administrative	3.9	3.4

[Range of 1-4, from Inadequate to Adequate]

Impact on Parental Involvement in Student Learning

	STANDARD	ENHANCED
Parents are much more involved	0	0
Parents are somewhat more involved	1	0
No change – about the same as before	8	9
Parents are somewhat less involved	0	0
Parents are much less involved	0	0
Total	9	9

Overall Rating Averages by Amplification Type

	STANDARD	ENHANCED
Parental involvement	2.9	3.0

[Range of 1-5, Much Less to Much More]

Frequency of Sharing Information from Classroom Amplification Technologies Training with Other Non-Participating Educators

	STANDARD	ENHANCED
Frequently	4	4
Occasionally	2	4
Rarely	2	1
Never	1	0
Total	9	9

Overall Rating Averages by Amplification Type

	STANDARD	ENHANCED
Information sharing	3.0	3.2

[Range of 1-4, from Never to Frequently]

APPENDIX D

Classroom Amplification Project – Student Motivation and Usage Survey

Fall 2010 Summary

STUDY GROUPS AND STUDENT RESPONDENTS

The Classroom Amplification Project (CAP) assigned 34 teachers to participate in one of three study groups: control, experiment–standard classroom amplification, and experiment–enhanced amplification. Students in study groups completed an online survey in fall 2010 and again in spring 2011 to examine their perceptions regarding the use of amplification technologies in their classrooms. This report summarizes the findings from the fall (pre-project) administration.

Student Surveys Completed by Grade Span and Study Group

GRADE SPAN	NUMBER SURVEYS	GROUP ASSIGNMENT		TYPE AMPLIFICATION	
		CONTROL	EXPERIMENT	STANDARD	ENHANCED
4-6	440	217	223	90	133
7-8	569	225	344	218	126
9-12	136	9	127	65	62
Total	1145	451	694	373	321

**This table represents a duplicated count of students. A majority of secondary students had more than one teacher participate in the CAP study and had opportunity to complete the survey more than one time per survey administration.*

ITEM RESPONSES AND OVERAL RATING AVERAGES

Overall Rating Averages are calculated based on the number of response choices. An item with five response choices, for example, has a five-point rating average scale where 1 indicates the least favorable response (such as "Strongly Disagree") and 5 represents the most favorable response (such as "Strongly Agree").

Class is Motivating

In this school…	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
We do a lot of fun activities	26%	38%	26%	7%	3%
We cover interesting topics	23%	43%	26%	6%	2%
My teacher makes good plans for us	36%	39%	21%	3%	1%
We learn about important things	50%	5%	11%	3%	1%
I usually dislike lessons	11%	15%	30%	23%	21%
Most lessons are fun	21%	32%	31%	11%	5%

Overall Motivation Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
We do a lot of fun activities	3.77	3.83	3.72	3.61	**3.84**
We cover interesting topics	3.79	**3.86**	3.74	3.70	3.79
My teacher makes good plans for us	4.06	4.11	4.03	3.92	**4.15**
We learn about important things	4.29	**4.36**	4.24	4.22	4.25
I usually dislike lessons	2.73	2.58	2.83	**2.93**	2.71
Most lessons are fun	3.52	**3.66**	3.43	3.34	3.55

[Rating Average Range of 1-5, from Strongly Disagree to Strongly Agree]

Effort

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I always try hard, no matter how difficult the work	53%	33%	12%	2%	1%
I try hard to do well	63%	30%	6%	1%	1%
When I fail, it makes my try that much harder	57%	28%	11%	3%	2%

Overall Effort Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
I always try hard, no matter how difficult the work	4.34	**4.39**	4.30	4.31	4.28
I try hard to do well	4.53	**4.56**	4.51	4.50	4.52
When I fail, it makes my try that much harder	4.32	**4.36**	4.30	4.30	4.31

[Range of 1-5, from Strongly Disagree to Strongly Agree]

