The Impact of eMINTS Professional Development on Teacher Instruction and Student Achievement

Year 1 Report

Chris Brandt, Coby Meyers, and Ayrin Molefe

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Executive Summary

In 2010, the eMINTS National Center received an Investing in Innovation (i3) validation grant to implement the eMINTS Comprehensive program in rural middle schools and test the efficacy of the program in a randomized controlled trial. The program is based on four underlying research-based components: inquiry-based learning, high-quality lesson design, community of learners, and technology integration. The program provides teachers with approximately 240 hours of professional development (PD) spanning two years and support that includes monthly classroom visits. The eMINTS National Center is developing a third year of PD with the Intel® Teach Program to build on what teachers learn during the first two years of eMINTS Comprehensive. The third year will combine additional professional development and Intel's® suite of Web-based teaching tools to expand teachers' use of inquiry-based learning. Key evaluation objectives include (1) employing experimental methods to rigorously examine the program's impact on teacher practice and student achievement, particularly for middle school students in rural settings; (2) examining impacts of a third year of professional development, using Intel® Teach Elements courses and tools, on teacher and student outcomes; and (3) expanding the applicability of evaluation results to middle school students in high-poverty rural schools. The study involves 191 teachers and 3,610 students in 60 high-poverty rural schools throughout Missouri. The current report examines implementation and impacts on teachers and students after one year of eMINTS Comprehensive implementation.

The study will investigate the following confirmatory research questions:[1]

1. What is the impact of the eMINTS Comprehensive program on Grade 7 and 8 students' mathematics and communication arts performance?
2. What is the impact of the eMINTS Comprehensive program on Grade 7 and 8 students' 21st century skills, which include communication, technology literacy, and critical thinking?
3. Does eMINTS plus a third year of professional development supported by the Intel® Teach program result in a greater impact on Grade 7 and 8 students' performance than is seen in traditional eMINTS Comprehensive and control schools?

This Year 1 report provides preliminary results on questions one and two, as well as exploratory results on teachers' practices after one year of implementation. Sixty schools, 191 teachers (134 eMINTS and eMINTS + Intel, 57 control) and 3,610 seventh- and eighth-grade students (2,700 eMINTS and eMINTS + Intel, 910 control)[2] were randomly assigned to one of three groups: (1) the traditional eMINTS Comprehensive Program, (2) eMINTS Comprehensive plus a third year of professional development using the Intel® Teach Elements courses, or (3) business as usual.

[1] Confirmatory research questions are the main questions this study is designed to address. This study was designed using an experimental design to provide rigorous estimates of the causal effects of the eMINTS and eMINTS + Intel Teacher Program.

[2] Because eMINTS and eMINTS + Intel Teach Program groups receive the same professional development in the first two years of this study, results are analyzed as one group in this report.

By design, eMINTS Comprehensive is a two-year PD program, and the eMINTS + Intel® Teach Program adds a third year to the original program length. In this first year of implementation, eMINTS teachers had not yet received one full year of eMINTS PD; thus, the study team did not expect strong contrasts between treatment and control classrooms in teachers' instruction or student performance at the end of the 2011–12 school year. ***Because of the preliminary nature of these analyses, results presented here should be interpreted with caution.***

eMINTS Program Implementation: After one year of eMINTS, implementation results are encouraging. Across all eMINTS and eMINTS+Intel Teach Program schools, eMINTS technical and professional development staff provided the resources, professional development, and guidance essential to support implementation at the district, school, and classroom levels. Twenty-nine of the 38 (76 percent)[3] treatment schools demonstrated high levels of implementation fidelity across four of five major implementation components: technology infrastructure, technology use, teacher professional development, and principal professional development. In particular, 30 of 34 schools (88 percent) reported more than 90 percent attendance on the teacher professional development component (includes formal professional development and in-classroom coaching and mentoring), which is considered the most important component of the eMINTS Comprehensive program. It is important to note, however, that the technology resources provided to classrooms in the eMINTS Comprehensive program are purposely staggered in their installation and implementation. The full suite of technology resources (hardware and software) was fully installed and functional in the treatment schools by mid-February. Thus, students had full access to the technology for approximately two and one-half to three months of the first year of eMINTS. By contrast, students will have access to the entire suite of technology for the full school year beginning in the second year of eMINTS.

Teacher Impacts: Teacher self-report surveys and classroom observations were used to measure changes in teachers' instructional practices. Results on the observations and surveys showed a positive and statistically significant difference between teachers' integration of technology in eMINTS schools and that seen in control schools. In addition, survey results found positive and significant differences in the quality of lesson designs among teachers in eMINTS schools. Classroom observations also showed a positive and statistically significant difference in teachers' use of inquiry-based learning strategies. Although similar positive differences in teachers' use of inquiry-based learning strategies emerged on teacher surveys; survey differences were not statistically significant and, therefore, may have occurred by chance. Impacts on classroom community were not significantly different on either measure of teacher practice.

Student Impacts: Year 1 student impacts on all achievement outcomes—mathematics, communication arts, and 21st century learning skills—were all positive; none, however, reached a level of statistical significance and, therefore, may have occurred by chance. Impacts on student engagement were lower in the treatment schools, and these results also were nonsignificant.

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3 Not including ongoing technology support, all schools had high implementation in at least three of the four remaining components.

Overall, study results and program developers' experiences suggest that teachers and schools are progressing well in their implementation of eMINTS PD. As expected, eMINTS teachers are indeed changing their practices, using new instructional approaches and technology to move from a teacher-centered to a student-centered approach to classroom instruction. Although not significant, student achievement in eMINTS schools appears to be increasing at a faster rate than in control schools. Implementation and impact after one year of implementation are consistent with results from prior research on eMINTS classrooms that has demonstrated significant student achievement impacts after two to three years of implementation.

Chapter 1: Introduction

Overview

Missouri's rural K–12 student population is nearly one-quarter of a million students, the 18th largest in the United States. Poverty is high, with 44 percent of Missouri rural students qualifying for free or reduced-price lunch (Strange, Johnson, Showalter, & Klein, 2012). The Institute of Education Sciences (IES; 2010) reported that only 19 percent of Missouri students eligible for FRPL attained proficiency or better on the 2009 National Assessment of Education Progress (NAEP) mathematics test. Student mobility in Missouri rural schools ranks 14th highest in the United States, with 12.4 percent of families reporting changing residences in the 15 months prior to being surveyed (Strange et al., 2012). Per-pupil expenditure for Missouri rural schools is the 13th lowest in the United States (Strange et al., 2012). The attributes of many rural communities (isolation, a low tax base, an aging population, and higher poverty levels) contribute to the scarcity of qualified teachers for rural schools nationally and in Missouri (Monk, 2007). Among the promising practices that rural schools might use to recruit and retain high-quality teachers is improvement of the school's culture and working conditions (McClure & Reeves, 2004).

Middle schools (typically Grades 6–8) provide additional challenges. Middle school represents a critical time for students to develop the knowledge and skills they will need to achieve college and career readiness. Olson (2006) found that the reading and mathematics skills needed for success in the workplace are comparable to those needed for success in the first year of college. Unfortunately, middle school also is the period in which students may begin to lag in academic performance. Lembke and Gonzales (2006) reported that the performance of United States middle school students is lower than that of their peers in other countries, particularly when tested on tasks embedded in 21st century skills. Tasks of this nature commonly require skills cited by groups such as the Partnership for 21st Century Skills (Bellanca & Brandt, 2010) as being associated with problem solving, communication, collaboration, creativity and innovation, and use of information technology.

Schoolwide and teacher professional development programs focused on developing students' 21st century skills have recently emerged to help prepare students for college and the workforce. According to the Partnership 21st Century Skills, successful professional development programs should emphasize a comprehensive approach that includes updates to standards and assessments and that incorporates the following components:

- Ensure that educators understand the importance of 21st century skills and how to integrate them into daily instruction.
- Enable collaboration among all participants.
- Allow teachers and principals to construct their own learning communities.
- Tap the expertise within a school or school district through coaching, mentoring, and team teaching.

- Support educators in their role of facilitators of learning
- Use 21st century tools

(Partnership for 21st Century Skills, 2006)

Most programs include professional development to improve specific aspects of effective teaching such as standards-based lesson design, data-driven decision making, differentiation, inquiry- or project-based instruction, collaborative learning structures, and technology integration; few, however, incorporate a comprehensive approach to 21st century skill development to the extent that eMINTS does.

The eMINTS (Enhancing Missouri's Instructional Networked Teaching Strategies) National Center at the University of Missouri (UM), in partnership with the Missouri Department of Higher Education (DHE) and the Missouri Department of Elementary and Secondary Education (DESE), offers the eMINTS professional development (PD) program to teams of educators, especially those serving high-need students. eMINTS PD generates buildingwide reform by helping teachers master the translation of any state standards and information from assessments into engaging classroom practices that employ technology. The program is based on four underlying research-based components: inquiry-based learning, high-quality lesson design, community of learners, and technology integration. It addresses issues identified as barriers in the consistent use of standards-based instruction and technology. The program provides teachers with approximately 240 hours of PD spanning two years and support that includes monthly in-classroom coaching and mentoring visits. As part of refining and improving eMINTS PD, eMINTS staff integrated the Intel® Teach Program recently, adding a third year of PD to help teachers sustain and build on the first two years of eMINTS PD. The third year combines online and face-to-face professional development for teachers to expand their use of inquiry-based learning. Teachers also gain access to Intel's suite of online tools designed to involve students in 21st century higher-order thinking and problem solving.

Despite years of implementing standards-based accountability systems, many teachers today lack necessary preparation to develop standards-based instructional strategies and to inform decisions utilizing student assessments (Drake, 2007). eMINTS Comprehensive is designed to help teachers use standards-based instructional strategies and assessment in their lesson planning, implement inquiry-based instruction, facilitate a vibrant learning community, and integrate technology into their instruction. As teachers begin to apply these approaches to their lesson planning and instruction, it is expected that student engagement, application of 21st century skills, and academic performance will improve. A decade of evaluation of the eMINTS original two-year program consistently has shown promise in changing teachers' practice and raising student achievement. The evaluation studies are limited, however, in their generalizability across multiple settings and their methodological rigor (Martin Strother, & Reitzes, 2009; Martin, Strother, Weatherholt, & Dechaume, 2008; OSEDA, 2001b, 2002, 2003b, 2003c; Tharp, 2004, 2006). Prior eMINTS program evaluations often focused on intermediate elementary students (Grades 3–6) in urban settings and were conducted using either nonequivalent comparison group designs or pre-post designs with no comparison groups. A number of middle school principals in Missouri had previously expressed interest in eMINTS, and the provision of the professional development at that level was determined to be a logical next step in delivery.

In 2010, the eMINTS National Center received an Investing in Innovation (i3) validation grant to implement eMINTS in rural middle schools and test the efficacy of the program in a randomized controlled trial. Key objectives of the evaluation were (1) improving the rigor of the research base addressing the eMINTS Comprehensive program's effectiveness in improving teacher practice and student achievement; (2) examining the difference that a third year of professional development makes for eMINTS teachers, using Intel® Teach Program courses and tools, on teacher and student outcomes; and (3) expanding the applicability of evaluation results to middle school students in high-poverty rural schools. The study involves 191 teachers and 3,610 students in 60 high-poverty rural schools throughout Missouri. The current report examines implementation and impacts on teachers and students after one year of eMINTS Comprehensive implementation.

About the eMINTS National Center and Intel Foundation

The eMINTS National Center offers a wide range of professional development options to teachers, administrators, technology specialists, and other educators. Leading experts at the University of Missouri, the Missouri Department of Elementary and Secondary Education, and the Missouri Department of Higher Education collaborate to produce programs intended to engage students and enrich teaching by integrating technology and student-centered instruction. Programs range from short-term, customized awareness sessions to full school or organizationwide implementations requiring a long-term commitment. Professional development is geared to the needs and interests of PK–16 educators and is delivered either by eMINTS staff or local trainers who have completed eMINTS train-the-trainer certification.

The Intel Foundation was established in 1988 to develop programs, exercise leadership, and provides grant funding to fuel innovation in science, technology, engineering, and mathematics (STEM) education. The foundation strives to increase opportunities for people and communities worldwide—especially girls, underserved youth, and underrepresented populations. Intel's premier professional development program, Intel® Teach, consists of a series of K–12 professional development programs designed to introduce, expand, and support student-centered approaches in the classroom through technology integration. Intel® Teach has a large audience to which it delivers programming, reaching more than 350,000 U.S. teachers and 6 million teachers in 50 countries worldwide since 2002. Courses include both face-to-face and online professional development and are supported by free Web resources such as unit plans, assessment strategies, and tools to support higher-order thinking skills. Through these courses, teachers learn how to use teacher and student online resources and online "thinking tools" to create new strategies for encouraging classroom collaboration and enhancing critical thinking skills.

Description of the eMINTS Comprehensive Program

The eMINTS Comprehensive program is considered the National Center's flagship program. It began in 1999 as a professional development program for teachers in Missouri and has expanded into nine U.S. states and Australia. The overall goal of eMINTS Comprehensive is to help teachers develop student-centered, purposeful instruction fostered by technology utilization. The program addresses issues identified as barriers among teachers in the consistent use of standards-based instruction, student assessment information, and technology.

eMINTS Comprehensive is based on four underlying research-based components: inquiry-based learning, high-quality lesson design, community of learners, and technology integration.[4] The program includes a specific set of school and classroom technology equipment, intensive on-site professional development, online and face-to-face professional learning communities, and job-embedded coaching to enhance teachers' classroom practices (Joyce & Showers, 1995). Details on eMINTS Comprehensive, including equipment requirements, the teacher professional development program, and the recently added third-year professional development option with Intel, are provided in the following sections.

Equipment Requirements

To be properly implemented, eMINTS classrooms must first meet minimum hardware, software, Internet and equipment connectivity requirements.[5] An official eMINTS Comprehensive classroom at the middle school level includes an interactive whiteboard (e.g., SMART Board), LCD projector, teacher laptop, digital camera, printer/scanner, and at least a 1:1 ratio of students to computers. Specific Internet and equipment connectivity requirements must be met in an eMINTS classroom to ensure proper instructional functionality. Connectivity requirements may be met using either wired or wireless connectivity configurations or may be a combination of the two. In addition to Internet connectivity, the following setup requirements must be met to achieve minimum instructional functionality:

- A teacher laptop/workstation must connect to a classroom interactive whiteboard.
- A teacher laptop/workstation image must appear on the teacher monitor and interactive whiteboard simultaneously.
- Students must be able to display their work on the interactive whiteboard through a shared folder system or server.

Professional Development

eMINTS Comprehensive consists of professional development for school principals, district and school technology coordinators, and classroom teachers. Before the start of the school year, a certified eMINTS instructional specialist is assigned to a collection of schools according to the instructional specialist's geographic location to provide formal and individualized professional development to teachers and to communicate with principals and technology coordinators. The instructional specialist facilitates the ongoing development of a school-based leadership team within each school to support implementation and ensure that the required technology infrastructure and equipment functionality is maintained in eMINTS classrooms.

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[4] See Appendix B for a detailed description of the four eMINTS Instructional Model components.

[5] During the spring 2011 semester before the eMINTS study began, eMINTS National Center staff visited all study schools to assess their readiness for eMINTS implementation. When schools assigned to implement the eMINTS program (the "program schools") did not meet minimum infrastructural, hardware, or software requirements, center staff paid for the necessary equipment and infrastructure upgrades using Investing in Innovation (i3) grant funds.

eMINTS National Center program coordinators train principals and technology specialists to monitor and support eMINTS teachers' instructional improvements. Specifically, during a one-day face-to-face professional development session early in the school year, program coordinators introduce principals to constructivist theories underlying the eMINTS model and their implications for classroom teaching and learning. They introduce principals to an observation rubric for supervising and supporting eMINTS teachers' instructional performance according to eMINTS standards. During the winter and spring of each school year, the program coordinator or other certified eMINTS consultant returns to conduct a school walk-through with the principal to support implementation and to help the school integrate eMINTS with other school initiatives. During the two years, principals receive about 12 hours of professional development. They also receive a monthly newsletter with information about important elements of the eMINTS model and how they are applied in schools and classrooms. School technology coordinators are trained to understand eMINTS pedagogy and how technology is intended to support instruction. A certified eMINTS consultant conducts two two-hour online sessions with coordinators (four hours total) during each school year to introduce technology coordinators to eMINTS pedagogy and train them on equipment maintenance.

Teachers receive about 240 hours of professional development for two years to design high-quality inquiry-based lesson plans, implement inquiry-based learning strategies, build community among teachers and students, and integrate technology into classroom instruction. The instructional specialist works with his or her assigned schools and teachers throughout the year to secure dates and times to conduct formal professional development sessions. During the first year of professional development, teachers receive 126 hours of formal professional development in 26 sessions that are held throughout the school year. Sessions typically take place in an eMINTS classroom or computer lab in a central location and last between 4 and 6.5 hours each. The first-year curriculum focuses on basic technology applications, understanding constructivist pedagogy, community-building strategies (including interaction and interdependence), inquiry-based learning strategies, technology integration, and introducing authentic learning experiences into the classroom. At the end of the first year, teachers spend up to 12 additional hours developing a classroom website with the help of the instructional specialist. During the second year, the specialist conducts 88 hours of professional development in 20 sessions throughout the school year. The Year 2 curriculum focuses on classroom management, website enhancement, assessment, interdisciplinary teaching and learning, and development of multimedia and online projects. One session each year is reserved for teachers to travel to an eMINTS school and observe a certified eMINTS teacher. During both years, the specialist supplements these formal professional development sessions with nine to ten on-site and individualized coaching sessions (about 14 hours total) and within-building communities of practice where teaching staff meet to share ideas, collaborate on online project development, and deepen their existing understanding of concepts embedded in the eMINTS instructional model. Finally, eMINTS provides teachers with support materials and just-in-time learning opportunities via online learning communities to help teachers improve their practice over time.

Appendix A provides a detailed professional development schedule for the eMINTS Comprehensive program. Appendix B provides detailed definitions of the four components of the eMINTS instructional model.

Description of Intel® Teach

eMINTS will combine the 30 hours required to complete the Intel® Teach Elements online course "Project Based Approaches" with 12 hours of face-to-face professional development. The 12 hours of face-to-face professional development will be delivered in the following sequence and include the following topics:

- Session 1 (4 hours)—late summer or early fall 2013—preparation for taking the online Intel® Teach Elements course, expectations for unit (project) development, introduction of TWT Visual Ranking Tool
- Session 2 (4 hours)—December 2013—developing the unit (project) plan that is the product of the Intel® Teach Elements course, introduction of TWT Seeing Reason Tool
- Session 3 (4 hours)—late January or early February 2014—refining and completing the unit (project) plan for submission to program evaluators, introduction of TWT Showing Evidence Tool

When possible, the eMINTS instructional specialists who provide Year 1 and Year 2 professional development to their assigned schools will facilitate the online course to the same schools. The online professional development will be delivered in fall 2014 to the eMINTS + Intel group (September, October, and November). The course examines the features and benefits of project-based learning. Throughout the course, teachers consider their own teaching practice as they follow a teacher new to project-based learning who discusses strategies with a mentor teacher. Teachers also consider the ways that technology supports project-based approaches:

- Principles of project-based learning
- The Steps of Project design
- Integrating assessment throughout a project
- Developing a project timeline and implementation plan
- Guiding learning through questioning, collaboration, self-direction, and reflection

In addition to the face-to-face and online professional development sessions, teachers will receive four or five in-classroom coaching and mentoring visits approximately one hour in length from the eMINTS instructional specialist assigned to their cohort group. The coaching and mentoring sessions will occur in fall 2013 and winter 2014.

eMINTS Comprehensive + Intel® Teach Model of Change

As mentioned earlier, eMINTS and the Intel Corporation recently partnered to establish a third year of professional development for eMINTS teachers to augment the current eMINTS Comprehensive program. This combined program, referred to as "eMINTS+Intel" provides a third year of professional development using the Intel® Teach courses and online tools to further enhance teachers' technology integration skills and provide a specific set of online resources for teachers to support the four eMINTS components.