Self-concept

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I am sure that I can learn in school	67%	27%	5%	<1%	<1%
I can get good grades	59%	32%	7%	1%	<1%
I don't think I could do advanced school work	11%	19%	24.4%	22%	24.2%
I am sure of myself when I do school work	33%	42%	22%	2%	1%
I think I could handle more difficult school work	20%	22%	33%	17%	9%
I'm not good at school	4%	5%	13%	30%	49%

Self-concept Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
I am sure that I can learn in school	4.59	**4.62**	4.58	4.60	4.55
I can get good grades	4.48	4.46	**4.49**	**4.49**	4.48
I don't think I could do advanced school work	2.69	**2.73**	2.66	2.71	2.61
I am sure of myself when I do school work	4.04	4.06	4.03	3.96	**4.10**
I think I could handle more difficult school work	3.26	3.26	3.26	3.23	**3.30**
I'm not good at school	1.86	**1.88**	1.84	1.84	1.85

[Range of 1-5, from Strongly Disagree to Strongly Agree]

Enjoyment of School

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
School is dull and boring	9%	12%	28%	25%	26%
I have good feelings toward school	25%	35%	29%	7%	5%
I really like school	26%	26%	30%	11%	7%
I get bored watching programs about school on TV	19%	22%	29%	15%	16%
I would like to be given a book or learning games as presents	20%	19%	24%	18%	19%
I would like to do school work at home	9%	9%	20%	20%	42%

Enjoyment of School Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
School is dull and boring	2.54	2.40	2.63	**2.72**	2.54
I have food feelings toward school	3.69	**3.79**	3.62	3.57	3.68
I really like school	3.53	**3.65**	3.45	3.37	3.54
I get bored watching TV programs about school	3.13	2.99	3.23	**3.38**	3.06
I would like to be given a book or learning games as presents	3.02	**3.20**	2.90	2.78	3.03
I would like to do school work at home	2.22	**2.36**	2.13	2.00	2.29

[Range of 1-5, from strongly disagree to strongly agree]

Value/Importance

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I don't expect to use that much of what I learned in school when I get out of school	10%	12%	21%	25%	32%
School will not be important to me in my life's work	6%	5%	11%	26%	51%
Coming to school is a waste of time	5%	5%	14%	27%	50%
What I have learned at school will help me earn a living	62%	26%	9%	2%	2%
Doing well in school is not important for my future	12%	5%	7%	19%	58%
I will use what I learned in school in many ways as an adult	58%	25%	12%	2%	2%

Value Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
I don't expect to use much of what I learned in school	2.43	**2.53**	2.36	2.37	2.36
School will not be important in my life's work	1.87	1.84	1.90	1.83	**1.97**
Coming to school is a waste of time	1.85	1.78	1.90	1.90	**1.91**
What I learned will help me earn a living	4.42	**4.48**	4.41	4.40	4.43
Doing well in school is not important	1.94	1.95	1.93	1.90	**1.97**
I will use what I learned as an adult	4.36	4.37	4.34	4.31	**4.38**

[Range of 1-5, from strongly disagree to strongly agree]

Teacher Encouragement

My teachers…	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
Encourage me to study more	38%	36%	17%	5%	3%
Think advanced school work will be a waste of time for me	4%	4%	21%	31%	40%
Want me to learn as much as I can	66%	26%	6%	<1%	1%
Would not take me seriously if I told them I was interested in going to college	8%	7%	12%	21%	52%
Have made me feel I have the ability to go on in school	52%	29%	14%	3%	2%
Think I'm the kind of person who could do well in school	50%	32%	15%	2%	2%

Encouragement Rating Averages by Study Group

My teachers…	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Encourage me to study more	4.01	4.03	3.99	3.91	**4.09**
Think advanced school work will be a waste of time for me	2.01	2.01	2.01	**2.04**	1.98
Want me to learn as much as I can	4.55	**4.63**	4.50	4.47	4.55
Would not take me seriously if I told them I was interested in college	1.97	1.98	1.97	1.92	**2.03**
Have made me feel I have the ability to go on in school	4.26	4.25	4.27	4.23	**4.32**
Think I'm the kind of person who could do well in school	4.28	4.27	4.29	4.24	**4.36**

[Range of 1-5, from strongly disagree to strongly agree]

Amplification Technology Usage

(To be completed by experiment group only. No responses recorded in fall 2010.)