Figure 1.1 describes the model of change underlying the eMINTS Comprehensive and eMINTS+Intel programs. In the eMINTS Comprehensive program, the technology resources combined with intensive teacher professional development and schoolwide support is intended to transform teachers' classroom lesson planning and instruction. Through intensive professional development and one-on-one support, teachers learn how to develop high-quality lesson plans and integrate technology in their classroom instruction, in order to promote inquiry-based lessons and collaborative classroom communities. These instructional changes should, in turn, influence students' engagement in school and improve students' 21st century skills (i.e., critical thinking, communication, technology literacy) and achievement on annual state-administered assessments. The third year of Intel® Teach professional development is expected to accelerate outcomes for teachers and students by providing teachers with additional professional development and Web-based tools to build on what they learned during the first two years of the program.

Figure 1.1. eMINTS Comprehensive + Intel® Teach Elements Model of Change

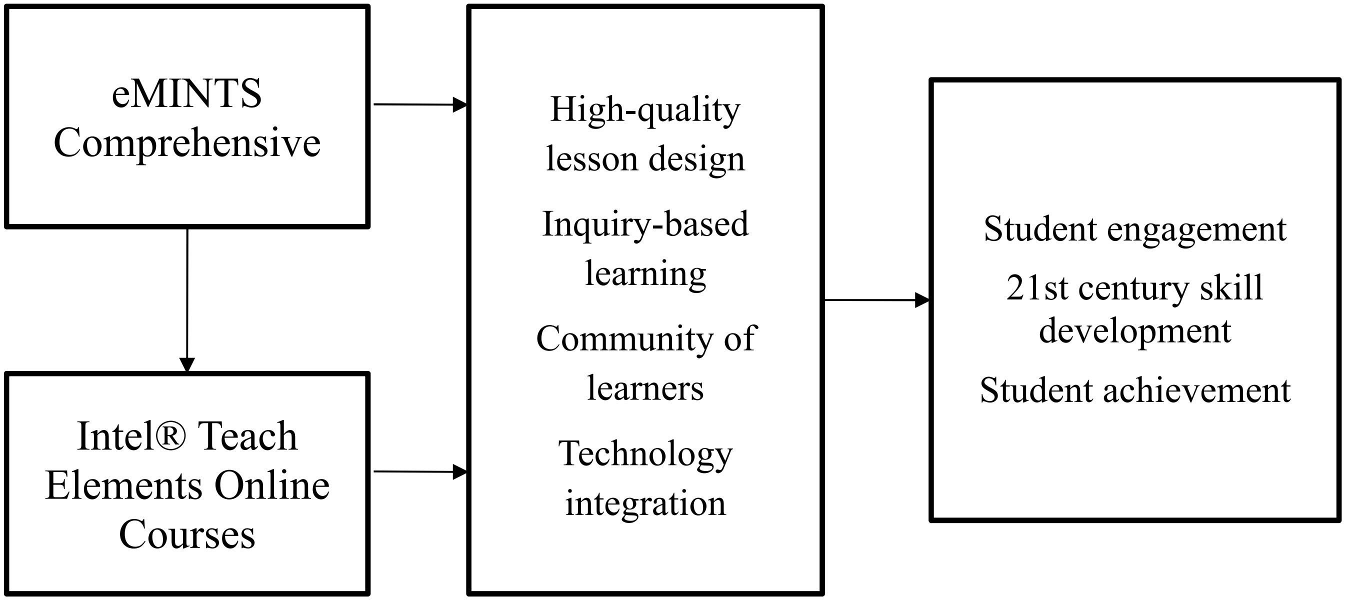


Figure 1.2 provides a more detailed logic model, which diagrams the resources, processes, teacher outputs, and expected student outcomes to be realized as a result of implementing the eMINTS Comprehensive and eMINTS+Intel programs. Building-level inputs include improvements to the school's technology equipment and infrastructure such as computers, SMART Boards, digital cameras, scanners, LCD projectors, advanced software programs for teachers and students, and technology support and bandwidth.

The eMINTS theory holds that school conditions should improve teachers' classroom practice when

- schools are provided with up-to-date technology and a high-performing technological infrastructure
- principals are trained to understand constructivist pedagogy and its potential for accelerating students' learning
- principals support and monitor eMINTS classroom improvements over time
- technology specialists are available in the school to support technology use and conduct regular equipment maintenance
- school decision making occurs regularly through professional learning communities involving teachers, school leadership, and outside consultants (e.g., the instructional specialist)

With adequate conditions in place at the school level, classroom practice should improve when teachers

- understand the benefits of constructivist pedagogy for accelerating students' learning
- learn to design standards-based lessons, implement inquiry-based learning strategies, build collaborative classroom communities, and infuse technology into their instruction
- receive individualized support from a specialist to reinforce what they learn in formal professional development sessions
- participate in a professional learning community to share ideas and receive feedback from their colleagues
- receive support and accountability from their school leadership (via walk-throughs and ongoing feedback)

With intensive and differentiated professional development grounded in constructivist pedagogy, an adequate technology infrastructure to engage teachers and students, support to understand and apply new strategies in their classrooms, and accountability from colleagues and school leadership, teachers should gradually improve the extent to which their lesson plans are aligned to standards and grounded in assessment, incorporate more inquiry-based learning strategies in their instruction, strengthen relationships with students, improve their own technology literacy, and facilitate a vibrant classroom community of learners.

As schools and teachers gradually develop and demonstrate these characteristics, students should demonstrate

- improvement in academic orientation in school
- improvement in 21st century skill development such as communication, technology literacy, and critical thinking
- improvement in achievement as measured by statewide achievement tests

Integration of eMINTS Comprehensive and Intel® Teach Programs

As mentioned in the previous section, the theory supporting the eMINTS + Intel model holds that a third year of professional development should accelerate the changes observed in teachers' practices and students' achievement over and above the traditional two-year eMINTS model. This occurs primarily through professional development to reinforce concepts in standards-based lesson design, inquiry-based learning strategies and assessment, and technology integration.

Figure 1.2. Logic Model for eMINTS Comprehensive + Intel

RESOURCES

Technology equipment

- 1 to 1 student/ laptop computer ratio
- Interactive whiteboard
- Teacher laptop
- Digital camera
- Scanner/ printer

Technology infrastructure

- Data storage
- Backup and disaster recovery
- Internet connectivity
- Internet security
- Wireless connection
- Shared folder system or server

ACTIVITIES

eMINTS Comp (Years 1–2)

Teacher professional development

- Year 1—26 PLC sessions, 126 hours
- Year 2—20 PLC sessions, 88 hours
- 10 classroom visits/year
- Online access to curriculum and course materials

Administrative support

- School administrator professional development
- School administrator support for eMINTS

Ongoing technology support

- Technology coordinator professional development

Intel Teach (Year 3)

Teacher professional development

- 11 PLC sessions, 40 hours
- Access to curriculum and online resources

SHORT TERM OUTCOMES

Increase in teacher effectiveness

- High-quality lesson design
- Inquiry-based learning strategies
- Community of learners
- Technology integration

Increase in student engagement

LONG-TERM OUTCOMES

Improvement in 21st century skills

- Critical thinking,
- Communication
- Technology literacy

Increases in performance on the state achievement test

Prior Research on the eMINTS Program

eMINTS is one of only a few PD programs with data to support the chain of evidence from delivery of a specific PD program to changing teacher practice and to positive impact on student achievement (Martin, Strother, Beglau, Bates, & Reitzes, 2010). Since its inception in 1999, annual external evaluations of the eMINTS program have been conducted to determine the effects of eMINTS PD on teacher and student outcomes. Qualitative research and formative evaluations also contributed to a better understanding of the facilitating factors and challenges associated with school and classroom implementation of eMINTS. In the following paragraphs, we summarize 10 years of eMINTS PD research and evaluation and assess the quality of evidence reported on the program's effectiveness to date. "eMINTS classroom" refers to classes taught by certified eMINTS teachers and fulfilling eMINTS technology requirements.

Teacher Outcomes

eMINTS PD is designed to help teachers learn how to integrate technology into their teaching, use instructional strategies that promote standards- and inquiry-based learning, and encourage collaboration and community building among students and teachers. One of the earliest reports on eMINTS from Missouri's Office of Social and Economic Data Analysis ([OSEDA], 2001a) presented the results of surveys taken by the first cohort of eMINTS teachers and administered at three points throughout two years. In these early self-reports, teachers reported improvements in their inquiry-based teaching activities, their computer usage, and their perception of computing skills. A second report that focused on teacher change in lesson typology through multiple observations found that after one year of eMINTS implementation, participating teachers transitioned from teacher-centered models to hybrid or student-centered models (OSEDA, 2001b). Furthermore, early evaluations (OSEDA, 2003b) demonstrated a positive relationship between eMINTS professional development on inquiry-based learning strategies and teachers' enactment of those components in their practice.

Using an observation scale to measure classroom climate of eMINTS teachers, early eMINTS evaluations also found evidence suggesting that eMINTS teachers who facilitated student-centered instruction were significantly more likely to construct a well-ordered and effective learning environment than those eMINTS teachers who were less focused on facilitating student-centered instruction (OSEDA, 2003c). Subsequent research demonstrated that eMINTS teachers' instruction became increasingly student-centered, and their classrooms became increasingly linked to effective behavior management strategies (Tharp, 2004). Similar findings were observed among principals participating in the eMINTS program (Tharp, 2006), in that principals of eMINTS schools more frequently engaged students and increasingly monitored student achievement and progress.

More recent eMINTS program evaluations have placed a focus on program fidelity and its impact on teachers' mastery (Martin et al., 2009; Martin et al., 2008). Education Development Center's (EDC's) Center for Children and Technology's 2008 external evaluation (Martin et al., 2008) found high levels of fidelity in terms of program delivery, and teachers demonstrated high levels of mastery on classroom technology integration and inquiry-based learning strategies. These high levels were found in programs implemented primarily under the direction of eMINTS staff members and those implemented under the direction of district-level instructional specialists who had satisfactorily completed or were actively participating in the eMINTS train-the-trainer program called Professional Development for Educational Technology Specialists.

The evaluation also found significant positive correlations between program fidelity and teacher mastery scores on eMINTS lesson planning procedures and the WebQuests[6] teachers submitted as part of program participation requirements (Martin et al., 2008). Specifically, the following factors of program fidelity were correlated with lesson planning at the .01 level of significance: scaffolding instruction (.263[7]), active work/learning (.296), modeling instruction (.388), technology utilization (.268), connection to practice (.217), and inquiry-based learning (.205). An EDC evaluation (Martin et al., 2009) substantiated these findings, adding that "evidence [suggests] that the more closely aligned the local implementation of eMINTS is to core program goals, the greater the impact the program has on teachers' understanding of the material and on students' performance on standardized assessments." For example, in communication arts and mathematics for Grades 4 and 5, correlations between PD fidelity and student achievement is significant at the .05 level in both 2007 and 2008. Of the various components of PD fidelity, technology utilization and inquiry-based learning became more strongly correlated with student test scores in both communication arts and mathematics as grade levels increased (Martin et al., 2010).

Student Outcomes

eMINTS external program evaluations conducted from 2002 through 2005 used a quasi-experimental design that compared the performance of students in eMINTS classrooms with performance of students in non-eMINTS classrooms. These evaluations consistently found that intermediate elementary (Grades 3–6) students enrolled in eMINTS classrooms significantly outperformed students enrolled in non-eMINTS classrooms on Missouri's state standardized performance assessment, the Missouri Assessment Program (MAP), in communication arts, mathematics, science, and social studies. These results primarily pertained to students in Grade 3 communication arts and science and Grade 4 mathematics and social studies, with small sample sizes suggesting similar results may exist at Grades 5 and 6 (Hager, 2004; Hunter & Greever-Rice, 2007; OSEDA, 2002, 2003a, 2004, 2005; Tharp, Bickford, & Hager, 2005). OSEDA analyses were conducted using student achievement data from MAP to compare the percentage of students attaining proficient and advanced levels of achievement in eMINTS classrooms with the percentage of students reaching those levels in non-eMINTS classrooms. A larger percentage of eMINTS students attained proficiency or advanced levels of achievement than did non-eMINTS students in communication arts from 2002 to 2005, the difference being statistically significant at the .05 level from 2003 to 2005. Mathematics results are similar, with the only exception being 2004, when non-eMINTS students had a slightly (0.4 percent) higher rate of proficiency. The other three years of mathematics assessment data indicate statistically significant differences in favor of eMINTS students.

More recent evaluations conducted by the EDC from 2006 to 2009 substantiated OSEDA's earlier findings. EDC's evaluations focused on schools that received competitive Title II.D Enhancing Education Through Technology (EETT) grant awards in Missouri. The first study consisted of a sample of about 7,000 students, approximately one third of whom were in treatment classes, spread across 340 classes in 31 districts. Later reports more evenly distributed

[6] A WebQuest is an inquiry-oriented lesson format in which most information used is derived from the Internet.

[7] Numbers in parentheses represent Pearson correlation coefficients.

the number of students in eMINTS classrooms and the number of students enrolled in non-eMINTS classrooms (approximately 6,000 students total per year) across 35 to 40 schools and fewer districts (about 10). These reports of a more established eMINTS program extended to Grades 5 and 6, where students in eMINTS classrooms consistently attained higher rates of proficiency or advanced levels in all grades (3–6) in communication arts and mathematics, with significant results at the .01 level in most comparisons, including Grades 5 and 6 (Strother, Martin, & Dechaume, 2006).

Turning to mean achievement differences on the MAP state tests, early reports (2002 and 2003 results) indicate that students in eMINTS classes consistently outscored their peers in non-eMINTS classes as well as all other Missouri students. MAP communication arts findings revealed that eMINTS students had higher mean scores across years, with significant differences growing larger each year (from less than 1 point to more than 10 points) and producing greater effect sizes (.013 to .173). On the MAP mathematics test, the mean score differential (7 to 10 points) and effect sizes (approximately .25) remained stable and significant throughout the reports. In the first two reports (OSEDA, 2002, 2003a), eMINTS students scored higher in science but not significantly so. The results in social studies are significant, however, with effect sizes between .16 and .18.

For all subjects, the magnitude of the gap between eMINTS and non-eMINTS students by group—those with an individualized education program (IEP), in a Title I school, who qualified for the free or reduced-price lunch program, minority—was statistically significant after their teachers had received one year of professional development. Effect sizes were consistently larger for some subgroups, especially students qualifying for free or reduced-price lunch. For example, the OSEDA (2004) analysis of 2003 MAP data reported the following effect sizes: communication arts (.21), mathematics (.19), science (.11), and social studies (.20). Even larger effect sizes were found when student achievement in Schoolwide Title I schools was analyzed: .29, .32, .16, and .25, respectively. These findings were consistent across OSEDA reports. In addition, students with IEPs and students with limited English proficiency (LEP) in eMINTS schools outscored their non-eMINTS peers by approximately one standard deviation in each of the four subjects, and the differences in means were statistically significant at the .001 level (Martin et al., 2008; Strother et al., 2006). "The fact that the effects were most dramatic among the highest need students suggests that the kind of environments eMINTS teachers create in their classrooms may be particularly effective for these students" (Strother et al., 2006, p. 7).

The original eMINTS intervention was a two-year program. Analyses indicate students of second-year eMINTS teachers significantly outscore non-eMINTS students and students with first-year eMINTS teachers (Martin et al., 2009; OSEDA, 2003c). Results of perhaps the strongest evaluation of eMINTS yet conducted appear to confirm this. Martin et al.'s (2009) longitudinal analysis of student performance for two years (fall 2007 to spring 2009), utilizing a matched-schools design, found that students assigned to eMINTS classrooms during both years significantly outperformed students assigned to non-eMINTS classrooms for both years at Grade 5 in communication arts ($p < .05$) and Grade 6 in communication arts ($p < .05$) and mathematics ($p < .001$). In addition, scores of students having two years with eMINTS teachers were significantly greater than those of students having an eMINTS teacher for only one year in Grade 6 communication arts ($p < .01$) and Grade 6 mathematics ($p < .001$). Moreover, the variance explained by having two eMINTS teachers was sizeable, especially for mathematics (23.8 percent).

As described earlier, a decade of evaluation on eMINTS consistently has shown promise in changing elementary teachers' practice and raising student achievement. In particular, these results were found to exist in communication arts, mathematics, and social studies among intermediate elementary students representing a range of demographics in more than 40 school districts across Missouri.

Collectively, the studies of eMINTS on teacher and student outcomes suggest that the program makes a difference. Teachers appear to change practices, and students seem to achieve at higher levels. But none of the studies is a rigorous quasi-experimental design or randomized controlled trial. In addition, the studies overall lack a focus beyond elementary schools, that is, the studies include elementary students, ranging from Grades 3 to 6, and the participating schools represent multiple states and populations (e.g., rural and urban settings). The current evaluation elevates the level of rigor through a randomized controlled trial and expands the reach of research results to middle school students (Grades 7 and 8) in high-poverty rural settings across Missouri.

Research Questions

Unlike previous evaluations of eMINTS professional development, this study focuses on the evaluation of rural middle schools only and uses experimental design to assess the effectiveness of the eMINTS Comprehensive Model on teacher practice and student achievement. After the first and second year of implementation, we plan to assess the impact of the eMINTS Comprehensive Model against control schools that are conducting business as usual. After a third year, the study assesses the added impact of teacher professional development supported by Intel professional development curriculum and instructional resources on teacher practice and student achievement against two groups of schools: those implementing the traditional two-year eMINTS Comprehensive program and control schools. In Years 1–3, the study investigates the following confirmatory research questions:[8]

1. What is the impact of the eMINTS Comprehensive program on Grade 7 and 8 students' mathematics and communication arts performance?
2. What is the impact of the eMINTS Comprehensive program on Grade 7 and 8 students' 21st century skills, which include communication, technology literacy, and critical thinking?
3. Does eMINTS plus a third year of professional development supported by the Intel Teach program result in a greater impact on Grade 7 and 8 students' performance relative to traditional eMINTS Comprehensive and control schools?

In addition, exploratory questions on teacher practices will be examined, including impacts on the extent to which teachers demonstrate high-quality lesson design, implement inquiry-based

[8] Confirmatory research questions are the main questions this study is designed to address. This study was designed using an experimental design to provide rigorous estimates of the causal effects of the eMINTS and eMINTS + Intel programs.

learning strategies and a community of learners, and integrate technology in their instruction. In Years 2 and 3, the study will investigate variations across subgroups of students, including special education students and students who qualify for the free or reduced-price lunch program. Year 2 and Year 3 reports also will explore whether a difference in years of student exposure to eMINTS-trained teachers results in differences in impact on performance.

This Year 1 report provides preliminary results on questions one and two, as well as exploratory results on teachers' practices after one year of implementation. A total of 60 schools, 191 teachers (134 eMINTS and eMINTS + Intel, 57 control), and 3,610 seventh- and eighth-grade students (2,700 eMINTS and eMINTS + Intel, 910 control)[9] were randomly assigned to one of three groups: the traditional eMINTS Comprehensive Program, eMINTS Comprehensive plus a third year of professional development using the Intel® Teach Elements courses, or business as usual. By design, eMINTS Comprehensive is a two-year PD program, and the eMINTS + Intel® Teach Elements adds a third year to the original program length. The MAP state tests are administered annually in the spring. Similarly, the research team administers the 21st Century Skills Assessment in the spring of each study year. In this first year of implementation, eMINTS teachers had not yet received one full year of eMINTS PD. The study team did not expect strong contrasts between treatment and control classrooms in teachers' instruction or student performance at the end of the 2011–12 school year. ***Because of the preliminary nature of these analyses, results presented here should be interpreted with caution.***

Roadmap to This Report

Chapter 2 provides details on the study's research design, sample recruitment and characteristics, data collection and outcome measures, data analytic methods, and limitations of the study design. Chapter 3 presents a discussion of the eMINTS intervention as implemented for this study and provides fidelity of implementation findings, including the extent of program delivery by eMINTS staff, the extent to which principals and other school staff supported the eMINTS program, and the extent to which teachers participated in eMINTS professional development and consultation services. Chapter 4 addresses research question 2, the study's main research on impacts on communication arts and mathematics achievement for the study sites, as well as levels of student engagement. Chapter 5 addresses exploratory impacts of the eMINTS Comprehensive program on teachers' practices after one year of implementation.