About the amplification system	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
My teacher uses the sound system in our classroom every day					
I can hear my teacher better in this classroom than in other classrooms that do not have this system					
I can hear my teacher's voice from anywhere in the room					
My teacher's instructions are cleared to me when he/she uses the system					
I like to use the microphone					
I am learning more					
It's easier for me to pay attention to my teacher					
My teacher does not talk as loudly when she uses the sound system					
It seems the other students are paying attention to the teacher and each other when we use the system					
I hope that my classroom next year has a sound system					

APPENDIX E

Classroom Amplification Project – Student Motivation and Usage Survey
Spring 2011 Summary

STUDY GROUPS AND STUDENT RESPONDENTS

The Classroom Amplification Project (CAP) assigned 34 teachers to participate in one of three study groups: control, experiment–standard classroom amplification, and experiment–enhanced amplification. Students in study groups completed an online survey in fall 2010 and again in spring 2011 to examine their perceptions regarding the use of amplification technologies in their classrooms. This report summarizes the findings from the spring (post-project) administration.

Student Surveys Completed by Grade Span and Study Group

GRADE SPAN	NUMBER SURVEYS	GROUP ASSIGNMENT		TYPE AMPLIFICATION	
		CONTROL	EXPERIMENT	STANDARD	ENHANCED
4-6	389	194	195	75	120
7-8	630	285	345	251	94
9-12	168	6	162	57	105
Total	1187	485	702	383	319

**This table represents a duplicated count of students. A majority of secondary students had more than one teacher participate in the CAP study and had opportunity to complete the survey more than one time per survey administration.*

ITEM RESPONSES AND OVERAL RATING AVERAGES

Overall Rating Averages are calculated based on the number of response choices. An item with five response choices, for example, has a five-point rating average scale where 1 indicates the least favorable response (such as "Strongly Disagree") and 5 represents the most favorable response (such as "Strongly Agree").

Class is Motivating

In this school…	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
We do a lot of fun activities	23%	37%	28%	7%	5%
We cover interesting topics	22%	40%	27%	7%	4%
My teacher makes good plans for us	33%	40%	21%	4%	3%
We learn about important things	45%	37%	15%	2%	2%
I usually dislike lessons	13%	16%	30%	23%	19%
Most lessons are fun	17%	28%	36%	12%	7%

Overall Motivation Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
We do a lot of fun activities	3.67	3.70	3.65	3.58	**3.74**
We cover interesting topics	3.70	3.73	3.67	3.56	**3.80**
My teacher makes good plans for us	3.96	3.96	3.96	3.79	**4.17**
We learn about important things	4.21	**4.29**	4.16	4.10	4.23
I usually dislike lessons	2.81	2.77	2.84	**3.05**	2.60
Most lessons are fun	3.35	3.38	3.33	3.21	**3.47**

[Rating Average Range of 1-5, from Strongly Disagree to Strongly Agree]

Effort

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I always try hard, no matter how difficult the work	47%	36%	15%	2%	1%
I try hard to do well	57%	32%	10%	1%	0%
When I fail, it makes my try that much harder	55%	28%	12%	3%	2%

Overall Effort Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
I always try hard, no matter how difficult the work	4.26	**4.31**	4.23	4.19	4.19
I try hard to do well	4.43	**4.48**	4.40	4.35	4.35
When I fail, it makes my try that much harder	4.32	**4.37**	4.28	4.31	4.31

[Range of 1-5, from Strongly Disagree to Strongly Agree]

Self-concept

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I am sure that I can learn in school	64%	31%	5%	0%	1%
I can get good grades	58%	32%	8%	1%	1%
I don't think I could do advanced school work	10%	16%	23%	23%	28%
I am sure of myself when I do school work	33%	41%	23%	2%	1%
I think I could handle more difficult school work	19%	26%	33%	13%	9%
I'm not good at school	4%	6%	15%	28%	48%