[9] Because eMINTS and eMINTS + Intel groups receive the same professional development in the first two years of this study, results are analyzed as one group in this report.

Chapter 2: Study Design and Methodology

Study Design

This study employs a three-year cluster-randomized design, assigning 20 schools each (60 schools in total) to one of three groups (eMINTS only, eMINTS + Intel, or business as usual) to obtain unbiased estimates of the impact of the eMINTS and eMINTS+Intel programs on middle school students' communication arts and mathematics achievement. A cluster-randomized design randomly assigns clusters of units (i.e., schools) to either a treatment or a control condition. Randomization ensures that the treatment and control groups are, in expectation, equivalent on baseline characteristics, and therefore yields unbiased estimates of the causal effects of the intervention. This chapter describes the research design, recruitment of districts and schools, randomization of schools to treatment or control condition, analysis sample, and baseline characteristics of participating schools, teachers, and students. It also discusses attrition, data collection and measures, methods used for impact estimation, and study limitations.

Participant Eligibility and Recruitment

Participating study schools include high-poverty rural Missouri middle schools with Grade 7 and 8 students. To qualify for the study, schools had to meet requirements under Title I (schoolwide or targeted) or Missouri's historical requirements for Title II.D (50 percent of students in poverty) and be part of the Small Rural School Achievement program or the Rural and Low-Income School program authorized under the Elementary and Secondary Education Act Title VI, Part B. Grade 7 and 8 teachers were targeted for this study for two reasons: First, as indicated previously, more empirical research is needed to substantiate the effects of eMINTS on teachers and students at the middle school level. Second, high dropout rates are persistent in poor and rural districts (Mac Iver & Mac Iver, 2009). Grades 7 and 8 represent a critical transition period for students who may be at risk of failing or dropping out of high school in later years (Herlihy, 2007). This study represents the first step toward examining the extent to which the eMINTS program improves middle school students' engagement and achievement levels and puts them on track to high school graduation.

The eMINTS National Center at the University of Missouri has offered their professional development for more than a decade. During that period, eMINTS steadily increased the number of participating schools and teachers across Missouri. Because the demand for eMINTS among high-poverty rural Missouri districts far exceeds the number that have traditionally been funded by federal or state funds, the incentives to participate in this study for many rural districts were self-evident, even if that meant being assigned to the control condition. For example, during the last 10 years, only 36 percent of eligible Title II.D districts that applied for eMINTS were awarded a grant. Moreover, no additional grants are expected after 2010 because of federal cuts in Title II.D. In addition, 20 percent of eligible districts submitted applications more than twice, with some districts applying in seven separate years without receiving an award, indicating persistent strong interest in eMINTS despite repeated failures to secure an award. Within only two weeks of recruitment, 68 districts/schools provided letters of interest to participate in the study, indicating high demand for eMINTS, and consequently, schools' willingness to wait three years if they are guaranteed an opportunity to implement eMINTS. Schools that participated in the study were guaranteed to receive the program either immediately or after a three-year delay. Control group teachers and data points of contact (POCs) received a small monetary incentive of $250 for their participation in data collection activities (teacher survey and classroom observation).

The study team collected signed student assent forms and signed consent[10] forms from teachers and parents of Grade 6, 7, and 8 students annually. eMINTS conducted information meetings with parents and students in the fall of the 2011–12 school year. As part of these meetings, eMINTS provided disclosure information about the study as required by the University of Missouri's institutional review board and consent and assent forms for the parents and students to complete. The same process is present in treatment and control schools. Student assent and parent consent is primarily needed for student academic orientation surveys and the 21st Century Skills Assessment because these assessments are being administered to students as part of the study and are not considered a regular part of students' instruction or schooling. Ultimately, the study team obtained signed consent from 185 teachers and consent and assent from 2,999 parents and students in Year 1 (the 2011–12 school year).

Random Assignment

After receiving signed commitments from the 60 schools, we randomly assigned schools to one of three groups. As shown in Table 2.1, schools assigned to Group 1 were offered the traditional two-year eMINTS Comprehensive program (eMINTS) beginning in fall 2011;[11] Group 2 schools were offered the traditional two-year eMINTS program plus a third year of Intel® Teach professional development (eMINTS+Intel) beginning in fall 2013; and Group 3 was asked to conduct business as usual (BAU) with no exposure to the eMINTS or eMINTS+Intel Teach (Control) until fall 2014.

Table 2.1. School Assignment

Summer 2010	Fall 2010		2011–12	2012–13	2013–14
Recruit 60 schools for participation*	Random assignment of N=60 schools	eMINTS N=20	eMINTS	eMINTS	No additional professional development
		eMINTS+ Intel N=20	eMINTS	eMINTS	Intel® Teach
		Control N=20	BAU	BAU	BAU

To determine school assignments, we used one blocking variable, placing schools into the following three groups according to their grade configuration:

[10]For students, signed parent consent forms with an affirmative notation allow the students to be in the study. Signed student assent forms with an affirmative notation indicate students' willingness to be in the study.

[11] All schools in the study will receive the full three years of PD. The eMINTS-only group will receive the third year of professional development after the third year of data collection is complete, beginning in fall 2014. Similarly, the BAU schools will begin receiving the three-year eMINTS program in fall 2014.

- Block 1 (30 schools): PK–8 schools (coded as 1)
- Block 2 (8 schools): 5–8, 6–8, and 7–8 schools (coded as 2, 3, and 4, respectively)
- Block 3 (22 schools): 6–12 and 7–12 schools (coded as 5 and 6, respectively)

Next, a random number was generated for each school within each block and, within each block, we assigned schools with random number values in the lowest third to Group 1, eMINTS, the middle third to Group 2 to eMINTS +, and highest third to control.

Blocks 2 and 3 were not divisible by three and, therefore, could not be equally distributed into each of three groups. To ensure equal sample sizes across study conditions, we assigned one less school to the BAU condition in block 2 and one additional school to the BAU condition in Block 3 before generating random numbers for sample schools.

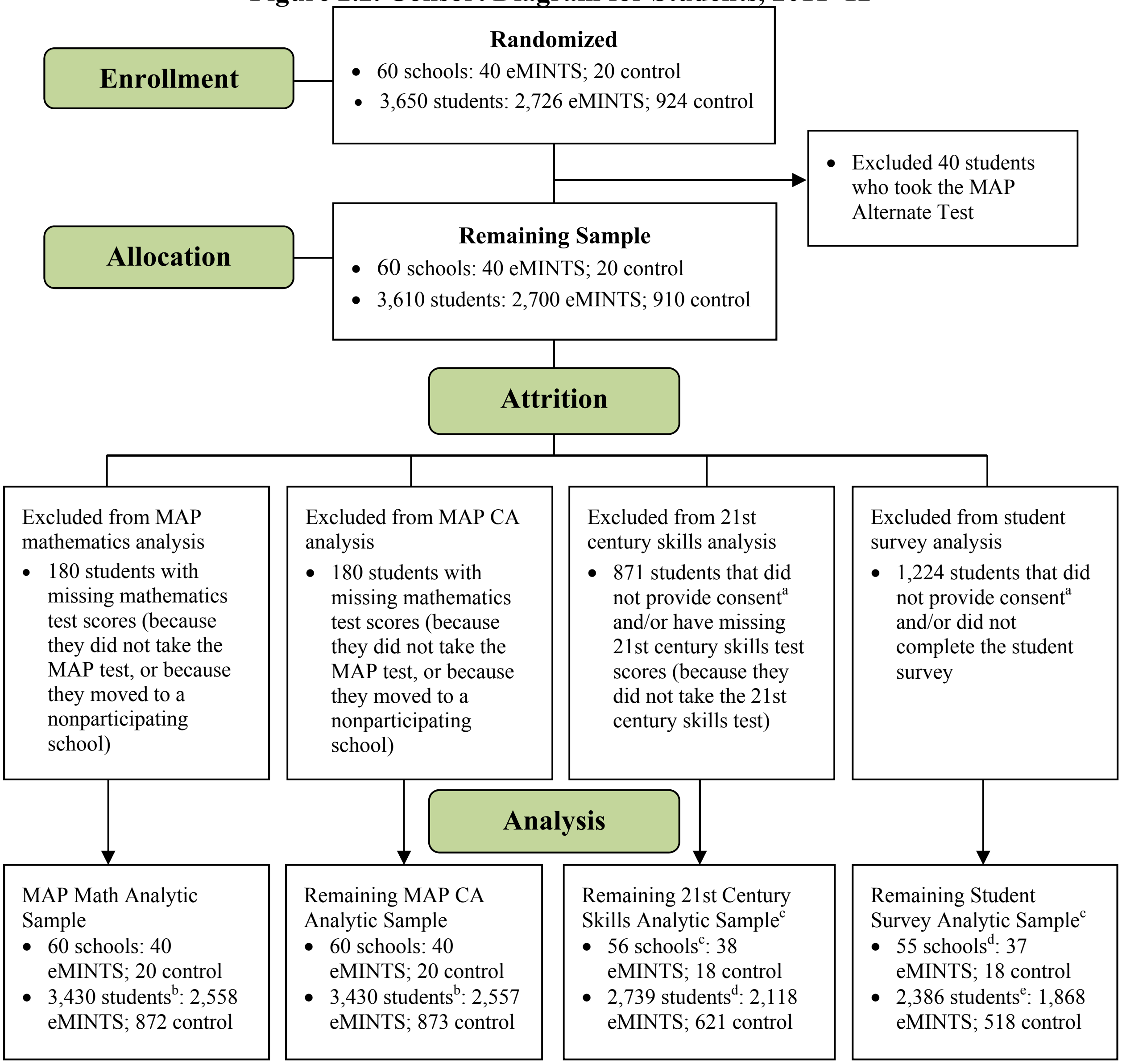
Analytic Sample

Figure 2.2 describes the construction of the Year 1 (2011–12) analytic sample for the MAP and 21st Century Skills Assessments. Of the 60 schools randomly assigned to groups, two withdrew from the study before Year 1 implementation began. Students from these two schools are not included in sample attrition on the MAP mathematics and communication arts outcomes because students in the schools that left the study took the MAP assessment in spring 2012. Because these schools were included in random assignment, they are included in the intent-to-treat analysis of the Year 1 sample presented in chapter 4. Students from these two schools did not take the 21st Century Skills Assessment or student engagement survey and, thus, are included in sample attrition results on this outcome.

As Figure 2.2 illustrates, 60 schools were randomized to one of three treatment groups. For the purposes of our Year 1 analysis, schools in eMINTS and eMINTS+Intel groups were combined because each group received the same treatment in Year 1. A total of 3,430 students were included in the final Year 1 MAP mathematics (2,558 treatment, 872 control) and communication arts 2,557 treatment, 873 control) analytic samples; 2,739 students (2,118 treatment, 621 control) were included in the 21st Century Skills Assessment analytic sample, and 2,386 (1,868 treatment, 518 control) students were included in the student engagement survey analysis.[12]

[12] The 21st Century Skills Assessment and student engagement sample sizes are lower than the MAP test student samples because parent consent and student assent with affirmative notation were required for students to complete the 21st Century Skills Assessment and student engagement survey. The study team needed to collect parent consent and student assent for these measures because neither are not part of the school's regular data collection activities.

Figure 2.2. Consort Diagram for Students, 2011–12



[a]Students who did not provide assent were excluded from the 21st Century Skills Assessment and student survey analyses. These students were, however, included in the MAP mathematics or communication arts analyses provided they had nonmissing MAP mathematics or communication arts scores.

[b]3,426 of the 3,430 students in the MAP mathematics analytic sample also are in the MAP communication arts analytic sample. The remaining 4 of the 3,430 students the mathematics sample are not in the communication arts sample, and the remaining 4 of the 3,430 students in the communication arts sample are not in the mathematics sample.

[c]Four schools had missing 21st century skills test scores: two of these schools withdrew after randomization, one school was not able to administer the test, and students in one school either did not take the test or did not provide student assent or parent consent.

[d]Five schools had missing student survey data: two of these schools withdrew after randomization, and three schools did not have any student survey data.

[e]The 2,739 students in the 21st century skills analytic sample are all in the MAP mathematics analytic sample, and all except one are in the MAP communication arts analytic sample.

Source: Authors' analysis based on data from Missouri Department of Elementary and Secondary Education (MO DESE) and the study districts.

A similar figure is included in Appendix C to show the construction of the Year 1 analytic sample for teacher outcomes. The analytic sample on teacher survey results included 155 teachers (106 eMINTS; 49 control); the analytic sample on classroom observation results included 161 teachers (112 eMINTS; 49 control).

Baseline Equivalence

Random assignment, particularly when the sample sizes in each group are large,[13] is expected to result in statistically equivalent groups on all observable and unobservable variables. Group equivalence strengthens our capability to attribute any observed differences in outcomes between the groups to the intervention. Although it is not possible to test equivalence for unobservable variables, baseline equivalence of the groups can be assessed for variables on which data are available. In this section, we examine the initial equivalence of eMINTS, eMINTS+Intel, and control group teachers and students on all observable variables collected.

Although schools were randomized into three groups (eMINTS, eMINTS+Intel Teach, and Control), the eMINTS+Intel Teach PD will be implemented only in Year 3. This means that although the Year 3 analyses involve three groups, the Year 1 and Year 2 analyses will include only two groups: eMINTS (which includes all schools assigned to either eMINTS or eMINTS+Intel Teach) and control. Hence, we will conduct two sets of baseline comparisons:

1. Baseline comparison for Year 1 and Year 2 analyses: (eMINTS and eMINTS+Intel Teach combined) versus control
2. Baseline comparison for Year 3 analyses: eMINTS versus eMINTS+Intel Teach versus Control

For the Year 1 student analyses, which are the sole focus of this report, differences in baseline student characteristics are estimated using a two-level model on the pooled sample of seventh- and eighth-graders, adjusting for student's grade in Year 1. Differences were estimated separately by randomization block and then pooled into an overall weighted average, using the number of study schools in each block as weight. (See Appendix D for the model used.)

[13] As Bloom (2006) underscores, the randomization process yields, on average, intervention and control groups that are equivalent on all observable and nonobservable characteristics. Randomization applied to a specific sample, however, does not guarantee group equivalence, since it is possible to obtain groups that differ simply by chance.

Comparisons of baseline teacher characteristics for the Year 1/Year 2 and Year 3 analyses were conducted similarly, except that single-level (OLS) regression models were used in place of two-level models. Similarly, baseline school characteristics were compared using the OLS models, but without the grade indicator ($Grade_{ij}$) as predictor.

The chi-square test of independence was used to test for group equivalence with respect to categorical variables, and the two-sided t test for equality of means was used for continuous variables.

Baseline School Characteristics

Of the 60 schools, 30 serve Grades PK–8 or Grades K–8, 8 serve Grades 6–8 or Grades 7–8, and the remaining 22 serve Grades 6–12 or Grades 7–12. Table 2.2 compares the baseline demographic characteristics and performance of schools in the sample. Across all school demographic characteristics examined, results showed that eMINTS and control schools were relatively similar with the exception of one variable: school enrollment. Enrollment in both groups was less than 200 students, reflecting the small and rural aspects of the sample schools. eMINTS schools, however, enrolled 50 more students than control schools did, and the between-group difference in enrollment was statistically significant. Across both groups, about 5 percent of students were minorities, 58 percent qualified for free or reduced-priced lunch, less than 2 percent were English language learners, and between 12 and 13 percent had an identified disability. Teachers in eMINTS schools averaged almost one year more of experience than their control counterparts (11.9 versus 11.0), but 2 percent more teachers in control schools had a master's degree. Average state test results among seventh- and eighth-grade students on the MAP mathematics and communication arts assessments were nonsignificant with one exception. Specifically, eighth-grade control students scored significantly higher on the communication arts assessment, with scores averaging about seven points higher than scores at eMINTS schools.

Table 2.2. Characteristics of Study Schools, 2010–11 (Before Year 1 Implementation)

Characteristic	eMINTS Mean[a]	Control Mean	Estimated Difference	*p*-value	Effect Size[b]
Number of schools	40	20			
Average total school enrollment	181.7	128.2	53.5	0.046*	0.52
Average percentage of students eligible for free/reduced-price lunch	58.2	57.6	0.6	0.856	0.03
Average percentage of nonwhite students	5.1	5.2	–0.1	0.970	–0.10
Average percentage of male students	50.5	49.9	0.6	0.586	0.14
Average percentage of limited English proficient students	1.8	1.2	0.6	0.668	0.09

Characteristic	eMINTS Mean[a]	Control Mean	Estimated Difference	*p*-value	Effect Size[b]
Average percentage of students with a disability	13.3	12.4	0.9	0.413	0.28
Average years teaching experience	11.9	11.0	0.9	0.229	0.31
Average percentage of teachers with master's degree	41.7	43.7	–2.0	0.667	–0.14
Mean scale score in spring 2011 MAP communication arts					
Grade 7	679.3 (*n* = 38)[2]	678.0 (*n* = 19)	1.3	0.714	0.10
Grade 8	692.5 (*n* = 36)	699.2 (*n* = 19)	–6.7	0.047*	–0.55
Mean scale score in spring 2011 MAP Mathematics					
Grade 7	688.2 (*n* = 38)	682.4 (*n* = 19)	5.9	0.152	0.41
Grade 8	705.4 (*n* = 36)	708.4 (*n* = 19)	–3.0	0.426	–0.26
Joint test of difference in school characteristics between control and eMINTS groups[c] □2 = 22.5, df = 14, *p*-value = 0.068					

* Difference statistically significantly different from zero at the .05 level.

[a]Means and differences are weighted averages across blocks, weighted by the number of study schools in each block. The *p*-values are from two-tailed tests of equality of means (or proportions).

[b]When data are missing, *n* is the actual number of schools used to calculate the average characteristic in each treatment group. Missing data on the spring 2011 school mean MAP scores in communication arts and in mathematics are due to the fact that MO DESE does not report grade-level school means when less than five students in a grade took the test. As the table shows, less than five seventh-grade students took the test in two eMINTS schools and in one control school, and less than five eighth-grade students took the test in four eMINTS schools and in one control school.

[c]An overall test of the difference between eMINTS and control groups based on all school characteristics in the table was conducted using a chi-square test. The chi-square test is from a logistic regression model with the binary treatment indicator as outcome, and the school characteristics in this table, as well as indicators for missing school mean MAP scores, as covariates.

Source: Authors' analysis based on data from the National Center for Education Statistics Common Core of Data 2010–11 and the MO DESE.

Baseline Teacher Characteristics

Demographic characteristics of participating Grade 7 and 8 teachers are summarized by subject area (communication arts and mathematics, respectively) in Tables 2.3 and 2.4. Among communication arts teachers, demographic characteristics of the two groups were similar in terms of percentage male/female teachers, years of experience, and percentage with graduate degrees. Teachers in both groups had about 10.5 years' experience and about 60 percent had graduate degrees. Six percent more communication arts teachers in the eMINTS group were male (12.7% versus 6.7%). None of the differences was statistically significant.

Table 2.3. Characteristics of Teachers in the MAP Communication Arts Analytic Sample, 2010–11 (Before Year 1 Implementation)

Characteristic	eMINTS Mean[a]	Control Mean	Estimated Difference	*p*-Value	Effect Size[b]
Number of teachers	72	25			
Percentage male	12.7	6.7	6.0	0.381	0.43
Percentage with graduate degree	59.6	60.9	–1.4	0.906	–0.05
Years teaching experience	10.4	10.7	–0.3	0.878	–0.05
Joint test of difference in student characteristics between eMINTS and control groups $\chi^2 = 0.77$, df = 3, *p*-value = .380					

[a]Means and differences were regression-adjusted to account for block effects and weighted by the number of schools in each block. Because of a zero cell count for males in one block, however, differences between males and females were estimated on the whole sample (instead of separately by blocks). *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means (or proportions).

[b]Except for gender, effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*) for continuous variables, and using Cox index for binary variables.

[c]An overall test of the difference between the eMINTS and control groups based on the teacher characteristics in this table was conducted using a chi-square test. The chi-square test is from a logistic regression model with the binary treatment indicator as outcome and the teacher characteristics in this table as covariates.

Source: Authors' analysis based on the teacher baseline data collected in spring 2011 from study districts and the MO DESE.

In mathematics, the percentage of male teachers in the eMINTS group was higher by 7.6 percentage points than in the control group (23.7% versus 16.0%). In contrast, the percentage of mathematics teachers with a master's degree was higher by about 9 percentage points in the control group (41.6% versus 50.5%). Teachers in both groups averaged more than 12 years of experience. None of these group differences was significant.[14]

[14] It should be noted here that teacher characteristics were not included in 21st century learning skills or student engagement analyses because some students might have multiple eMINTS teachers, so baseline comparisons between teachers for those analyses are not necessary.

Table 2.4. Characteristics of Teachers in the MAP Mathematics Analytic Sample, 2010–11 (Before Year Implementation)

Characteristic	eMINTS Mean[a]	Control Mean	Estimated Difference	p-Value	Effect Size[b]
Number of teachers	63	30			
Percentage male	23.6	16.0	7.6	0.426	0.29
Percentage with graduate degree	41.6	50.5	–8.9	0.469	–0.21
Years teaching experience	12.3	12.1	0.2	0.924	0.04
Joint test of difference in student characteristics between eMINTS and control groups[c] $\chi^2 = 0.90$, df = 3, *p*-value = .825					

[a]Means and differences were regression-adjusted to account for block effects and weighted by the number of schools in each block. Because of a zero cell count for males in one block, however, differences between males and females were estimated on the whole sample (instead of separately by blocks). *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means (or proportions).

[b]Except for gender, effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*) for continuous variables, and using Cox index for the binary variables.

[c]An overall test of the difference between the eMINTS and control groups in the teacher characteristics in this table was conducted using a chi-square test. The chi-square test is from a logistic regression model with the binary treatment indicator as outcome and the teacher characteristics in this table as covariates.

Source: Authors' analysis based on the teacher baseline data collected in spring 2011 from study districts and the MO DESE.

Student Characteristics

Table 2.5 shows the characteristics of the seventh- and eighth-grade MAP analytic student samples in the study schools. There are more than 3,400 students in the analytic sample for MAP testing of communication arts and mathematics (see Table 2.5). For the most part, student characteristics are similar across the groups. The only significant difference between the groups is found in the pooled baseline MAP scores for mathematics, where eMINTS students scored significantly higher than their control group peers. This will be addressed more directly in the Limitations section. A joint test of overall difference, however, suggests that the student characteristics of eMINTS and control group students are equivalent.

Similar baseline comparisons of the student analytic group for 21st century learning skills and student engagement are in Appendix E. The analytic samples for these outcomes are smaller, primarily because student assent and parent consent was necessary to administer these measures to students. The baseline characteristics of students across the MAP, 21st century learning skills, and student engagement samples are similar with one exception: MAP scores differed significantly in the MAP sample, but not in the 21st century learning skills and student engagement samples. In addition, the percentage of limited English proficient students was significantly higher among control students in these two samples.

Table 2.5. Characteristics of Students in the Pooled MAP Communication Arts and Mathematics Analytic Samples,[a] 2010–11 (Before Year 1 Implementation)

Characteristic	eMINTS Mean[b]	Control Mean	Estimated Difference	*p*-Value	Effect Size[c]
Number of students	2,559	875			
2011 MAP mathematics z-scores	0.057 (n = 2,465)	–0.096 (n = 841)	0.153	0.034*	0.15
2011 MAP communication arts z-scores	0.018 (n = 2,463)	–0.059 (n = 842)	0.077	0.243	0.08
Percentage eligible for free or reduced-price lunch	55.8	58.2	–2.3	0.550	–0.06
Percentage nonwhite	4.5	6.6	–2.1	0.340	–0.19
Percentage with disability	13.9	15.4	–1.5	0.453	–0.06
Percentage limited English proficient	4.2	4.6	–0.4	0.775	–0.02
Percentage male	50.7	50.0	0.7	0.794	0.02
Joint test of difference in student characteristics between eMINTS and control groups[d] F = 0.09, df = (8,55), p-value = 0.999					

* Difference statistically significantly different from zero at the .05 level.

[a]Baseline comparisons were conducted on the pooled (3,434 students) mathematics (3,430 students) and communication arts (3,430 students) analytic samples. Of this pooled sample, 3,426 students were in both the mathematics and communication arts samples, four students were in the mathematics sample but not in the communication arts sample, and four students were in the communication arts sample but not in the mathematics sample.

[b]Means and differences were regression-adjusted to account for block effects, grade, and clustering of students within schools and weighted by the number of schools in each block. When data are missing, *n* is the actual number of students used to calculate the average characteristic in each treatment group. *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means (or proportions).

[c]Effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*) for continuous variables, and using Cox index for binary variables.

[d]An overall test of the difference between the eMINTS and control groups in all student characteristics in this table was conducted using an *F*-test adjusted for the randomization of blocks within districts and the clustering of students within schools. The *F*-test is from a two-level logistic regression model with the binary treatment indicator as outcome and the student characteristics in this table as covariates.

Source: Authors' analysis based on the student baseline data collected from study districts in spring 2011, when Grade 7 students were in Grade 6 and Grade 8 students were in Grade 7.

Differential Attrition

Differential attrition, or differences in the number of participants lost from the treatment and control groups, can introduce violations to the critical assumption of baseline equivalence in experimental designs (McKnight, McKnight, Sidani, & Figueredo, 2007) and, if severe enough, can result in seriously biased impact estimates. When data can be assumed missing completely at random or missing at random, then differential attrition is not a problem because the participants who dropped out can be assumed to be representative of the original population sample. In this section, we examine overall and differential attrition after one year of implementation.

During the study's first year, two eMINTS schools dropped out. The first school dropped out about four months after random assignment was announced and shortly after baseline data collection began. A second school dropped out during the summer before Year 1 implementation. Although student data from 58 schools are included in the Year 1 analysis, a third school was closed after the 2011–12 year (Year 1) and students were reassigned to one of several districts in the area; therefore, our Year 2 and Year 3 report will include 57 schools at most.[15]

Data Collection and Outcome Measures

Table 2.6 summarizes the study's data collection plan for the entirety of the study, including what we report on in this report—the baseline year (2010–11)—and subsequent years of eMINTS implementation (2011–12, 2012–13, and 2013–14). Fidelity measures collected for this study include a school technology coordinator survey, a teacher survey, records of professional development provided (and staff attendance), logs of eMINTS instructional specialists' teacher coaching visits, observations of eMINTS professional development sessions, and teacher lesson plans (to be collected in Years 2 and 3 only).[16] Changes in teachers' instructional practices were measured using annual classroom observations and an annual teacher survey,[17] both of which were administered in the spring 2011 and 2012 semesters. Student outcome measures included a student engagement survey, the Learning.com 21st Century Skills Assessment, and annual student assessment results on the MAP communication arts and mathematics. The Learning.com 21st Century Skills Assessment, student engagement survey, and MAP tests were administered in spring 2011 (baseline) and spring 2012. These measures are described in the following sections.

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[15] Because the cause of the third school's attrition from the study is purely exogenous (i.e., the school's closure was completely unrelated to the school's involvement in the study), the school should not be counted against the sample's overall attrition rate, per the What Works Clearinghouse professional development manual (IES, 2011, p. 65).

[16] Observations of eMINTS professional development sessions were not included in the Year 1 analysis but will be included as part of our comprehensive fidelity of implementation analysis after Year 2.

[17] Only one teacher survey was administered to obtain measures of both implementation fidelity and teachers' instructional practices across the four eMINTS instructional model components. Thus, teachers were asked to complete only one annual teacher survey each spring.

Table 2.6. Data Collection Timeline

	2010–11 Baseline		2011–12 Year 1		2012–13 Year 2		2013–14 Year 3	
Teacher and student outcome measures	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
MAP test (mathematics, ELA)		X		X		X		X
Student 21st century test		X		X		X		X
Student survey		X		X		X		X
Teacher survey		X		X		X		X
Teacher observations		X		X		X		X
Implementation fidelity measures	Fall	Spring	Fall	Spring	Fall	Spring	Fall	Spring
Technology coordinator survey				X		X		X
Teacher survey[a]				X		X		X
Professional development records			X	X	X	X	X	X
Staff attendance records			X	X	X	X	X	X
Instructional specialist coaching logs			X	X	X	X	X	X
Observations of eMINTS professional development sessions				X		X		X
Teacher lesson plans[b]						X		X

[a]Survey represents the same survey as was administered to measure teacher outcomes.

[b]Lesson plans will be included in Year 2 and 3 only to assess differences in the quality of teachers' lesson plans between the eMINTS and eMINTS+Intel groups.

Fidelity of Implementation Measures

School Technology Specialist Survey. The research team developed a survey to assess schools' infrastructure and access to the technology resources associated with the eMINTS program. As noted earlier, eMINTS classrooms must meet minimum school infrastructure requirements (see Description of the eMINTS Comprehensive Program on page 5 to support the safe and effective use of the technology resources and equipment provided to eMINTS schools. Key infrastructure elements include Internet connectivity, speed, and capacity; wireless connections; and data storage; among others. This survey asked each school's technology specialist about all relevant aspects of the school's infrastructure that are deemed necessary to support teachers' technology integration and implementation of the four eMINTS instructional components.

Teacher Survey. The teacher survey included items constructed to measure teachers' implementation of the eMINTS Comprehensive program. More specifically, these items asked teachers to report on the extent to which they had access to technology, equipment, and professional development associated with the eMINTS Comprehensive program. It also asked teachers to report on the extent to which they participated in the required professional development and coaching sessions and utilized the technology available to them.

Records of Professional Development Provided and Staff Attendance. Records of professional development included the number of modules delivered and hours of professional development and coaching provided to teachers in the eMINTS and eMINTS +Intel groups. These records were used to assess the amount of professional development provided against the full amount required for the eMINTS program. Each instructional specialist submitted attendance records to staff at the eMINTS National Center, which provided these records to the research team. Attendance records included the total hours of professional development received by each teacher for each of 26 sessions provided in Year 1.

Logs of eMINTS Instructional Specialists' Coaching Visits. An important element of eMINTS is the regular coaching visits that an instructional specialist makes to each eMINTS teacher's classroom monthly for two years. Using a predeveloped and validated log instrument (Martin et al., 2008), each instructional specialist records the length of each visit and how much time was spent on each of the following activities:

- Modeling instruction: activities such as modeling inquiry-based learning techniques or coteaching a lesson
- Lesson planning: helping review or plan lessons
- Technology assistance: troubleshooting and modeling
- Reflective practice: reviewing goals for teaching
- Problem solving: answering questions or specific issues with program implementation

The logs allowed the research team to examine the types of support offered to teachers during the coaching visits.

Professional Development Observations. Using the eMINTS Professional Development Protocol, each eMINTS Area instructional specialist (AIS) observed at least one professional development session for each eMINTS instructional specialist (eIS) they were assigned to supervise in Year 1.[18] The AIS completed two protocols during each observation: the eMINTS Snapshot and eMINTS Checklist. Both instruments were developed by external researchers (Martin et al., 2008). The Checklist was developed as a descriptive tool to confirm content delivery. The Snapshot was developed by researchers to record information on the ways content was delivered within each professional development. The protocols allow the AIS to record the key activities and behaviors conducted by the eIS during each professional development session. An expert panel with deep knowledge of the program curriculum and implementation model reviewed the instruments and provided feedback to establish the content validity. A prior study on the eMINTS program, and the Snapshot tool specifically, established an 88 percent interrater

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[18] eMINTS Area instructional specialists (AIS) are eMINTS National Center employees who supervise eMINTS instructional specialists (eIS).The eIS facilitate the eMINTS professional development sessions and provide coaching to eMINTS teachers in their assigned cohort groups.

reliability score and internal reliability estimates on the four core constructs: inquiry-based learning, community of learners, technology integration, and connection to practice, ranging from .60 to .78 (Martin et al., 2008).

Teacher Outcome Measures

A variety of data sources are used to answer research questions on the impact and effectiveness of the eMINTS PD program. Table 2.7 presents the domains, outcome measures, and data sources to be used for assessing teacher practice[19] and student learning. We began with a set of established, psychometrically valid and reliable data-collection instruments and augmented them with new items to more closely reflect key eMINTS program components. The research team worked closely in conjunction with program developers to ensure that the instruments appropriately operationalized eMINTS program features and functions. In addition, we ascertained the psychometric properties of the augmented instruments used in this study. Each of the instruments used are administered annually in the spring of each school year, including once in spring 2011 (baseline) before eMINTS implementation commenced.

Table 2.7. Domains, Outcome Measures, and Data Sources

Domains	Outcome Measures	Data Sources
Teachers		
High-quality lesson planning	Index of a teacher's use of content standards and data to inform instructional planning.	Teacher survey
Inquiry-based learning	Index of a teacher's use of inquiry-based learning and assessment strategies.	Classroom observations; teacher survey
Community of learners	Index of a teacher's use of strategies encouraging teacher and student collaboration and classroom community.	Classroom observations; teacher survey
Technology integration	Index of a teacher's access to and knowledge of skills needed to integrate and utilize various types of technology for instructional purposes.	Teacher survey
Students		
Academic orientation	Index of a student's academic orientation, measuring a student's sense of engagement, academic efficacy, relevance of school for future success, educational aspirations, self-directed learning, and perception of the quality of emotional and relational support from teachers.	Student survey
21st century skills test	Measure of 21st century skills—based on the National Educational Technology Standards for Students, developed by the International Society for Technology in Education (2012). Constructs measured in the assessment include creativity and innovation; communication and collaboration; research and information fluency; critical thinking, problem solving, and decision making; digital citizenship; and technology operations and concepts.	Learning.com 21st Century Skills Assessment

[19] Many of the teacher outcome measures double as fidelity-of-implementation measures.

Domains	Outcome Measures	Data Sources
Academic performance	Mean scaled score for seventh- and eighth-grade students, represented as a continuous measure of students in mathematics and English language arts.	MAP mathematics and English language arts assessments

Teacher Survey. Items from the following publicly available surveys were included to measure each of the four eMINTS instructional components of high-quality lesson planning, inquiry-based learning, classroom community, and technology integration:

- SRI Innovative Teaching and Learning Research Survey (Microsoft Partners in Learning, 2010)
- eMINTS Teacher Technology Literacy Skill Survey (eMINTS, 2009)
- Intel Teach Program Essentials Course Impact Survey (Intel Corporation, 2006)
- Buck Institute National Survey of High School Reform and Project Based Learning (Buck Institute, 2007)
- Surveys of Enacted Curriculum (Wisconsin Center for Education Research, 2004)
- Special Education Elementary Longitudinal Study (Office of Special Education Programs, 2007)
- *MetLife Survey of the American Teacher* (MetLife, 2011)

The majority of items measuring a community of learners and inquiry-based learning practices came from SRI's Teaching and Learning Research Survey (Microsoft, 2010) and the Buck Institute's (2007) National Survey of High School Reform and Project Based Learning. Items measuring technology integration primarily came from the eMINTS technology literacy survey (eMINTS National Center, 2009) and the Intel Teach impact survey (Martin and Shulman, 2006). Items to measure high-quality lesson planning were developed by the research team or pulled from SRI's survey. We also used a minimum number of items from the other surveys mentioned here. Items are designed to measure teachers' pedagogical beliefs (e.g., beliefs and practices aligned with an inquiry-based, constructivist approach), approaches to lesson planning, and instructional practices.

Content validity was established for this survey in spring 2011. Baseline survey results were used to assess item reliabilities using the Rasch dichotomous model (Rasch, 1980; Wright & Masters, 1982). Internal reliability estimates for each domain ranged between .83 and .94.

Classroom Observations. Classroom observations were conducted in spring of 2011 and 2012 to measure teaching outcomes across the four eMINTS model components. The observation protocol measures teaching practices, including inquiry-based learning, collaborative teaching, student and teacher use of technology, use of community resources, classroom organization, instructional support, and emotional/relational support. To measure changes in community of learners and inquiry-based learning constructs, we used the observation protocol Classroom Assessment Scoring System-Secondary ([CLASS-S], Pianta, La Paro, & Hamre, 2008). CLASS-S is a theoretically driven and empirically supported conceptualization of classroom interactions organized into three major domains—emotional supports, classroom organization, and instructional supports. CLASS-S scales have been found to be reliable and predictive of student gains in a study of middle and high school professional development (Allen, Pianta, Gregory, Mikami, & Lun, 2011). This protocol also contains a set of scales related to teaching procedures, skills, and content knowledge that can be adapted to infuse a specific content area (e.g., mathematics) and instructional strategies (e.g., inquiry-based learning) into existing CLASS dimensions.

In addition to the CLASS-S, a number of items were developed to obtain a comprehensive measure of technology integration. We initially conducted a literature review of technology use and technology integration literature to establish a conceptual framework. After discussion with eMINTS personnel and review of eMINTS material, we created a brief observation protocol to measure technology use in the classroom by the teacher and students and used preexisting observation tools to measure technology integration in the classroom (Northwest Regional Educational Laboratory, 2004; West Virginia Department of Education, n.d.). The complete observation protocol, which included CLASS-S and these additional technology items, was reviewed by instructional content experts and eMINTS staff members to establish content validity in Spring 2011.

Student Outcome Measures

Student Survey. The student survey was used to measure students' engagement and academic orientation. Student surveys included measures associated with students' engagement in school, academic efficacy, relevance of school for future success, educational aspirations, self-directed learning, and perceptions of the emotional and relationship support from teachers. Items were selected primarily from the University of Chicago's Consortium on Chicago School Research student survey (2007a, 2007b). We also reviewed student surveys used in the New Hope Study (Huston et al., 2003), the Research Assessment Package for Schools ([RAPS], Midgley et al., 2000), and other scales of student efficacy and engagement with strong psychometric properties, including Cook et al. (1996), Middleton and Midgley (2002), and Zimmerman, Bandura, and Martinez-Pons (1992). The reported reliability estimates for the scale are .80 or higher.

21st Century Skills. To measure students' skills in areas identified as 21st century skills, we used the 21st Century Skills Assessment developed by Learning.com (Condon, Dawson, Molefe, & Swanlund, 2009). The 21st Century Skills Assessment is a 72-item criterion-referenced assessment used to measure each of the six International Society for Technology in Education (ISTE) National Educational Technology Standards for Students, which include creativity and innovation, communication and collaboration, research and information fluency, critical thinking, problem solving, decision making, digital citizenship, and technology operations and concepts (ISTE, 2012). A Rasch analysis conducted by Condon, Dawson, Molefe, and Swanlund (2009) demonstrated high levels of reliability and validity on the Learning.com's 21st Century Skills Assessment. The person reliabilities of the pre- and posttests for each grade were consistently greater than .90. In addition, content validity was established by having (1) content experts create the items and (2) a standards-setting panel review the items. The Rasch analysis found that the assessment measured only one construct (i.e., technology literacy), and the items fit the Rasch model well.

Missouri Assessment Program. Primary student outcome data includes annual MAP results for Grade 7 and 8 students in communication arts and mathematics. MAP assessments are norm-referenced and administered annually in the spring of each school year to students in Grades 3–8. Designed to measure student acquisition of skills and knowledge as described in Missouri's Grade-Level Expectations, the assessment provides information on academic achievement at the student, class, school, and district levels. Student data are provided both as scale scores and performance level (e.g., Below Basic, Basic, Proficient, and Advanced) (CTB/McGraw-Hill, 2012).

Data Analysis

This section provides an overview of the analytic strategy used to examine confirmatory impacts on student outcomes and exploratory impacts on teacher outcomes. The randomization of schools to an eMINTS, eMINTS + Intel Teach, or control condition provides a strong framework with which to accurately estimate program impact. This is because the randomization of a sufficient number of participants to one of three conditions should, on average, equalize any measured and unmeasured baseline differences among the three groups that may confound impact estimates. Nevertheless, to obtain more precise estimates, the research team directly accounted for student, classroom, and school characteristics in the analytic models.