Self-concept Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
I am sure that I can learn in school	4.57	4.59	4.56	4.52	**4.61**
I can get good grades	4.44	**4.46**	4.44	4.42	4.45
I don't think I could do advanced school work	2.57	**2.59**	2.56	2.57	2.54
I am sure of myself when I do school work	4.04	**4.08**	4.02	4.02	4.03
I think I could handle more difficult school work	3.32	3.21	3.41	3.38	**3.43**
I'm not good at school	1.90	1.84	1.94	**2.00**	1.87

[Range of 1-5, from Strongly Disagree to Strongly Agree]

Enjoyment of School

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
School is dull and boring	13%	13%	30%	23%	21%
I have good feelings toward school	22%	33%	31%	9%	6%
I really like school	21%	26%	34%	10%	9%
I get bored watching programs about school on TV	22%	21%	30%	14%	13%
I would like to be given a book or learning games as presents	16%	13%	26%	20%	25%
I would like to do school work at home	9%	9%	21%	21%	41%

Enjoyment of School Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
School is dull and boring	2.75	2.67	2.80	**2.98**	2.57
I have good feelings toward school	3.58	3.62	3.56	3.46	**3.67**
I really like school	3.39	3.40	3.38	3.27	**3.52**
I get bored watching programs about school on TV	3.23	3.17	3.27	**3.36**	3.16
I like to be given a book or learning games as presents	2.75	2.81	2.72	2.59	**2.87**
I like to do school work at home	2.24	2.19	2.27	2.21	**2.34**

[Range of 1-5, from strongly disagree to strongly agree]

Value/Importance

	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
I don't expect to use that much of what I learned in school when I get out of school	8%	12%	19%	27%	34%
School will not be important to me in my life's work	5%	6%	12%	27%	49%
Coming to school is a waste of time	4%	6%	15%	27%	48%
What I have learned at school will help me earn a living	56%	28%	12%	2%	2%
Doing well in school is not important for my future	10%	6%	9%	20%	55%
I will use what I learned in school in many ways as an adult	52%	27%	17%	3%	2%

Value Rating Averages by Study Group

	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
I don't expect to use much of what I learned in school	2.34	2.27	2.38	**2.46**	2.28
School will not be important in my life's work	1.91	1.74	2.03	**2.13**	1.91
Coming to school is a waste of time	1.91	1.87	1.94	**2.02**	1.84
What I learned will help me earn a living	4.33	**4.47**	4.24	4.22	4.26
Doing well in school is not important	1.96	1.84	2.05	**2.13**	1.95
I will use what I learned as an adult	4.25	**4.36**	4.17	4.12	4.23

[Range of 1-5, from strongly disagree to strongly agree]

Teacher Encouragement

My teachers…	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
Encourage me to study more	36%	37%	19%	6%	2%
Think advanced school work will be a waste of time for me	5%	6%	20%	28%	41%
Want me to learn as much as I can	61%	28%	8%	2%	1%
Would not take me seriously if I told them I was interested in going to college	6%	7%	13%	22%	52%
Have made me feel I have the ability to go on in school	51%	30%	15%	3%	1%
Think I'm the kind of person who could do well in school	50%	32%	14%	2%	3%

Encouragement Rating Averages by Study Group

My teachers…	TOTAL	CONTROL	EXPERIMENT	STANDARD	ENHANCED
Encourage me to study more	4.01	**4.09**	3.94	3.86	4.04
Think advanced school work will be a waste of time for me	2.04	1.92	2.13	**2.20**	2.04
Want me to learn as much as I can	4.47	**4.54**	4.42	4.33	4.53
Would not take me seriously if I told them I was interested in college	1.92	1.83	1.99	**2.07**	1.88
Have made me feel I have the ability to go on in school	4.26	**4.32**	4.21	4.12	4.31
Think I'm the kind of person who could do well in school	4.24	4.25	4.23	4.18	**4.29**

[Range of 1-5, from strongly disagree to strongly agree]