Analysis of Student Outcomes

This study was designed to obtain statistically unbiased estimates of the average effect of eMINTS PD on Grade 7 and 8 students' performance within four domains: mathematics achievement, communication arts achievement, 21st century learning skills, and student engagement and academic orientation. To measure performance in mathematics and communication arts, we used student results from the MAP, which was administered in April 2012. To measure 21st century learning skills, we used the learning.com 21st Century Skills Assessment. We used a student survey to measure students' engagement and academic orientation. The 21st Century Skills Assessment and student engagement survey were both administered between April and May 2012.

Unless noted otherwise, our analyses employed two-level hierarchical linear models with students nested within schools. Means and differences were regression-adjusted to account for blocked effects, grade, and clustering of students within schools and weighted by the number of schools in each block. Effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Impact results for each domain are calculated separately as pooled averages of scores collected from Grade 7 and 8 students.

For both MAP assessments (mathematics and communication arts), the following covariates were included:

- Student pretest: Spring 2011 MAP scores in mathematics or communication arts
  School pretest: School mean spring 2011 scores in mathematics or communication arts

- Student characteristics:
    - Gender (male/female)
    - White (yes/no)
    - FRPL (yes/no)
    - LEP (yes/no)
    - IEP (yes/no)
- Teacher characteristics:[20]
    - Gender (male/female)
    - Graduate degree (yes/no)
    - Years teaching experience

For 21st century learning skills and student engagement, the following covariates were included:[21]

- Student pretest: Spring 2011 MAP scores (z-scores) in mathematics and communication arts
  School pretest: Spring 2011 school mean scores (z-scores) in mathematics and communication arts
- Student characteristics:
    - Gender (male/female)
    - White (yes/no)
    - FRPL (yes/no)
    - LEP (yes/no)
    - IEP (yes/no)

Data was not imputed for missing outcomes on any of the four student outcomes we examined. There were no missing values for student characteristics and school means for any of the analytic samples. For missing teacher characteristics and missing pretest data, the dummy variable approach advanced by Puma, Olsen, Bell, and Price (2009) was used to impute these missing covariate values.

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[20] In our analysis plan, we stated that we would keep teacher covariates in the model only if they were statistically significant. As it turns out, for the mathematics analysis, the three variables under discussion were statistically significant at either the .05 or .10 levels (*p*-values equal to 0.072, 0.020, and 0.053, respectively), but none was statistically significant for the communication arts analysis. For consistency, we decided to keep the teacher covariates in both analyses.

[21] We did not include teacher characteristics as covariates in the 21st century learning skills and student engagement analyses because students in the 21st century learning skills and student engagement analytic samples often were associated with two different teachers (their mathematics and communication arts teachers).

To compare the combined eMINTS groups to control in Year 1, the impact of eMINTS on student outcomes was estimated using the two-level model given below. This model estimated impacts separately by randomization block, which were then pooled into an overall impact, weighted by the number of schools in each block.

Level 1 (students)

$$Y_{ij} = \pi_{0j} + \pi_{1j} Grade_{ij} + \mathbf{X_{ij}} \boldsymbol{\pi_{2j}} + \mathbf{C_{ij}} \boldsymbol{\pi_{3j}} + \varepsilon_{ij}$$

Level 2 (schools)

$$\pi_{0j} = \sum_k \beta_{00k} D_k + \sum_k \beta_{01k} T_j * D_k + r_{0j}$$

$$\pi_{1j} = \beta_{10}, \ \pi_{2j} = \boldsymbol{\beta_{20}}, \ \pi_{3j} = \boldsymbol{\beta_{30}},$$

where
Y_{ij} is the outcome (i.e., communication arts or mathematics test score, or measures of academic orientation or 21st century skills) of student *i* in school *j*;
D_k = 1 if school *j* is in randomization block *k*, and 0 otherwise, $k = 1, \cdots, 3$
T_j = 1 if school *j* belongs to the eMINTS or eMINTS+Intel group, and 0 otherwise
$Grade_{ij}$ is a grade-level indicator that is equal to 1 for eighth-grade students and 0 for seventh-grade students (centered around the grand mean)
$\mathbf{X_{ij}}$ is a row vector of background characteristics (e.g., prior academic achievement, race/ethnicity) of student *i* in school *j*
$\mathbf{C_{ij}}$ is a row vector of teacher characteristics (e.g., teaching experience, degrees held, gender) for student *i* in school *j*
$\mathbf{Z_j}$ is a row vector of school characteristics (e.g., average school achievement, percentage of racial/ethnic minority students, school size) for school *j*
ε_{ij} and r_{0j} are random residuals at the student and school levels, respectively.

$Grade_{ij}$ was centered around the grand mean (that is, the overall proportion of eighth-graders in the sample) to control for differences in the proportions of seventh- and eighth-graders across schools.

With the above formulation, β_{00} is the overall average achievement level of seventh- and eighth-graders, and β_{10} is the average level of achievement gap between seventh- and eighth-graders. The mean of the block-specific impact estimates β_{01k} ($k = 1, \cdots, 3$), weighted by the number of schools in each block, is an estimate of the overall average impact of eMINTS on the performance of seventh- and eighth-graders in a particular subject area relative to the control group. A test of the null hypothesis that $\beta_{01} = 0$ is a test of whether eMINTS has a statistically significant impact.[22]

Analysis of Teacher Outcomes

Single-level instead of multilevel models were used to measure teacher outcomes because several schools in the analytic samples had only one teacher, precluding estimation of either the between-school variance or the block-specific impact estimates. Means and impacts reported on domains from the teacher survey and teacher observations were regression-adjusted using ordinary least squares to account for block effects and baseline teacher and classroom characteristics, and weighted by the number of schools in each block. Effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's g). p-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means.

To examine the impact of one year of eMINTS Comprehensive implementation on teachers' use of inquiry-based learning strategies, a community of learners, and technology integration, results from teacher surveys and classroom observations were analyzed separately. High-quality lesson design (e.g., teachers' use of data and standards to guide lesson planning) was examined using results from the teacher survey only.

Teacher Survey Analysis

The teacher survey was administered in spring 2011 and spring 2012. Teacher outcomes on each of the four constructs—community of learners, inquiry-based learning, high-quality lesson design, and technology integration—are the logit ability measures from a Rasch analysis of the survey items belonging to each construct.[23] The Rasch analysis was conducted separately for mathematics and communication arts teachers. Teachers who taught both subjects were included in both the mathematics and communication arts analyses, and then their scores from the two subjects were averaged. Analysis of impact of eMINTS on teacher survey logit scores was then conducted on the pooled sample of mathematics and communication arts teachers.

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[22] In Year 3, we plan to examine the differential impact of subgroups and the impact of an extra year of training on student outcomes (eMINTS+Intel) in a comparison with eMINTS and control. To do this, we will modify the model presented here to include an interaction of the treatment indicator(s) with the appropriate student-level covariates (e.g., race/ethnicity).

[23] The Rasch model uses (dichotomous or Likert scale) responses to selected survey items (questions) to produce an interval scale that estimates *item difficulties* and *person abilities*. The model posits that a person's "success" on an item is equal to the difference between that person's ability and the item's difficulty. Fitting the Rasch model places items on the scale according to how likely they are to be endorsed (*item difficulty*). Similarly, a quantitative measure of a person's attitude or "ability" (*person ability*) is placed on the same scale. The scale units are called logits (log odds units). Because the logit scales are linear, they are amenable to statistical procedures, such as calculation of averages and standard deviations. (For more information on the Rasch scale, see Wright and Masters, 1982).

Pretest: Teachers' logit ability scores from Rasch analysis of baseline (spring 2011) teacher survey

Teacher characteristics:

- Gender (male/female)
- Graduate degree (yes/no)
- Years teaching experience
- Subject taught (mathematics, communication arts, both)
- Grade taught (Grade 7, Grade 8, both)

Classroom characteristics:

- Percentage of male students
- Percentage of white students
- Percentage of FRPL students
- Percentage of LEP students
- Percentage of IEP students
- Means of students' spring 2011 MAP scores in mathematics and communication arts

The subject by treatment interaction was initially included in the regression models but was dropped from the analysis because, in all four outcomes, the interaction was not statistically significant. This means that the results for mathematics and communication arts teachers were similar across the four constructs.

Data was not imputed for missing outcomes on any of the four teacher domains we examined. There were no missing values for student characteristics or school means for any of the analytic samples. For missing teacher characteristics and missing pretest data, the dummy variable approach advanced by Puma et al. (2009) was used to impute the missing covariate values.

Classroom Observation Analysis

Classroom observations of teachers were conducted with CLASS-S certified observers in spring 2011 and spring 2012. As in the teacher survey outcomes, classroom observation outcomes on each of three constructs[24]—community of learners, inquiry-based learning, and technology integration—were placed on a Rasch scale for comparison. Each classroom observation was made up of at most two 10-minute observation segments. The Rasch analysis was conducted separately by segment and then the resulting logit scores were averaged across segments. Analysis of impact of eMINTS on classroom observation scores were conducted on the pooled

[24] There were no items in the classroom observation protocol that measured the high-quality lesson design construct, and so this construct was measured only through the teacher survey.

sample of mathematics and communication arts teachers. The following covariates were used in the classroom observation analysis:

Pretest: Logit ability scores from Rasch analysis of baseline (spring 2011) classroom observations

Teacher characteristics:

- Gender (male/female)
- Graduate degree (yes/no)
- Years teaching experience
- Subject of the classroom observed (mathematics, communication arts)
- Grade of the classroom observed (grade 7, grade 8, both)

Classroom characteristics:

- Percentage of male students
- Percentage of white students
- Percentage of FRPL students
- Percentage of LEP students
- Percentage of IEP students
- Means of students' spring 2011 MAP scores in mathematics and in reading

As in the analysis using teacher surveys, a subject-by-treatment interaction was initially included in the regression models but was dropped from the analysis because, in all three outcomes, the interaction was not statistically significant.

Implementation Fidelity

In collaboration with eMINTS staff, we identified five major components of eMINTS Comprehensive implementation:

- Technology infrastructure
- Technology use
- Teacher professional development
- Administrative support
- Ongoing technology support

Although each component is necessary to establish and maintain the integrity of eMINTS PD, we worked with eMINTS personnel to determine the relative weight of each component with teacher professional development ranking as most important (weighted at 45 percent) and technology use and ongoing technology support as less important (weighted at 10 percent each).

Each component consists of multiple criteria with associated descriptive measures, including technology audits, teacher surveys, technology coordinator surveys, eMINTS teacher attendance files, eMINTS principal attendance files, principal walkthrough data, and technology coordinator attendance files. Minimum requirements (e.g., survey score responses per item, rates of professional development attendance) were established for each measure as an item metric, which were in turn aggregated and divided, producing criterion-level scores.

To illustrate our approach to measuring implementation fidelity in each school, consider the technology use component as one example. For the eMINTS Comprehensive program to be properly implemented, teachers and students must frequently use the technology available to them in classroom lessons. In Year 1, each eMINTS teacher is expected to increasingly rely on the teacher laptop and interactive whiteboard (i.e., use them at least once per week) to deliver inquiry-based lessons and units. It follows that the inquiry-based project work and lesson assignments delivered by eMINTS teachers should require that students use laptops to complete inquiry-based projects or lesson assignments. Thus, three subcomponents of technology use were included in the technology use component: use of student laptops, use of teacher laptops, and use of interactive whiteboards. Teachers who reported using their teacher laptops at least once per week were assumed to be implementing this component of the program and received a 1 on this subcomponent; those reporting less frequent use received a 0. Similar criteria were established for student laptop and interactive whiteboard subcomponents. The sum of these subcomponents (either 3, 2, 1, or 0) was calculated for each teacher. Teachers with a technology use component score equal to 2 or 3 were identified as high implementers on this component. Teachers with a total score of 1 were identified as moderate implementers, and those reporting a total score of 0 were identified as low implementers. We followed a similar approach when calculating a total component score for all five key implementation components. Appendix F provides established criteria for determining high, moderate, and low implementation on each component, identifies the measures used to establish implementation scores, and describes how implementation values were determined.

Using the metrics described in Appendix F, we calculated fidelity scores for each component separately and then calculated the overall fidelity score for each treatment school as a weighted average of the individual components.

Study Limitations

The key questions addressed in this report pertain to the impact of eMINTS professional development on communication arts and mathematics achievement and 21st century skills after Year 1 of the cluster randomized trial. The strength of this evaluation lies in the randomization of schools to treatment and control, which allows us to draw causal inferences about the program's impact on student achievement. It is important to point out some caveats, however, regarding the design and analysis of Year 1 outcomes that restrict the conclusions that can be drawn from this report.

The first caveat is the sample selection. The schools that were recruited and volunteered to be part of the study are not necessarily representative of the universe of schools that are currently using or are intending to implement eMINTS. The sample is limited to rural schools with high levels of poverty. In addition, the study is restricted to schools in Missouri. Thus, conclusions drawn from this report should be limited to the purposeful sample of participating schools and districts.

Second, because participation is voluntary, the observed effects in this study could be different from what might be observed in less motivated settings. In general, the schools involved in the study were motivated to adopt and implement the eMINTS Comprehensive program. The history of eMINTS in Missouri and the anticipation of district and school personnel about receiving the professional development is probably unparalleled elsewhere. The adoption of eMINTS in other settings may not be transferrable.

Third, although random assignment typically establishes the treatment and control groups as equivalent on observable and unobservable traits and characteristics, the process remains random, which means that an improbable but possible difference between the groups could exist. Considering the significant difference between treatment and control groups at baseline for mathematics achievement, this difference could exist.

The limitations just listed serve to underscore that although we can make causal inferences from the first year of the study, the findings reported here are restricted in generalizability and are preliminary. More definitive answers to our research questions (both confirmatory and exploratory) will be provided in Year 2 (e.g., treatment on treated impacts, subgroup analyses), but these same caveats will apply to findings for the duration of this study.

Chapter 3: Program Implementation

This chapter presents evidence on the first year of implementation of the eMINTS program. It describes program implementation in the treatment schools, focusing on the extent to which eMINTS staff and teachers, school leaders, and technology coordinators who participated in eMINTS professional development implemented core components of the eMINTS model as planned, and schools implemented the necessary technology infrastructure and technology support elements. In other words, this chapter describes "what happened" as eMINTS staff delivered the eMINTS program components, and as principals, teachers, and district personnel attempted to implement these program components. It does not attempt to explain why there is variation in the extent to which schools and teachers implemented various components of the program. Subsequent reports will address the influence of variation in implementation on student outcomes.

This chapter is divided into two sections. Section 1 presents information on the extent to which eMINTS staff implemented core program components in the treatment schools and offered required professional development to teachers, administrators, and technology coordinators. The second section examines how faithfully schools implemented the professional development and support that was provided to them.

Section 1: Did eMINTS staff deliver the eMINTS Comprehensive Program as designed during Year 1?

The eMINTS instructional model combines four overarching concepts—high-quality lesson design, inquiry-based learning, a community of learners, and technology integration—to improve teacher instruction and student learning. To ensure that teachers and school leaders are equipped with the knowledge and skills needed to implement the model effectively and that eMINTS personnel engage teachers, principals, and technology coordinators in professional development sessions; establish the necessary infrastructure within the schools; provide technological resources; and offer instructional support.

eMINTS Implementation: Resources, Professional Development, and Coaching

The developers of the eMINTS program posit that successful implementation requires eMINTS staff to do the following: (1) monitor the purchase and installation of essential resources (e.g., student and teacher laptops in each school, SMART Boards) through subaward processes approved by the University of Missouri, (2) schedule and deliver 26 teacher professional development modules, (3) schedule and conduct 10 coaching visits per teacher, (4) offer each teacher online access to curriculum and professional development materials, (5) provide principals with one two-day professional development session, (6) conduct two walkthroughs of schools with principals, and (7) offer two WebEx sessions for district technology coordinators. This section focuses on the extent to which eMINTS personnel implemented the program's components in the schools participating in this study.

eMINTS Resources. Overall, eMINTS was successful in monitoring the purchase and installation of program resources, professional development, and consultation. Subawards to purchase and install the equipment necessary for program implementation were made available, as planned, in all 38 treatment schools.[25] Prior to the execution of subaward contract that provided funding for the purchase and installation of equipment, eMINTS conducted technology audits at all study schools. Decisions were made in consultation with personnel from each school and district about equipment needs. Some schools already possessed some of the necessary technology (e.g., SMART Boards in their classrooms). eMINTS facilitated the execution of subawards to cover the costs of all equipment and installation necessary for each treatment school to comply with program requirements. Across the 38 treatment schools, equipment purchase and implementation included 2,613 student laptops, 179 teacher laptops, 178 wireless access points, 146 whiteboards/SMART Boards, 43 printers and scanners, and 173 digital cameras.

Who Participated in eMINTS Professional Development? The eMINTS staff kept attendance records of teacher professional development sessions and coaching visits. According to these records, eMINTS provided professional development and coaching to 128 teachers[26] from the 38 treatment schools participating in this study. All teacher participants taught seventh- and/or eighth-grade classes, with 45 (35 percent) teaching communication arts, 44 (34 percent) mathematics, 7 (5 percent) both communication arts and mathematics, and 32 (25 percent) other subjects.[27] At least one administrator from every school participated in principal professional development and eMINTS walkthroughs.

What Professional Development Was Delivered? Between August 2011 and June 2012, 15 eMINTS instructional specialists (eIS) offered the 26 intended professional development modules as planned to regional cohort groups of teachers. (See Appendix A for a list of Year 1 modules.) A total of 105 to 115 hours of professional development was offered using the modules, with variation due to rounding of the length of individual modules by site. In addition to the professional development modules, eMINTS offered 10 coaching visits per teacher. Of the 1,280 possible coaching visits (10 per teacher), eMINTS delivered 1,191 (93 percent), with roughly equivalent percentages of coaching visits occurring for each treatment group (95 percent for eMINTS and 92 percent for eMINTS+). All treatment teachers were offered online access to curriculum and professional development materials. eMINTS also provided 74 of their intended 76 (97 percent) school walkthroughs with principals. In addition, eMINTS offered a two-day professional development session to principals and two WebEx sessions for technology coordinators in treatment districts. See Table 3.1.

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[25] Two treatment schools dropped out before Year 1 implementation began.

[26] An additional 74 teachers received professional development and coaching visits as part of program implementation, but 11 taught special education classes to students who were not eligible to take the MAP assessment, and 63 either did not provide consent or were not eligible to participate (i.e., they did not teach mathematics or communication arts).

[27] It should be noted that although some teachers taught science or social studies, many of the teachers listed as "other" identified themselves primarily as special education teachers but also taught regular education classes, including communication arts and mathematics classes.

Table 3.1. eMINTS Delivery of Professional Development Sessions and Other Program Components

		All Treatment Schools (*N* = 38)		eMINTS (*N* = 18)		eMINTS+ (*N* = 20)	
Teachers	**Year 1 Criteria**	**Planned**	**Delivered**	**Planned**	**Delivered**	**Planned**	**Delivered**
Professional development sessions	26 PLC sessions	26	26	26	26	26	26
Coaching visits	10 visits per teacher × 128 teachers	1,280	1,191	580	550	700	641
Online access to curriculum and professional development materials	Each of 128 teachers receive online access	128	118	58	54	70	64
Principals							
Professional development session	One two-day session	1	1	1	1	1	1
Walkthroughs (Two/year; × principals)	Two/year × 38 principals	76	74	36	35	40	39
Technology Coordinators							
WebEx sessions	Two sessions	2	2	2	2	2	2

Summary of eMINTS Implementation. The essential resources, professional development, and guidance needed to support the eMINTS program at the district, school, and classroom levels were provided by eMINTS staff. eMINTS staff conducted technology audits in all treatment schools to identify areas of equipment need. They also followed up with the necessary resources and support to ensure that all schools met minimum infrastructure and equipment requirements within the expected timeframe. Teacher, administrator, and technology coordinator professional development, which included formal professional development sessions, school visits, and coaching sessions, were offered to all eligible participants in all treatment schools. eMINTS professional development was scheduled and conducted in a timely fashion.

Section 2: To what extent did schools implement the eMINTS Comprehensive Program as Planned in Year 1?

Teacher professional development builds knowledge and understanding about how to implement inquiry-based learning strategies and classroom communities. Classroom technology integration promotes the use of eMINTS learning strategies (as defined in the eMINTS model) through the availability of a specific set of technology resources, along with minimum school technology infrastructure levels and ongoing support to promote technology integration over time.

The eMINTS instructional model cannot be fully implemented without appropriate classroom technology resources. Minimum levels of school infrastructure and ongoing technology support are needed to promote and sustain technology integration over time. Technology alone, however, is insufficient to promote students' 21st century skill development. Teacher professional development is essential for understanding how technology tools can be used to optimize learning through inquiry-based instruction and constructive classroom communities. Administrative support also is critical for ensuring that the tools and conditions are optimal for eMINTS program implementation over time and supporting teachers' implementation of the instructional strategies embedded in the eMINTS program.

To determine treatment schools' implementation fidelity levels, we worked with the program developers to identify the core program components and weight them according to their relative importance toward achieving optimal school performance. These components and their weights are presented in Table 3.2. Teacher professional development was determined to be the most central piece to the eMINTS program (45 percent), followed by administrative support (20 percent), technology infrastructure (15 percent), and technology use and ongoing technology support (10 percent each).

Table 3.2. Overall Fidelity Components Proposed for Measuring School eMINTS Program Receipt[a]

	Technology Infrastructure	Technology Use	Teacher Professional Development	Administrative Support	Ongoing Technology Support	Overall Fidelity Score
School	Score weight = 15%	Score weight = 10%	Score weight = 45%	Score weight = 20%	Score weight = 10%	Score weight = 100%
1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
2	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
3	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1

[a]Total score will equal the weighted average of components 1–6. Total school implementation score = 0 (no implementation to 1 (full implementation). Individual component values are presented as percentages of total implementation (see Table 3.10).

Part 1 of this chapter confirms that eMINTS delivered the program as planned during Year 1. Part 2 reports on the extent to which schools implemented the program as designed during Year 1. Here, we examine the extent to which schools met minimum technology infrastructure requirements; teachers used technology equipment; school staff attended the required training sessions and teachers completed coaching visits; and technology coordinators provided support for classroom technology use. Data from teacher surveys, technology coordinator surveys, teacher attendance files, principal attendance files, and principal walkthrough data inform implementation fidelity determinations at the school level. (See Appendix F for a table detailing the calculations of component and overall fidelity scores.) We discuss the implementation of each of the fidelity components separately before presenting findings on overall school-level fidelity.

Technology Infrastructure

The following infrastructure requirements are necessary in all eMINTS schools:

- *Data storage:* Each teacher and each student requires a minimum of 1 gigabyte of network-based storage.
- *Backup and disaster recovery:* A system and procedure must be in place for backing up the student, teacher, and administrative data stored on the network.
- *Internet connectivity:* Building connectivity must be a reliable 1–2 Mbps connection, and a switched network is needed from the Internet connection at the district level to the eMINTS school building.
- *Internet security:* Schools must have the ability to unblock and approve specific sites; computers must run filtering software that is centrally managed by the district; license agreements must be current and regularly updated; and antivirus software must run on all computers.
- *Wireless network:* Schools must have wireless network capability, and students must be able to reliably access the network.
- *Shared folder system or server:* A shared folder system or server must be available for students to display and share their work.

eMINTS established fidelity cut points signifying high fidelity, moderate fidelity, and low fidelity. Schools that demonstrated high fidelity on this component implemented 75 percent or more of the required elements just listed by February 2012. Schools that demonstrated moderate fidelity implemented between 50 and 74 percent of all elements, and low-fidelity schools implemented less than 50 percent of all elements.

To measure the extent to which technology infrastructure elements were implemented in the school, we administered a survey to each school district's technology coordinator[28] (one item was taken from the teacher survey). As Table 3.3 reports, 34 of 38 schools reported high levels of technology infrastructure. No data was available from 2 of these 38 schools.

Table 3.3. School Level of Technology Infrastructure

Technology Infrastructure	Frequency	Percentage
Missing data	2	5.26
Low	0	0
Moderate	2	5.26
High	34	89.47

[28] The technology coordinator was asked whether schools met eMINTS basic levels of the following: data storage space, backup and disaster recovery ability, Internet connectivity, wireless connection, and shared folder system.

Technology Use

The following technology use requirements are necessary in all eMINTS schools:

- *Student laptops*: Students must use computers in at least 1–3 classroom sessions per week.
- *Teacher laptops:* Teachers must use computers in at least 1–3 classroom sessions per week.
- *Interactive whiteboards:* Classrooms (whether teachers or students) must use whiteboards (e.g., SMART Board) 1–3 classroom sessions per week.

eMINTS schools that demonstrated high fidelity on this component reported implementing 67 percent, or at least two of the three required elements. Schools that demonstrated moderate fidelity implemented one of three (between 33 and 66 percent) elements, and low-fidelity schools implemented none of the elements.[29] To measure the extent to which technology use elements were implemented in the school, we administered a survey to each seventh- and eighth-grade teacher of communication arts and/or mathematics.[30]

According to teacher survey responses, 32 of the 38 schools (see Table 3.4) reported high levels of technology use, including the use of student laptops, teacher laptops, and whiteboards. Two schools reported moderate levels of technology use and two reported low levels of technology use. Teachers at the remaining two schools did not respond to these survey items.

Table 3.4. School-Level Technology Use

Technology Use	Frequency	Percentage
Missing data	2	5.26
Low	2	5.26
Moderate	2	5.26
High	32	44.21

Teacher-Level Implementation: Teacher Professional Development

The following teacher professional development requirements are necessary in all eMINTS schools:

- *Professional learning community professional development participation*: Teachers must attend 26 professional learning community professional development sessions or approximately 124 hours.

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[30] The teacher survey asked how often teachers or their students used computers and whiteboards in the classroom: never or almost never, 3–6 sessions per year, 1–3 sessions per month, 1–3 sessions per week, or every or almost every session.

- *Participation in coaching sessions:* Teachers must participate in 10 coaching visits conducted by eMINTS staff.

eMINTS schools that demonstrated high fidelity in professional development participation had teachers who collectively attended at least 90 percent of the sessions, whereas 80 percent to 89 percent attendance warranted a rating of moderate fidelity. Professional development participation was considered low if it was less than 80 percent. Similarly, schools that demonstrated high fidelity in their participation of coaching sessions had teacher attendance rates at 90 percent or higher, with 80 percent attendance being the threshold between moderate levels and low levels of fidelity. The same 90 percent and above, 80 percent to 89 percent, and 79 percent or below determination of fidelity implementation is applied for overall teacher professional development levels of fidelity implementation. To measure the extent to which elements of technology use were implemented in the school, we analyzed eMINTS teacher attendance files of all professional development and coaching sessions.

Changing teacher instructional practices is the heart of the eMINTS program. For the program to be effective, it has to be properly implemented by eMINTS personnel, and the program components and resources have to be used in classrooms by teachers. The professional development sessions and coaching visits are intended to prepare teachers to use eMINTS resources in an inquiry-based lesson design. The participation of teachers in eMINTS professional development and coaching visits is a critical step in the change process. In this section, we first examine the degree to which teachers participated in eMINTS PD and coaching overall before considering implementation fidelity levels at the school level.

Overall Teacher Participation in Professional Development and Coaching Visits. Having established that the professional development, resources, and support components for eMINTS PD were offered as planned by eMINTS personnel, this section looks at the extent to which the teachers adhered to a major requirement of the program model—attendance at the 26 professional development sessions by academic quarter. Table 3.5 provides attendance rates at professional development sessions offered each academic quarter for all treatment teachers and by treatment group. We see that quarter by quarter, attendance for eMINTS teachers ranged between 85.3 percent and 94.5 percent. The eMINTS+Intel teacher attendance rates ranged from 88.1 percent to 97.3 percent.

Table 3.5. Percentage of Professional Development Sessions Completed by Quarter by Treatment Teachers

	All Treatment Teachers (*N* = 128)	eMINTS Teachers (*N* = 58)	eMINTS+ Teachers (*N* = 70)
Quarter 1	95.5	93.2	97.3
Quarter 2	95.3	94.5	96.0
Quarter 3	92.8	92.2	93.3
Quarter 4	86.8	85.3	88.1
Total	93.1	92.2	93.9

Teachers also were required to participate in 10 coaching visits in the first academic year. Overall, coaching classroom visits were completed regularly by all teachers. (See Table 3.6.) Ninety-three percent of coaching visits were completed despite very low classroom visit completion rates for the 10th and final visit for the first academic year. In fact, if coaching visit completion rates are calculated only for the first nine classroom visits, more than 98 percent of coaching visits were completed. Every teacher in the study except one completed at least eight coaching visits. Completion rates were equally high in each treatment group.

Table 3.6. Percentage of Coaching Visits Completed by Treatment Teachers

	All Treatment Teachers (*N* = 128)	**eMINTS Teachers (*N* = 58)**	**eMINTS+ Teachers (*N* = 70)**
Classroom Visit 1	100.0	100.0	100.0
Classroom Visit 2	99.2	98.3	100.0
Classroom Visit 3	99.2	100.0	98.6
Classroom Visit 4	100.0	100.0	100.0
Classroom Visit 5	96.9	98.3	95.7
Classroom Visit 6	99.2	100.0	98.6
Classroom Visit 7	98.4	100.0	97.1
Classroom Visit 8	97.7	100.0	95.8
Classroom Visit 9	93.8	98.3	90.0
Classroom Visit 10	46.1	53.4	40.0
Total	**93.0**	**94.8**	**91.6**

Teacher Professional Development Implementation Fidelity at School Level. At the school level, attendance records showed that teachers within 32 of 38 treatment schools attended more than 90 percent of the formal professional development sessions and coaching sessions, meeting the criteria for high implementation levels. In the remaining six schools, attendance rates ranged between 86 and 89 percent, which was categorized as moderate implementation. (See Table 3.7.)

Table 3.7. School-Level Teacher Professional Development

Teacher Professional Development	**Frequency**	**Percentage**
Missing data	0	0.00
Low	0	0.00
Moderate	6	15.78
High	32	84.22

Administrative Support

The following administrative support requirements are necessary in all eMINTS schools:

- *Formal professional development participation*: Principals must attend one two-day professional development session led by eMINTS personnel.
- *Principal participation in school walkthroughs:* Principals must complete two school walkthroughs with eMINTS personnel to evaluate the school's current adoption of eMINTS technology and professional development.

eMINTS schools that demonstrated high fidelity on this component were those in which an administrator (e.g., principal or assistant principal) participated in 100 percent of the required professional development sessions, including the two-day professional development session and two walkthroughs (three total sessions). Schools that demonstrated moderate fidelity were those in which an administrator participated in two of three, or 67 percent, of all sessions (i.e., two of three required). Administrators in low-fidelity schools participated in less than 67 percent of the required professional development sessions. To measure the extent to which administrative support elements were implemented in the school, we analyzed attendance files for the formal professional development session and walkthrough visits.[31]

As Table 3.8 indicates, 36 (95 percent) principals participated in all sessions, and two principals completed two of three sessions.

Table 3.8. Fidelity of Principal Professional Development

Principal Professional Development	Frequency	Percentage
Missing data	0	0.00
Low	0	0.00
Moderate	2	5.26
High	36	94.74

Ongoing Technology Support

eMINTS also attempts to ensure participating schools have sufficient ongoing technical support from internal district and school-level technology staff. One aspect of this support is identifying a technology coordinator to answer questions and help teachers troubleshoot issues when they arise. eMINTS offers technology coordinators and other district or school personnel the opportunity to participate in two optional online professional developments, one in each academic semester. Thus, the following ongoing technology support requirements are necessary in all eMINTS schools:

[31] The principal walkthrough survey requires ratings on the observed levels of teacher-facilitated learning, student-centered learning, teacher use of unique teaching pedagogy and learning strategies, student communities of learners, technology richness, and assessment of student performance in the context of inquiry-based learning.

- *Formal professional development participation*: Technology coordinators were *encouraged*, but not required, to attend two WebEx conferences that provide information on the technological components that eMINTS requires for initial and continued use.
- *Access to onsite technical assistance:* Teachers must have onsite access to technology coordinators who provide adequate troubleshooting and technical support. In addition, teachers must have support for integrating technology into their instruction.

To determine the extent of implementation on the ongoing technology support component, we implemented a three-step process. First, the school received a 2 (high-implementing) if a technology coordinator or support staff member from the school attended both online professional development sessions, a 1 (moderately implementing) if the school technology coordinator or staff member attended one of two sessions, or a 0 (low-implementing) if no one from the school attended any of the online professional development sessions. Second, scores from two teacher survey items were used to index the extent to which teachers experienced adequate technology support and instructional support when attempting to integrate technology into their instruction. These survey items are presented in the following discussion.

> *The following statements are about challenges you face integrating technology into classroom teaching. Please indicate the extent to which you agree or disagree with each statement below.*

- *I do not have adequate technical support.* (item was reverse coded)
- *I have adequate instructional support.*

Response options for these items were (1) completely disagree, (2) mostly disagree, (3) mostly agree, and (4) completely agree. Schools were identified as high-implementing on this subcomponent when the average response across teachers on both items was greater than or equal to 3 (item 1 + item 2/2). Moderately implementing schools had average scores greater than or equal to 2.5 and less than 3.0; low-implementing schools had average scores less than or equal to 2.4. High-implementing schools (schools with a total score of 3 or greater) received a score of 1 on this subcomponent, moderately implementing schools received a score of 0.5, and low-implementing schools received a subcomponent score of 0.

Third, to obtain the ongoing technology support component score, we summed the averages of each item metric: formal professional development participation (0–2), the first teacher survey item (1–4), and the second teacher survey item (1–4). Summed totals per school could range from 2 to 10. We then divided each summed total by 10. High-implementing schools were those with a total component score greater than or equal to 0.8; moderately implementing schools were those with a total component score between .6 and .79. Low-implementing schools had a total component score less than 0.6.

Perhaps because of the optional nature of the technology support component, implementation fidelity was considerably lower than on other fidelity measures. (See Table 3.9.) Six of the 38 schools reported high levels of fidelity, and 20 schools reported moderate levels. In addition, 10 schools were low implementers.

Table 3.9. Fidelity of Ongoing Technology Support

Technology Support	Frequency	Percentage
Missing data	2	5.26
Low	10	26.32
Moderate	20	52.63
High	6	15.78

Overall Program Level of Implementation Fidelity

To determine overall program-level fidelity, we implemented three steps. First, for each school, we calculated a fidelity score on each the five core program components by aggregating individual-level data (e.g., teacher surveys) to the school level within each component. Second, we calculated an overall school-level fidelity score by taking the weighted average of the five component scores for each school (see Table 3.2 for the component weights). This gave us the total fidelity score for each school (see column labeled "Overall Fidelity Score" in Table 3.10). Third, we took the average of all school fidelity scores to determine a program-level fidelity score. Table 3.10 provides the fidelity scores for each school and across the 38 treatment schools. As the table indicates, 34 of 38 schools (89.47%) implemented the eMINTS program at high levels during Year 1. Overall levels of fidelity were high in all but one of the five core program components. Specifically, ongoing technology support fell in the moderate range (see last row, Table 3.10). The primary driver of implementation was teacher professional development (45 percent of overall fidelity) followed by administrative support (20 percent of overall implementation). The high levels of implementation on both of these components explain many of the treatment schools demonstrated overall levels of high implementation fidelity despite low levels of fidelity or missing data for other components, most notably that of ongoing technology support.

Table 3.10 Fidelity Implementation by School[32]

	Technology Infrastructure	Technology Use	Teacher Professional Development	Administrative Support	Ongoing Technology Support	Overall School Fidelity Score	Overall School Fidelity Level
Cut Points	**High >.74 Mod. .50–.74 Low <.50**	**High >.66 Mod. .34–.66 Low <=.33**	**High >.89 Mod. .8–.89 Low <.80**	**High >.67 Mod. .34–.67 Low <.34**	**High >.79 Mod. .60–.79 Low <.60**	**High >.79 Mod. .60–.79 Low <.60**	**High Moderate Low**
Treatment School ID	**Score Weight = 15%**	**Score Weight = 10%**	**Score Weight = 45%**	**Score Weight = 20%**	**Score Weight = 10%**	**Score Weight = 100%**	
1	.75	.67	.93	1.00	.58	.86	High
2	1.00	.83	.91	1.00	.48	.90	High
3	1.00	1.00	.92	1.00	.90	.95	High
4	.67	.67	.93	1.00	.70	.84	High
5	.92	.81	.92	1.00	.48	.88	High
6	1.00	.67	.95	1.00	.60	.91	High
8	1.00	.67	.95	.67	.50	.84	High
9	.92	.78	.91	1.00	.63	.89	High
10	.75	1.00	.92	1.00	.64	.89	High
11	1.00	.87	.91	1.00	.81	.93	High
12	.92	.63	.95	1.00	.59	.89	High
13	.92	.33	1.00	1.00	.85	.91	High
15	.92	.75	.91	1.00	.78	.91	High
16	.92	.44	.93	1.00	.63	.86	High
17	1.00	1.00	.95	1.00	.70	.95	High

[32] Some components include more unique values than might be expected (e.g., technology use) that result from the aggregation of two sets of variables (i.e., teachers reporting on mathematics and communication arts separately).

	Technology Infrastructure	Technology Use	Teacher Professional Development	Administrative Support	Ongoing Technology Support	Overall School Fidelity Score	Overall School Fidelity Level
Cut Points	**High >.74 Mod. .50–.74 Low <.50**	**High >.66 Mod. .34–.66 Low <=.33**	**High >.89 Mod. .8–.89 Low <.80**	**High >.67 Mod. .34–.67 Low <.34**	**High >.79 Mod. .60–.79 Low <.60**	**High >.79 Mod. .60–.79 Low <.60**	**High Moderate Low**
Treatment School ID	**Score Weight = 15%**	**Score Weight = 10%**	**Score Weight = 45%**	**Score Weight = 20%**	**Score Weight = 10%**	**Score Weight = 100%**	
19	.50	.83	.97	1.00	.60	.87	High
20	1.00	.33	.96	1.00	.60	.88	High
22	.75	.44	.86	1.00	.52	.80	High
23	.83	.67	.88	1.00	.53	.84	High
26	1.00	.89	.86	1.00	.83	.90	High
27	1.00	1.00	.94	1.00	.63	.94	High
31	.92	.92	.92	1.00	.63	.91	High
32	1.00	.92	.98	1.00	.60	.95	High
33	1.00	.78	.96	.67	.90	.86	High
34	.92	1.00	.93	1.00	.60	.92	High
35	—	1.00	.92	1.00	.86	.77	Moderate
39	.92	.94	.93	1.00	.65	.91	High
40	1.00	1.00	.94	1.00	—	.96	High
41	.92	1.00	.86	1.00	—	.88	High
43	.92	—	.86	1.00	—	.73	Moderate
45	.92	—	.90	1.00	.65	.74	Moderate
47	1.00	1.00	.93	1.00	.60	.94	High
51	.92	1.00	.96	1.00	.60	.93	High
52	.92	1.00	.94	1.00	.65	.91	High

	Technology Infrastructure		Technology Use		Teacher Professional Development		Administrative Support		Ongoing Technology Support		Overall School Fidelity Score		Overall School Fidelity Level
Cut Points	**High Mod. Low**	**>.74 .50–.74 <.50**	**High Mod. Low**	**>.66 .34–.66 <=.33**	**High Mod. Low**	**>.89 .8–.89 <.80**	**High Mod. Low**	**>.67 .34–.67 <.34**	**High Mod. Low**	**>.79 .60–.79 <.60**	**High Mod. Low**	**>.79 .60–.79 <.60**	**High Moderate Low**
Treatment School ID	**Score Weight = 15%**		**Score Weight = 10%**		**Score Weight = 45%**		**Score Weight = 20%**		**Score Weight = 10%**		**Score Weight = 100%**		
53	—		.72		.96		1.00		.57		.76		Moderate
54	.75		1.00		.94		1.00		.58		.89		High
55	.92		1.00		.97		1.00		.60		.94		High
60	.75		1.00		.97		1.00		.65		.92		High
Overall Program Fidelity Score	**.90**		**.82**		**.93**		**.98**		**.65**		**.88**		**High**

Summary

Across all eMINTS and eMINTS+Intel schools, eMINTS provided the resources, professional development, and guidance essential to support implementation at the district, school, and classroom levels. As to whether schools implemented the eMINTS program as designed in Year 1, 34 of the 38 (89.47 percent)[33] treatment schools were considered high implementers, four were moderate, and none of the schools were low implementers. In particular, 32 of 38 schools (84.22 percent) reported more than 90 percent attendance on the teacher professional development component (includes formal professional development and coaching), which is considered the most important component of the eMINTS Comprehensive program. Program-level implementation fell into the high range at 88.32 percent. Many schools experienced challenges reaching high levels of implementation on one major program component: ongoing technology support. Specifically, six of the 38 treatment schools (15.78 percent) implemented at high levels, 20 (52.63 percent) at moderate levels, and 10 (26.32 percent) at low levels on this component (two schools were missing data). It is worth noting that technology coordinator professional development—one of two major subcomponents to measure ongoing technology support—is optional.