Amplification Technology Usage

About the amplification system	STRONGLY AGREE	AGREE	NEUTRAL	DISAGREE	STRONGLY DISAGREE
My teacher uses the sound system in our classroom every day	26%	15%	24%	9%	26%
I can hear my teacher better in this classroom than in other classrooms that do not have this system	27%	16%	26%	10%	21%
I can hear my teacher's voice from anywhere in the room	42%	24%	20%	4%	10%
My teacher's instructions are cleared to me when he/she uses the system	25%	17%	29%	9%	20%
I like to use the microphone	23%	11%	29%	12%	25%
I am learning more	33%	19%	28%	7%	13%
It's easier for me to pay attention to my teacher	32%	18%	28%	7%	15%
My teacher does not talk as loudly when she uses the sound system	17%	14%	31%	12%	26%
It seems the other students are paying attention to the teacher and each other when we use the system	21%	19%	30%	9%	21%
I hope that my classroom next year has a sound system	35%	16%	28%	7%	14%

Impact Rating Averages by Experiment Group

My teachers…	EXPERIMENT	STANDARD	ENHANCED
My teacher uses the sound system in our classroom every day	3.76	3.66	**3.87**
I can hear my teacher better in this classroom than in other classrooms that do not have this system	3.65	3.60	**3.70**
I can hear my teacher's voice from anywhere in the room	4.10	4.02	**4.20**
My teacher's instructions are cleared to me when he/she uses the system	3.72	3.70	**3.74**
I like to use the microphone	3.38	3.25	**3.55**
I am learning more	3.72	3.65	**3.81**

It's easier for me to pay attention to my teacher	3.74	3.65	**3.85**
My teacher does not talk as loudly when she uses the sound system	3.29	3.18	**3.43**
It seems the other students are paying attention to the teacher and each other when we use the system	3.58	3.46	**3.73**
I hope that my classroom next year has a sound system	3.78	3.69	**3.89**

APPENDIX F

Classroom Amplification Project – Classroom Observations
Fall 2010 and Spring 2010 Summary Data

CLASSROOM OBSERVATION INFORMATION		FALL			SPRING		
		STANDARD	ENHANCED	TOTAL	STANDARD	ENHANCED	TOTAL
Number Teachers	Total	10	10	20	7	8	15
	• Com. Arts/Mathematics/Science	7 / 2 / 1	4 / 3 / 3	11 / 5 / 4	6 / 0 / 1	5 / 2 / 1	11 / 2 / 2
	• Elementary/Middle/High	4 / 3 / 3	5 / 3 / 2	9 / 6 / 5	2 / 3 / 2	4 / 3 / 1	6 / 6 / 3
Number Students	Total – Average per classroom	201 – 20	177 – 18	378 – 19	142 – 20	137 – 17	279 – 19
	• Elementary/Middle/High	79 / 73 / 49	106 / 44 / 27	185 / 117 / 76	41 / 69 / 32	80 / 44 / 13	121 / 113 / 45
Classroom Setting / Facility	CAP system in working order	10 / 100%	10 / 100%	20 / 100%	7 / 100%	8 / 100%	15 / 100%
	• Teachers' use and average time *(in minutes)*	100% – *40"*	100% – *32"*	100% – *36"*	100% – *24"*	100% – *36"*	100% – *30"*
	• Students' use and average time	5 / 50% – *23"*	6 / 60% – *22"*	11 / 55% – *22"*	3 / 43% – *13"*	5 / 63% – *21"*	8 / 53% – *18"*
	Adequate for number of students	9	10	19 / 95%	6	8	14 / 93%
	Adequate storage	9	9	18 / 90%	6	7	13 / 87%
	Allows inquiry-based learning	9	10	19 / 95%	6	8	14 / 93%
	Accommodates activities	8	10	19 / 95%	6	8	14 / 93%
	Flat surfaces available	10	10	20 /100%	7	8	15 /100%
Student Seating	Total - average configurations	16	18	34 – 1.7	13	17	30 = 2.0
	Rows / Pairs / Small Groups	6 / 5 / 2	3 / 5 / 5	9 / 10 / 7	5 / 5 / 2	1 / 7 / 6	6 / 12 / 8
Class Environment	Core curriculum materials	9	10	19 / 95%	6	8	14 / 93%
	Content area displays	8	9	17 / 85%	5	5	10 / 67%
	Student work displayed	8	9	17 / 85%	6	6	12 / 80%
	Hands-on resources	7	6	13 / 65%	4	6	10 / 67%
	Mathematics-Science materials	2	4	6 / 30%	2	6	8 / 53%
21st Century tools	Total - average equipment in room	27 total	28 total	55 – 2.8	26 total	38 total	54 – 3.6
	Interactive whiteboard/use	8 – *30"*	10 – *28"*	18 / 90% – *29"*	5 – *25"*	8 – *25"*	13 / 87% – *25"*
	Teacher compute – average use	7 – *19"*	7 – *22"*	14 / 70% – *20"*	5 – *22"*	5 – *9"*	10 / 67% – *15"*
	Student computers – average use	5 – *35"*	5 – *28"*	10 / 50% – *31"*	4 – *26"*	6 – *24"*	10 / 67% – *25"*
	• Total- average per room	152 / **1.3**	129 / **1.4**	281 / **1.3**	108 / **1.3**	79 / **1.7**	187 / **1.5**
	• Elementary/Middle/High ratios	1.6 / 1.7 / 0.8	1.7 / 1.0 / 1.4	1.6 / 1.3 / 1.1	1.6 / 1.4 / 0.9	1.7 / 1.4 / 0.0	1.6 / 1.4 / 0.5
Instructional Resources	Total - average resources used *(15 categories)*	26 total *(9 of 15)*	17 total *(7 of 15)*	54 – 2.7	28 total *(10 of 15)*	24 total *(9 of 15)*	52 – 2.9
	Other print (not text)	6	9	15 / 75%	3	6	9 / 60%
	Internet	6	5	11 / 55%	4	6	10 / 67%
	Software	3	2	5 / 25%	2	4	6 / 40%
Content Focus	Total - average areas of focus	19 *(8 of 11)*	19 *(10 of 11)*	38 – 1.9	14 *(11 of 11)*	20 *(11 of 11)*	34 – 2.3
	Reading/language arts	12	8	20	12	13	25
	Mathematics	2	10	12	0	7	7