33 Not including ongoing technology support, all schools had high implementation in at least three of the four remaining components.

Chapter 4: Student Impact Findings

In this chapter, we present findings for student and program impacts on student motivation and engagement. Then we present findings for the two key student outcome measures: students' test scores on the MAP in communication arts and mathematics and students' assessment scores on 21st century learning skills. These findings address the following exploratory research questions:

1. What is the impact of eMINTS PD on seventh- and eighth-grade students' academic engagement?
2. What is the impact of eMINTS PD on seventh- and eighth-grade students' performance in mathematics?
3. What is the impact of eMINTS PD on seventh- and eighth-grade students' performance in communication arts?
4. What is the impact of eMINTS PD on seventh- and eighth-grade students' 21st century learning skills?

Additional questions on the differential impact of eMINTS on student subgroups, as well as impacts of a third year of professional development (eMINTS+Intel) on student outcomes, will be addressed in the Year 3 report.

Table 4.1 summarizes the overall impact estimates across student outcomes. Impact estimates on all achievement outcomes—mathematics, communication arts, and 21st century learning skills—are positive; there are no statistically significant overall impacts of the eMINTS PD, however, on MAP mathematics or communication arts test scores or 21st century learning skills. A detailed description of estimated regression coefficients for each of the student outcome analyses is available in Appendix G. The lack of significant impacts on student achievement outcomes is not surprising when one considers that less than one year of eMINTS two-year PD had been implemented at the time of data collection and students had only two to four months of exposure to classroom technology resources. Significant effects on student outcomes are not expected until after the second and third years of implementation.

Impacts on student engagement are negative, indicating that engagement and academic orientation was lower in eMINTS schools than in control schools. As with achievement outcomes, however, these outcomes were nonsignificant and, therefore, may have occurred by chance.

Table 4.1. Year 1 Impact of eMINTS on Grades 7 and 8 Student Achievement Outcomes, 2011–2012

Outcome	Mean[a]		Estimated Impact[a]			
	eMINTS Mean	Control Mean	Impact	Standard Error	*p*-Value[b]	Effect Size[c]
MAP 2012 mathematics *z*-scores[d]	–0.228 (*n*[e]=2,558)	–0.294 (*n*=872)	0.067	0.044	0.128	0.071
MAP 2012 communication arts *z*-scores[d]	–0.771 (*n*=2,557)	–0.778 (*n*=873)	0.007	0.047	0.882	0.009
21st century learning skills scale scores[f]	271.4 (*n*=2,118)	270.3 (*n*=621)	1.100	5.970	0.847	0.022
Student engagement scores[f]	1.07 (*n*=1,868)	1.20 (*n*=518)	–0.130	0.125	0.287	–0.147

[a]Means and impacts were regression-adjusted to account for clustering of students within schools, block effects, and baseline student, teacher, and school characteristics and weighted by the number of schools in each block.

[b]None of the estimated impacts was statistically significant at the .05 level.

[c]Effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*). *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means.

[d]Because the student analytic samples are pooled samples of seventh- and eighth-graders, MAP scale scores were converted into a common metric by standardizing the scores separately by year (i.e., 2011 for the pretest and 2012 for the posttest), grade, subject (mathematics and communication arts), and randomization block. Specifically, each test score was converted into a *z*-score by subtracting from the test score the average score for a particular year, grade, subject, and block, and then dividing by the standard deviation for a particular year, grade, subject, and block.

[e]*n* gives the sample sizes used in the analysis. For the MAP mathematics and MAP communication arts analyses, *n* includes all eligible students with nonmissing outcomes. For the 21st century learning skills and student engagement analyses, *n* includes all eligible students who provided consent to participate and have nonmissing outcomes.

[f]Student engagement scores are Rasch logit ability measures from a Rasch analysis of students' responses to the spring 2012 Student Engagement Survey.

Source: Authors' analysis based on Year 1 implementation (2011–12) data from the study districts and the MO DESE.

Chapter 5: Teacher Impact Findings

In this chapter, we analyze teacher survey responses and observations of teachers to assess the impact of the first year of eMINTS PD on instructional practices. Specifically, this chapter answers the following exploratory research questions:

> What is the impact of eMINTS PD on seventh- and eighth-grade teachers' instructional practices?

According to our analyses of teacher self-report data (from the spring 2012 teacher survey) in Table 5.1, no statistically significant differences arose between treatment and control teachers for community of learners, inquiry-based learning, or high-quality lesson design after Year 1. eMINTS teachers did, however, report higher levels of technology integration relative to the control group. The difference between treatment and control on this measure was statistically significant, with a large effect size of 0.99.

Table 5.1. Overall Impact of eMINTS on Four Teacher Survey Outcomes in Implementation Year 1, 2011–12

Outcome[a]	Mean[b]		Estimated Impact[b]			
	eMINTS Mean	Control Mean	Impact	Standard Error	*p*-Value	Effect Size[c]
Community of learners	2.382 (*n*[d]=103)	2.77 (*n*=48)	–0.388	0.561	0.489	–0.129
Inquiry-based learning	–0.370 (*n*=105)	–0.479 (*n*=49)	0.109	0.118	0.355	0.166
High-quality lesson design	0.293 (*n*=105)	0.211 (*n*=49)	0.083	0.167	0.619	0.064
Technology integration	0.503 (*n*=103)	–0.087 (*n*=48)	0.590	0.076	<0.0001*	0.987

* Difference statistically significantly different from zero at the .05 level.

[a]Teacher outcomes are Rasch logit ability measures from a Rasch analysis of teachers' responses to the spring 2012 Teacher Survey items that fall under each of four constructs: community of learners (12 items), inquiry-based learning (43 for mathematics and 49 for communication arts), high-quality lesson design (9), and technology integration (98).

[b]Means and impacts were regression adjusted using ordinary least squares to account for block effects and baseline teacher and classroom characteristics, and weighted by the number of schools in each block.

[c]Effect sizes were calculated separately by block, and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*). *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means.

[d]*n* gives the sample sizes used in the analysis. It includes all eligible mathematics and communication arts teachers who provided consent to participate and have nonmissing outcomes.

Source: Authors' analysis based on Year 1 implementation (2011–12) data from the study districts and the MO DESE.

As highlighted in Table 5.2, observers found positive, statistically significant differences impacts on in treatment teachers' use of inquiry-based learning instructional practices and integration of technology after one year of implementation. The effect sizes of these impacts were relatively large at about a half standard deviation and one standard deviation, respectively. There was, however, no statistically significant difference between treatment and control teachers in the practice of community of learners.

Table 5.2. Overall Impact of eMINTS on Three Classroom Observation Outcomes in Implementation Year 1, 2011–12

Outcome[a]	Mean[a]		Estimated Impact[b]			
	eMINTS Mean	Control Mean	Impact	Standard Error	*p*-Value	Effect Size[c]
Community of learners	2.217 (*n*[d]=112)	1.853 (*n*=49)	0.363	0.237	0.126	0.392
Inquiry-based learning	0.166 (*n*=112)	–0.635 (*n*=49)	0.800	0.334	0.017*	0.520
Technology integration	–0.803 (*n*=112)	–1.315 (*n*=49)	0.512	0.141	<0.0001*	1.171

* Difference statistically significantly different from zero at the .05 level.

[a]Teacher outcomes are Rasch logit ability measures from a Rasch analysis of items in the spring 2012 classroom observation protocol that belong to each of three constructs: community of learners (6 items), inquiry-based learning (5), and technology integration (18). There were no items in the classroom observation protocol that measured the high-quality lesson design construct, and so this construct was measured only through the teacher survey.

[b]Means and impacts were regression-adjusted using ordinary least squares to account for block effects and baseline teacher and classroom characteristics and weighted by the number of schools in each block.

[c]Effect sizes were calculated separately by block and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*). *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means.

[d]*n* gives the sample sizes used in the analysis. It includes all eligible mathematics and communication arts teachers who provided consent to participate and have nonmissing outcomes.

Source: Authors' analysis based on Year 1 implementation (2011–12) data from the study districts and the MO DESE.

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Appendix A.
eMINTS Professional Development Timeline

Tables A-1 through A-3 present the timeline for delivery of eMINTS PD and eMINTS+Intel® Teach PD. The timeline is based on 10 years of PD delivery and follows the sequence that groups historically have used in the program.

Table A-1. Year 1 eMINTS + Intel Professional Development Timeline

Year 1 eMINTS PD	For Groups 1 and 2 From Fall 2011 to Spring 2012									
	Aug	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Getting Started	X									
Transforming Learning With Technology	X									
Constructivism	X									
Questioning Strategies	X									
Cooperative Learning		X								
Effective Uses of Productivity Tools		X								
Peer Visit		X								
Interactive Whiteboards			X							
Finding and Organizing Internet Resources			X							
Evaluating and Using Internet Resources				X						
Using Presentations in Inquiry-Based Learning				X						
Learning Communities and Technology				X						
Planning a Classroom Website					X					
Inquiry-Based Lessons					X					
Intro to WebQuests						X				
Visual Literacy						X				
Creating and Editing Digital Images						X				
Creating a Classroom Website							X			
Tools for Thinking							X			
Website Work Session							X			
Modifying a WebQuest								X		

Year 1 eMINTS PD	For Groups 1 and 2 From Fall 2011 to Spring 2012									
	Aug	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Collaboration Session 1—Troubleshooting								X		
Classroom Communication									X	
Collaboration Session 2									X	
Connections Between Inquiry-Based Teaching and State Assessment										X
File Management										X
Writing a WebQuest										X
eMINTS Coaching Visits	X	X	X	X	X	X	X	X	X	X

Table A-2. Year 2 eMINTS + Intel Professional Development Timeline

Year 2 eMINTS PD	For Groups 1 and 2 From Fall 2012 to Spring 2013									
	Aug	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Classroom Management	X									
Website Enhancement		X								
Working With Authentic Data		X								
Peer Visit		X								
Assessment			X							
Interdisciplinary Teaching and Learning			X							
Collaboration Session 1			X							
Revisiting WebQuests				X						
Collaboration Session 2				X						
Mapping a Multimedia Project					X					
Creating Multimedia Products					X					
Assessing Student Technology Products						X				
Lesson Design 1						X				
Lesson Design 2							X			
Collaboration Session 3							X			
eMINTS Winter Conference								X		
Online Projects								X		

Year 2 eMINTS PD	For Groups 1 and 2 From Fall 2012 to Spring 2013									
	Aug	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Lesson Design 3									X	
Collaboration Session 4									X	
Planning for Year 2 Professional Development										X
eMINTS Coaching Visits	X	X	X	X	X	X	X	X	X	X

Table A-3. Year 3 eMINTS + Intel Professional Development Timeline

Year 3 eMINTS+ Intel® Teach	For Group 2 ONLY Beginning Fall 2013–Spring 2014									
	Aug	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**
Targeting Thinking	X									
Designing Standards-Based Projects		X								
Creating Curriculum-Framing Questions to Support Thinking Skills			X							
Planning Student-Centered Assessment				X						
Visual Ranking Tool						X	X			
Seeing Reason Tool							X	X		
Showing Evidence Tool								X	X	
Completing Unit Plan, Evaluation, and Feedback										X

Appendix B.
eMINTS Instructional Model: Component Definitions

eMINTS Comprehensive professional development is designed to help teachers implement the eMINTS instructional model, which is based on four components: inquiry-based instruction, high-quality lesson design, a community of learners, and technology integration. More detailed descriptions of the four components follow.

Inquiry-Based Instruction

One of the core goals of the eMINTS professional development model is to increase teachers' capacity to utilize student-centered, inquiry-based instructional practices in the classroom (Minner, Levy & Century, 2010; Schroeder, Scott, Tolson, Huang, & Lee, 2007). Inquiry-based learning activities require students to construct knowledge through meaningful investigations that require higher-order thinking skills such as reasoning analysis, judgment, and decision making (Barron & Darling-Hammond, 2008; National Research Council, 2000). Instruction is typically framed around open-ended questions that are authentic and relevant to life outside the classroom (Barron & Darling-Hammond, 2008; Hmelo-Silver, Duncan, & Chinn, 2007). Investigations are intended to spark curiosity and encourage students to probe for deeper meaning (Barron & Darling-Hammond, 2008; Maxwell, Mergendoller & Bellisimo, 2005; Schroeder et al. , 2007). As part of their classroom pursuits, students typically have to draw on knowledge and skills from more than one academic discipline (Thomas, 2000). In addition, learners may be responsible for designing their own investigation, collecting relevant data, making inferences, drawing logical conclusions, supporting conclusions with valid information, and communicating their findings (Barron & Darling-Hammond, 2008; Minner et al., 2010; Taraban, Box, Myers, Pollard, & Bowen, 2007). Teachers strive to ensure that the learning process is individualized to meet different learning needs, that new material is connected to students' past experiences and current understanding of concepts, and that students have access to a variety of appropriate learning tools and resources (Schroeder et al., 2007). As a result, the teacher's role evolves away from giver of knowledge to facilitator of learning (Barron & Darling-Hammond, 2008; Finkelstein, Hanson, Huang, Hirschman, & Huang, 2010).

eMINTS Comprehensive illustrates for teachers how marrying standards-based instruction with interdisciplinary inquiry-based learning improves student performance. Teachers progress through stages from direct instruction to guided inquiry and finally to open inquiry using technology to skillfully guide students toward content knowledge needed for success on local and state assessments. Authentic assessments help students develop higher-order thinking skills and are critical to developing 21st century learners; assessment in standards- and inquiry-based classrooms, however, can be challenging for teachers new to the practice. In eMINTS PD, teachers learn about and practice using multiple types of assessment in sessions dealing with assessment and in content woven throughout the program.

High-Quality Lesson Design

High-quality lesson design emphasizes that student learning is best facilitated through a teacher's ability to engage students in lessons with meaningful content and through inquiry. In this model, effective facilitation is based on the teacher's ability to select instructional strategies to best meet the needs of the learners (Tomlinson et al., 2003) and their ability to help students build personal understanding of lesson content through processes such as reflection and metacognition (National Research Council, 2003). To support student learning, teachers must be attentive to what students currently know and what they are capable of, in order to be able to identify areas in which they require additional support (Wiliam & Thompson, 2007). Wiggins and McTighe (1998) suggest that assessing depth of understanding is best approached through the use of assessments in multiple contexts, which vary in when and how they are administered. The use of multiple data sources enables teachers to improve student achievement through prioritization of instructional time, targeted instruction for struggling students, identification of student strengths, gauging instructional effectiveness of classroom lessons, and refinement of instructional methods (DeMeester & Jones, 2009; Hamilton et al., 2009; Shavelson, 2006). In addition, feedback from assessments can help students focus their own efforts on areas for growth (Heritage 2007; Sadler, 1989) and reasoning ability (Belland, Glazewski, & Richardson, 2011; Chinn & Hung, 2007) and increase their achievement levels (Simons & Klein, 2007). Professional development focusing on lesson design enables teachers to plan standards-based instruction and inform instruction with formative and summative assessments. eMINTS PD guides teachers with lesson design processes created by eMINTS staff and based on the rigorous Japanese lesson study that researchers suggest improves instruction (Lewis, Perry, & Hurd, 2004).

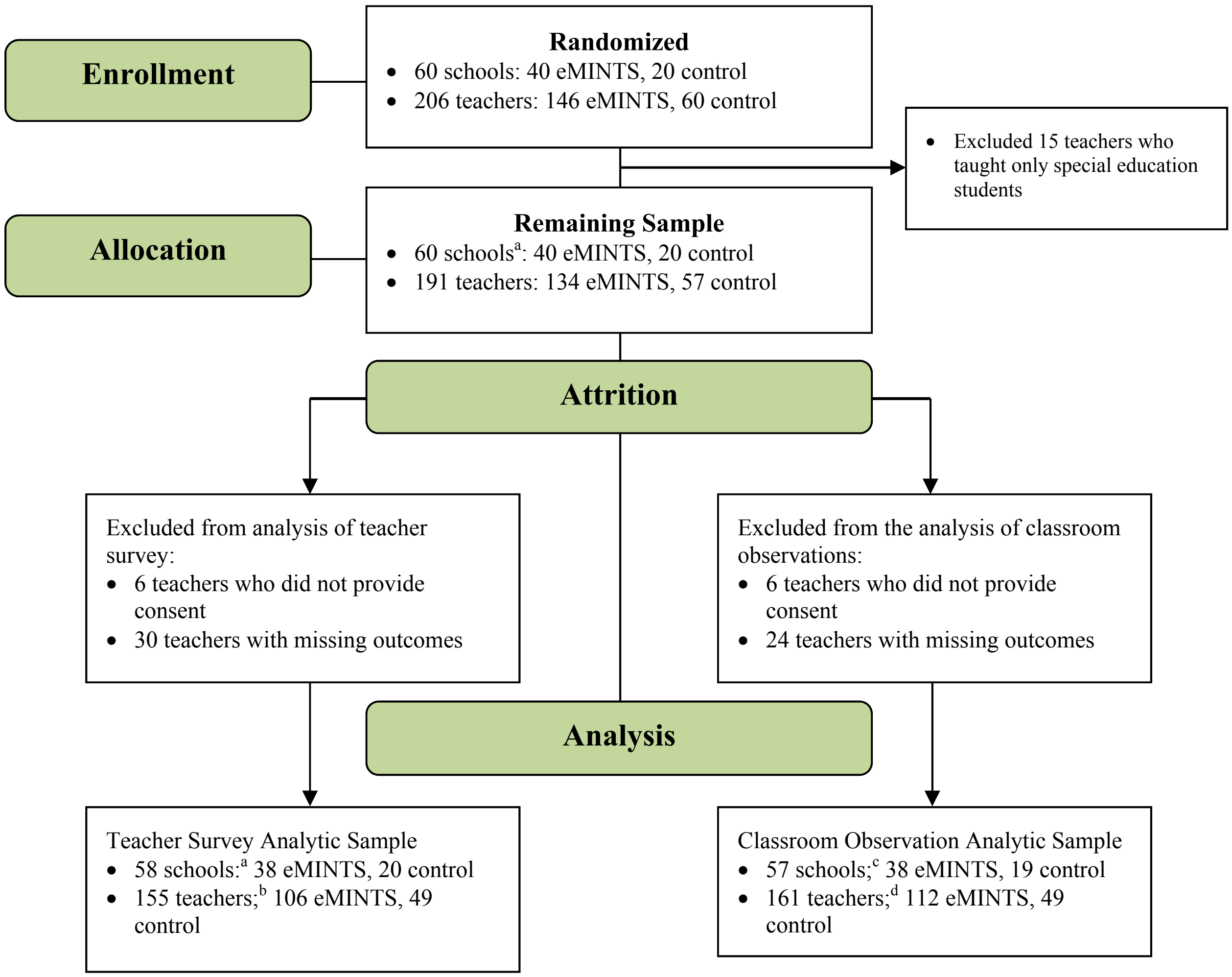
Community of Learners

eMINTS Comprehensive focuses on helping teachers learn how to establish a community of learners in support of standards- and inquiry-based instruction in their classrooms. In effective communities of learners, teachers expect students to support learning through respectful communication and by exhibiting a positive regard for diversity (Houston & Ferstl, 2007; Pulakos, Arad, Donovan, & Plamondon, 2000). The open-minded atmosphere, in which students feel comfortable taking risks and sharing ideas and experiences, allows for responsible social interactions to occur that underpin the development of 21st century life and career skills (Johnson & Johnson, 2009; Pulakos et al., 2000, Slavin, 2010). Students use interpersonal skills to guide others and respond to each other in a dependable, reliable, and trustworthy manner. Work is expected to be efficiently managed such that each student is responsible for his or her contribution and to see that ,projects are completed on time (Johnson & Johnson, 2005; Slavin, 2010). Students are actively involved in setting and managing personal goals (Guthrie, Wigfield, & VonSecker, 2000; Rohrbeck, Ginsburg-Block, Fantuzzo, & Miller, 2003), working independently to become self-directed learners (Houston & Ferstl, 2007). Throughout individual and group projects, students adapt to a variety of roles and responsibilities, learning to exhibit flexibility in different situations (Houston & Ferstl, 2007; Pulakos et al., 2000; Ruiz-Primo, 2009). Prior research suggests that students who learn in classrooms where decisions are made collaboratively display more creativity and higher-order thinking (Kohn, 2006).