CLASSROOM OBSERVATION INFORMATION (CONTINUED)		FALL			SPRING		
		STANDARD	ENHANCED	TOTAL	STANDARD	ENHANCED	TOTAL
Content – Instructional Materials Users	Both teacher and student users	6	6	12 / 60%	2	7	9 / 60%
	Mainly student users	4	3	7 / 35%	5	1	6 / 40%
	Mainly teacher user	0	1	1 / 5%	0	0	0 / 0%
Content – Method of Delivering Content	Problem-based learning	8	6	14 / 70%	4	5	9 / 60%
	Focus on problem solving	7	5	12 / 60%	0	3	3 / 20%
	Real-world context	6	4	10 / 50%	5	6	11 / 73%
	Lecture	3	2	5 / 25%	2	5	7 / 47%
Grouping Arrangements	Total – average configurations	24 *(5 of 5)*	22 *(5 of 5)*	46 – 2.3	14 *(5 of 5)*	18 *(5 of 5)*	32 – 2.1
	Whole group	8	7	15 / 75%	4	5	9 / 60%
	Small groups: same task	5	6	11 / 55%	4	5	9 / 60%
	Individuals: same task	7	5	12 / 60%	6	6	12 / 80%
	Appropriate for content / activity	9	9	18 / 90%	6	7	13 / 87%
Teacher Behaviors	Total – average behaviors	34 *(7 of 7)*	34 *(7 of 7)*	68 – 3.4	28 *(7 of 7)*	35 *(7 of 7)*	63 – 4.2
	• Monitor, question	8	8	14 / 70%	7	8	15 /100%
	• Encourage multiple solutions	6	5	11 / 55%	4	5	9 / 60%
	• Use manipulatives / technology	6	4	10 / 50%	4	7	11 / 73%
	• Lead discussion / journaling	6	8	14 / 70%	5	6	11 / 73%
	• Promote student inquiry	4	4	8 / 40%	4	4	8 / 53%
Student Behaviors	Total – average behaviors	22 *(4 of 5)*	18 *(5 of 5)*	40 – 2.0	15 *(4 of 5)*	16 *(5 of 5)*	31 – 2.1
	• Interact w/others	8	9	18 / 90%	7	7	14 / 87%
	• Work alone	8	4	12 / 60%	5	4	9 / 60%
	• Work in groups / teams	5	4	9 / 45%	2	3	5 / 33%
21st Century Information and Communication Skills	Total – average skills	16 *(4 of 4)*	21 *(4 of 4)*	37 – 1.9	15 *(3 of 4)*	18 *(4 of 4*	33 – 2.2
	Help clarify one another's learning	9	10	19 / 95%	6	7	13 / 87%
	Share solutions / processes	3	5	8 / 40%	5	7	12 / 80%
	Communicate mathematics ideas	3	4	7 / 35%	0	2	2 / 13%
	Defend solutions/ processes	1	2	3 / 75%	4	2	6 / 40%
Instructional Strategies	Total – average strategies	23 *(6 of 6)*	32 *(6 of 6)*	55 – 2.8	23 *(6 of 6)*	29 *(6 of 6)*	52 – 3.5
	Connecting prior knowledge	7	10	17 / 85%	7	7	14 / 93%
	Differentiating instruction	3	4	7 / 35%	4	5	9 / 60%
	Teacher modeling	4	7	8 / 40%	5	5	10 / 67%
	Collaborative grouping	5	7	12 / 60%	3	5	8 / 53%
	Opportunity to justify solutions	2	5	7 / 35%	3	5	8 / 53%
	Varied assessments	2	2	4 / 20%	3	2	5 / 33%
Questioning Strategies	Use of wait time	9	10	19 / 95%	6	7	13 / 87%
	Higher-order questions	5	6	11 / 55%	2	5	7 / 47%
	Ensuring all students can respond	7	4	11 / 55%	3	4	7 / 47%
	Probing follow-up questions	8	7	15 / 75%	3	6	9 / 60%
	Students can ask other students	9	10	19 / 95%	4	8	12 / 80%
	Teacher praise: specific	7	4	11 / 55%	4	7	11 / 73%
	Teacher praise: general	7	8	15 / 75%	5	5	10 / 67%

CLASSROOM OBSERVATION INFORMATION (CONTINUED)		FALL			SPRING		
		STANDARD	ENHANCED	TOTAL	STANDARD	ENHANCED	TOTAL
Student Involvement	Interested / engaged / on task	9	9	18 / 90%	7	7	14 / 93%
	Taking initiative	6	6	12 / 60%	5	5	10 / 67%
Classroom Management	Orderly, no disruptions	7	7	14 / 70%	7	6	13 / 87%
	Generally positive	10	9	19 / 95%	6	7	13 / 87%
	Enhanced learning opportunities	7	6	13 / 65%	6	6	12 / 80%
Development of Higher Order Thinking Skills	Total – average skills	39 *(12 of 15)*	48 *(12 of 15*	87 – 4.4	35 *(12 of 15*	50 *(12 of 15*	85 – 5.7
	Making observations	4	6	10 / 50%	5	6	11 / 73%
	Reciting / recalling facts	8	6	14 / 70%	5	5	10 / 67%
	Classifying	0	1	1 / 5%	1	2	3 / 20%
	Estimating	0	2	2 / 10%	0	2	2 / 13%
	Choosing strategies	4	3	7 / 35%	2	4	6 / 40%
	Measuring	0	2	2 / 10%	0	0	0 / 0%
	Collecting / recording data	2	1	3 / 15%	2	2	4 / 27%
	Comparing / contrasting	3	4	7 / 35%	3	4	7 / 47%
	Organizing / displaying data	4	3	7 / 35%	2	3	5 / 33%
	Drawing conclusions	5	7	12 / 60%	6	6	12 / 80%
	Interpreting / analyzing data	1	1	2 / 10%	2	3	5 / 33%
	Predicting	2	2	4 / 20%	3	5	8 / 53%
	Selecting problem-solving strategy	3	2	5 / 25%	1	2	3 / 20%
	Creating / formulating	2	3	5 / 25%	0	2	2 / 13%
	Justifying solutions / strategies	1	5	6 / 30%	3	4	7 / 47%
Learner Attitudes/ Attributes	Total – average student attributes	54 *(11 of 11)*	58 *(11 of 11)*	112 – 5.6	41 *(11 of 11)*	51 *(11 of 11)*	92 – 6.3
	Dependent on others	5	7	12 / 60%	1	3	4 / 27%
	Cooperation	9	10	19 / 95%	5	6	11 / 73%
	Persistence	1	3	4 / 20%	2	2	4 / 27%
	Responsibility	9	8	17 / 85%	6	7	13 / 87%
	Confidence	7	6	13 / 65%	6	6	12 / 80%
	Enthusiasm	7	7	14 / 70%	3	7	10 / 67%
	Objectivity	2	1	3 / 15%	3	3	6 / 40%
	Accuracy	5	4	9 / 45%	4	4	8 / 53%
	Critical thinking	1	3	4 / 20%	3	3	6 / 40%
	Self-directed	4	4	8 / 40%	5	5	10 / 67%
	Curiosity	4	5	9 / 45%	3	5	8 / 53%

APPENDIX G

Classroom Amplification Project – Teacher Focus Group

Summary of Teacher Focus Responses

Topic # 1 – Installation:

1. How did the installation of the technologies go?

   Follow-up – did you or your students experience any problems?

- No problems with installation = 20
  - Installation was completed before school started = 9
- Trouble sharing one student microphone = 6
  - Time spent [wasted] passing microphone among students = 4
  - Student competing for microphone = 2
- Trouble using teacher and student microphone at the same time = 3
- Microphones going out for periods of time = 4
  - Lower battery capacity by end of year = 2

Topic #2 – Professional Development

1. What professional development activities were conducted to help you learn to use the technologies?
   - Installers explained basic use = 8
   - eMINTS specialist (eIS) provided basic/follow-up training = 10

2. What part of learning to use the technologies was challenging for you?
   - Knowing how to integrate it and getting accustomed to using it = 7
   - Learning trouble spots
     - feedback when near speakers = 6
     - Interference or dead spots in the room = 4
   - Learning the technology
     - Adjusting volume/heaviness - 3
     - Pause button, channels = 3
     - Wearing the necklace = 3
     - Proper holding of student microphone = 2

3. If it were up to you, would you include more or less time for professional development on the technologies? Why?
   - No need for additional time on how to use the equipment = 5
   - More time on how to integrate the technology is instructional activities = 6
     - Convene [webinar] mid-year effective practices = 2

Topic #3 – Student Reactions

1. How did students react to using the technologies in the classroom?
   - Students loved using the technology = 7 (elementary teachers)
   - Some students were reluctant to use student microphones = 7 (both elementary and secondary teachers)
   - Students did not want to use student microphones = 3 (middle and high school teachers)

2. What students benefitted most from using the technologies in your classroom?
   Follow-up – any groups in particular?
   - All students = 7 (mostly elementary teachers)
   - Special needs students = 7
     - Special education = 2
     - Attention deficit disorders (diagnosed) = 2
     - Hearing impaired = 2
     - English language learners = 1
   - Students in back of room = 5
   - Boys = 5

3. Did any students appear to react negatively or not benefit from using the technologies?
   - Shy students and/or students with lower reading abilities were reluctant to using student microphone = 4

4. Were there any particular features of the technologies that you or your students liked more or less than others? Why?
   - Using microphone for oral readings, presentations, questions and answers, and while working at the board = 7 (mostly elementary teachers)
   - Even distribution of teacher and student voices = 5
   - Less wear of teacher's voice = 5
   - Hands-free use via the necklace microphone = 5
   - Use of system for classroom management = 4
   - Use of system to amplify audio for videos/video streaming = 2

5. What uses for the technologies would you like to explore next year?
   - Other ways to integrate the technology in instructional activities = 6
   - How to use system with other technologies/peripherals (such as iPod) = 2