Technology Integration

Lawless and Pelligrino (2007) argue that introducing teachers to new technologies for teaching and learning can support change in teaching practices. eMINTS PD centers on a suite of technologies and weaves technology integration into the practice of standards- and inquiry-based teaching. Instead of approaching teachers with a need to change their teaching, teacher buy-in for instructional change is facilitated by the addition of technology to the classroom. The eMINTS model develops the technological skills of its participating teachers so that teachers are able to integrate technology into their inquiry-based instructional practices and student activities. The technology itself is intended to enhance—not simply replace—teacher instruction to achieve desired instructional and learning goals; the use of technology should enable the teacher to instruct or students to demonstrate understanding in ways that would not be possible without the technology (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). Technology underpins the other three tenants of the eMINTS model by providing new modalities and tools for students to explore and construct knowledge as part of inquiry-based learning (e.g., manipulating digital artifacts, completing online drills, engaging in simulations or games; Geier et al., 2008; Li & Ma, 2010); and serving as a means of interaction to support collaborative and cooperative learning inside and outside the classroom (i.e., community of learners; U.S. Department of Education, 2012).

Appendix C.
Consort Diagram for Teachers, 2011–12



[a]Two eMINTS schools, each with two eligible teachers, withdrew from the study. In one of these two schools, both eligible teachers did not provide consent to participate. In the other school, both the eligible teachers provided consent but did not complete the teacher survey.

[b]The teacher survey was analyzed separately for four constructs of teacher practice: community of learners, inquiry-based learning, high-quality lesson design, and technology integration. The analytic samples for the four constructs had the following sample sizes: 151 teachers each for community of learners and technology integration constructs, and 154 teachers each for inquiry-based learning and high-quality lesson design constructs. When combined, these four samples had a total of 155 teachers.

[c]There were no classroom observation data on three schools: the two eMINTS schools that withdrew from the study, and one control school.

[d]The classroom observation was analyzed separately for three constructs of teacher practice: community of learners, inquiry-based learning, and technology integration (note that there were no items in the observation protocol that measured high-quality lesson design). The analytic samples for the three constructs were all the same and consisted of 161 teachers.

Source: Authors' analysis based on data from MO DESE and the study districts.

Appendix D.
Model for Baseline Equivalence Testing

Level 1 (students)

$$Ypre_{ij} = \pi_{0j} + \pi_{1j} Grade_{ij} + \varepsilon_{ij}$$

Level 2 (schools)

$$\square_{0\square} = \sum_{\square} \square_{00\square} \square_{\square} + \sum_{\square} \square_{01\square} \square_{\square} * \square_{\square} + \square_{0\square}$$

$$\pi_{1j} = \beta_{10}$$

where

$Ypre_{ij}$ is a baseline characteristic (e.g., pretest MAP mathematics or communication arts score) of student *i* in school *j*; $\square_{\square}$ = 1 if school *j* is in randomization block *k*, and 0 otherwise, $\square = 1, \cdots, 3$

$\square_{\square}$ = 1 if school *j* belongs to either the eMINTS or eMINTS+Intel Teach groups, and 0 otherwise

$Grade_{ij}$ is a grade-level indicator that is equal to 1 for eighth-grade students and 0 for seventh-grade students (centered around the grand mean)

ε_{ij} and r_{0j} are random residuals at the student and school levels, respectively.

For the Year 3 analyses, the following model will be employed for comparing baseline student characteristics:

Level 1 (students)

$$Ypre_{ij} = \pi_{0j} + \pi_{1j} Grade_{ij} + \varepsilon_{ij}$$

Level 2 (schools)

$$\square_{0\square} = \sum_{\square} \square_{00\square} \square_{\square} + \sum_{\square} \square_{01\square} \square 1_{\square} * \square_{\square} + \sum_{\square} \square_{02\square} \square 2_{\square} * \square_{\square} + \square_{0\square}$$

$$\pi_{1j} = \beta_{10}$$

where

$\square 1_{\square}$ = 1 if school *j* belongs to the eMINTS group, and 0 otherwise

$\square 2_{\square}$ = 1 if school *j* belongs to the eMINTS+Intel Teach group, and 0 otherwise

and all other variables are as defined in the previous model.

Appendix E.
Baseline Characteristics of Students in 21st Century Learning Skills and Student Engagement Analytic Samples

Table E-1. Characteristics of Students in the 21st Century Learning Skills Analytic Sample,[a] 2010–11 (Before Year 1 Implementation)

Characteristic	eMINTS Mean[b]	Control Mean	Estimated Difference	*p*-Value	Effect Size[c]
Number of students	2,118	621			
2011 MAP mathematics *z*-scores	0.049 (*n* = 2,072)	–0.088 (*n* = 605)	0.137	0.095	0.14
2011 MAP communication arts *z*-scores	0.007 (*n* = 2,071)	–0.011 (*n* = 605)	0.018	0.826	0.02
Percentage eligible for free or reduced-price lunch	52.8	54.5	–1.6	0.697	–0.04
Percentage nonwhite	5.0	7.7	–2.7	0.280	–0.26
Percentage with disability	12.6	13.9	–1.3	0.516	–0.02
Percentage limited English proficient	0.4	1.6	–1.2	0.001*	–0.88
Percentage male	50.1	47.5	2.6	0.353	0.06
Joint test of difference in student characteristics between eMINTS and control groups:[d] $F = 0.09$, df = (8, 55)					0.999

* Difference statistically significantly different from zero at the .05 level.

[a]The 2,739 students in the 21st century skills analytic sample are all in the MAP mathematics analytic sample, and all except one are in the MAP communication arts analytic sample.

[b]Means and differences were regression-adjusted to account for block effects, grade, and clustering of students within schools, and weighted by the number of schools in each block. Because of zero counts for limited English proficiency in some cells, differences between males and females were estimated on the whole sample (instead of separately by blocks).When data are missing data, *n* is the actual number of students used to calculate the average characteristic in each treatment group. *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means.

[c]Effect sizes were calculated separately by block, and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*) for continuous variables, and using Cox index for the binary variables.

[d]An overall test of the difference between the eMINTS and control groups based on all student characteristics in this table was conducted using an *F*-test adjusted for the randomization of blocks within districts and the clustering of students within schools. The *F*-test is from a two-level logistic regression model with the binary treatment indicator as outcome and the student characteristics in this table as covariates.

Source: Authors' analysis based on the student baseline data collected from study districts in spring 2011, when Grade 7 students were in Grade 6, and Grade 8 students were in Grade 7.

Table E-2. Characteristics of Students in the Student Engagement Analytic Sample,[a] 2010–11 (Before Year 1 Implementation)

Characteristic	eMINTS Mean[b]	Control Mean	Estimated Difference	*p*-Value	Effect Size[c]
Number of students	1,868	518			
2011 MAP mathematics *z*-scores	0.040 (*n* = 1,829)	–0.110 (*n* = 507)	0.150	0.110	0.15
2011 MAP communication arts *z*-scores	–0.014 (*n* = 1,829)	–0.023 (*n* = 507)	0.009	0.921	0.01
Percentage eligible for free or reduced-price lunch	54.2	53.9	0.2	0.965	0.003
Percentage nonwhite	4.6	8.4	–3.8	0.159	–0.380
Percentage with disability	11.6	14.4	–2.8	0.243	–0.080
Percentage limited English proficient	1.8	3.3	–1.5	0.042*	–0.370
Percentage male	49.2	45.3	3.9	0.223	0.100
Joint test of difference in student characteristics between eMINTS and control groups[d]: $F = 0.08$, df = (8, 49), p-value = 1.000					

* Difference statistically significantly different from zero at the .05 level.

[a]The 2,739 students in the Learning.com 21st Century Skills Assessment analytic sample are all in the MAP mathematics analytic sample, and all except one are in the MAP communication arts analytic sample.

[b]Means and differences were regression-adjusted to account for block effects, grade, and clustering of students within schools, and weighted by the number of schools in each block. Because of zero counts for limited English proficiency in some cells, differences between males and females were estimated on the whole sample (instead of separately by blocks).When data are missing data, *n* is the actual number of students used to calculate the average characteristic in each treatment group. *p*-values are from a two-tailed test of the null hypothesis of equality of eMINTS and control means.

[c]Effect sizes were calculated separately by block, and then pooled into an overall effect size weighted by the number of schools in each block. Block-specific effect sizes were computed using standardized mean differences (Hedges's *g*) for continuous variables, and using Cox index for the binary variables.

[d]An overall test of the difference between the eMINTS and control groups based on all student characteristics in this table was conducted using an *F*-test adjusted for the randomization of blocks within districts and the clustering of students within schools. The *F*-test is from a two-level logistic regression model with the binary treatment indicator as outcome and the student characteristics in this table as covariates.

Source: Authors' analysis based on the student baseline data collected from study districts in spring 2011, when Grade 7 students were in Grade 6, and Grade 8 students were in Grade 7.

Appendix F.
Calculating Implementation Fidelity Received

Components	Criteria	Measures	Item Metric	Component Metric
Technology infrastructure				
Adequate data storage	1gb	TCoordinator Survey Q1, Q2 For responses, code “yes” = 1; “no” = 0; “don’t know” = 0	If tc_stor (Q1) + tc_stor(Q2) = 2, then tc_stor_tot = 1 If tc_stor (Q1) + tc_stor(Q2) = 1, then tc_stor_tot =.5 If tc_stor (Q1) + tc_stor(Q2) = 0, then tc_stor_tot = 0	tech_infstr_tot tech_infstr _ave= (tc_stor_tot + tc_bckp_tot + tc_intcomm_tot + tc_sec_tot + wrlss_tot + tc_shrfldr_tot)/6 If tech_infstr _ave >= .75, then tech_insfstr_tot = 1 If tech_infstr _ave >= .5 and < .75, then tech_insfstr_tot = .5 If tech_infstr _ave < .5, then tech_insfstr_tot = 0 High: tech_infstr_tot = 1 Moderate: tech_infstr_tot = .5 Low: tech_infstr_tot = 0
Backup and disaster recovery	Backups for students, teachers, and administrators	TCoordinator survey Q3 = tc_bckp_adm TCoordinator survey Q4 = tc_bckp_tch TCoordinator survey Q5 = tc_bckp_std For responses, code “yes” = 1; “no” = 0; “don’t know” = 0	If tc_bckp_adm (Q3) + tc_backup_tch (Q4) + tc_backup_std (Q5) = 3, then tc_bckp_tot = 1 If tc_backup (Q3) + tc_backup(Q4) + tc_backup(Q5) = 2, then tc_bckp_tot =.5 If tc_backup (Q3) + tc_backup(Q4) + tc_backup(Q5) < 2 , then tc_bckp_tot =0	

Components	Criteria	Measures	Item Metric	Component Metric
Internet connectivity	1 Mbps connection speed or higher	TCoordinator Survey Q6 = tc_intcomm For responses, code “1 Mbps or higher” = 1; “less than 1 Mbps” = 0	If tc_intcomm = 1 then tc_intcomm_tot = 1; otherwise tc_intcomm_tot = 0	
Internet security	Fully implemented security criteria (filtering software, antivirus, automatic antivirus updates, Web blocking, malware protection)	TCoordinator Survey Q9/Q18 = tc_fltr (code “yes”=1, “no”=0) TCoordinator Survey Q10/20 = tc_antivrs (code “yes”=1, “no”=0) TCoordinator Survey Q11/22 = tc_vrsdef (code “yes”=1, “no”=0) TCoordinator Survey Q12/19 = tc_weblck (code “yes”=1, “no”=0) TCoordinator Survey Q14 = tc_mlwr (code “yes”=1,“no”=0)	If tc_fltr + tc_antivrs + tc_vrsdef + tcweblck + tc_mlwr >=3, then tc_sec_tot = 1; otherwise tc_sec_tot = 0	

Components	Criteria	Measures	Item Metric	Component Metric
Wireless connection	Wireless must be available; wireless must have adequate speed	TCoordinator Survey Q15/23 = tc_wrlss (code "yes"=1, "no"=0) Teacher survey (5.9e) = intspd (code "completely disagree"=1, "mostly disagree"=2, "mostly agree"=3, "completely agree"=4)	Teacher survey: If intspd (Q5.9e) >=3, then intspd_tot = 1; otherwise, intspd_tot = 0 If intspd_tot + tc_wrlss = 2 then wrlss_tot = 1 If intspd_tot + tc_wrlss = 1 then wrlss_tot = .5 If intspd_tot + tc_wrlss = 0 then wrlss_tot = 0	
Shared folder system	Shared folder system available to all eMINTS teachers and their students	TCoordinator Survey Q24 = tc_shrfldr (code "yes"=1,"no"=0)	If tc_shrfldr = 1, then tc_shrfldr_tot = 1 If tc_shrfldr = 0, then tc_shrfldr_tot = 0	

Components	Criteria	Measures	Item Metric	Component Metric
Technology use				
Student laptops	Student's use of laptop	Teacher Survey Q5.6b = stulap_use (code "never or almost never"=1, "3-6 sessions per year"=2, "1-3 sessions per month"=3, "1-3 sessions per week"=4, "almost every or every session"=5)	If stulap_use>=4, then X1=1; otherwise X1=0	tech_use_tot tech_use_ave= (X1+X2+X3)/3 If tech_use_ave >=.67, then tech_use_tot = 1 If tech_use_ave =.67, then tech_use_tot = .5 If tech_use_ave =.33, then tech_use_tot = 0 High: tech_use_tot = 1 Moderate: tech_use_tot = .5 Low: tech_use_tot = 0
Teacher laptop	Teacher's use of laptop	Teacher Survey Q5.6a = tchlap_use (code "never or almost never"=1, "3-6 sessions per year"=2, "1-3 sessions per month"=3, "1-3 sessions per week"=4, "almost every or every session"=5)	If tchlap_use>=4, then X2=1; otherwise X2=0	
Interactive whiteboard	Teacher's use of white board	Teacher Survey Q5.6g = whtbd_use (code "never or almost never"=1, "3-6 sessions per year"=2, "1-3 sessions per month"=3, "1-3 sessions per week"=4, "almost every or every session"=5)	If whtbd_use>=4, then X3=1; otherwise X3=0	
Scanner/ printer	Teacher's use of scanner or printer	Teacher Survey Q5.6d, e	Not included in index for Year 1	
Digital camera	Teacher's use of digital camera	Teacher Survey Q5.6f	Not included in index for Year 1	

Components	Criteria	Measures	Item Metric	Component Metric
Teacher Professional Development				
PLC professional development participation	26 sessions; 123.5 hours total	eMINTS teacher attendance file. Because the total number of hours varies across trainers and teachers (i.e., some sessions, although estimated to last 4 hours, actually take only 3.5 hours to complete), calculate the proportion of total hours that each teacher attended (tch_fmltrng).	tch_fmltrng = (number of hours a teacher attended)/123.5	tch_trng_tot tch_trng_ave = tch_frltrng + tch_cch/2 If tch_trng_ave >= .9, then tch_trng_tot = 1 If tch_trng_ave >= .8 and < .9, then tch_trng_tot = .5 If tch_trng_ave <.8, then tch_trng_tot = 0 High: tch_trng_tot = 1 Moderate: tch_trng_tot = 0.5 Low: tch_trng_tot = 0
Participation in coaching sessions	10 sessions per year	eMINTS teacher attendance file. Calculate the proportion of sessions a teacher attended out of 10 sessions (tch_cch).	tch_cch = (number of sessions a teacher attended)/10	

Components	Criteria	Measures	Item Metric	Component Metric
Administrative Support				
Formal professional development participation	One 2-day session	eMINTS principal attendance file (code prcpl_fmltrng: 0="attended",1="did not attend")	If prcpl_fmltrng = 1, then prcpl_fmltrng_tot = 1; otherwise prcpl_fmltrng_tot = 0	prcpl_trng_tot High: If prcpl_fmltrng + prcpl_wlkthrgh/3 = 1, then prcpl_trng_tot = 1 Moderate: If prcpl_fmltrng+ prcpl_wlkthrgh/3 = .67, then prcpl_trng_tot > = .5 Low: If prcpl_fmltrng+ prcpl_wlkthrgh/3< .67, then prcpl_trng_tot = 0 High: prcpl_trng_tot = 1 Moderate: prcpl_trng_tot = 0.5 Low: prcpl_trng_tot = 0
Participation in walkthroughs	2 sessions	Vovici principal walkthrough survey data (code prcpl_wlkthrgh=number of walkthroughs in which the principal participated).	If prcpl_wlkthrgh = 2, then prcpl_wlkthrgh_tot = 1 If prcpl_wlkthrgh = 1, then prcpl_wlkthrgh_tot = .5 If prcpl_wlkthrgh = 0, then prcpl_wlkthrgh_tot = 0	
Ongoing Technology Support				
Formal professional development participation	2 WebEx conferences	eMINTS technology coordinator attendance file. For each school, code tech_trng as 0="did not attend", 1="attended 1 session", and 2= "attended 2 sessions". A school is considered to have attended if anyone from the school attended the professional development session.	If tech_trng = 2, then tech_trng_tot = 1 If tech_trng = 1, then tech_trng_tot = .5 If tech_trng = 0, then tech_trng_tot = 0	ongoing_sup_tot High: If tech_sup + inst_sup + tech_trng /10 >= .8, then ongoing_sup_tot = 1 Moderate: If tech_sup +

Components	Criteria	Measures	Item Metric	Component Metric
Access to onsite technical assistance	Access to a technology coordinator for troubleshooting and instructional support	Teacher survey Q5.9j (5.9j REVERSE CODED; code tech_sup: “completely disagree”=4, “mostly disagree”=3, “mostly agree”=2, “completely agree”=1) Teacher survey 5.9l (code inst_sup: “completely disagree”=1, “mostly disagree”=2, “mostly agree”=3, “completely agree”=4)	If tech_sup (5.9j) +inst_sup (5.9l)/2 >= 3, then tech_sup_tot = 1 If tech_sup (5.9j) + inst_sup (5.9l)/2 >= 2.5< 3, then tech_sup_tot =.5 If tech_sup (5.9j) + inst_sup (5.9l)/2 < 2.5, then tech_sup_tot =0	inst_sup + tech_trng/10 >= .6 < .8, then ongoing_sup_tot = .5 Low: If tech_sup + inst_sup + tech_trng /10 < .6, then ongoing_sup_tot = 0 High ongoing_sup_tot= 1 Moderate ongoing_sup_tot= .5 Low ongoing_sup_tot= 0

Appendix G.
Estimated Regression Coefficients for the Analyses of the Four Student Outcomes

Table G-1. Estimates of Regression Coefficients for the Analyses of Impact of eMINTS on the Four Student Outcomes in Implementation Year 1, 2011/12

Parameter	MAP Math *z*-scores			MAP Communication Arts *z*-scores			21st Century Skills Scores			Student Engagement Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Block 1												
Intercept (control)	–0.267	0.11	0.015	–0.739	0.14	<.0001	279.990	13.48	<.0001	1.256	0.22	<.0001
Impact: eMINTS—control	0.021	0.07	0.757	–0.056	0.07	0.438	2.849	8.94	0.752	–0.146	0.19	0.448
Block 2												
Intercept (control)	–0.316	0.12	0.011	–0.767	0.16	<.0001	270.850	17.04	<.0001	1.122	0.30	0.000
Impact: eMINTS—control	0.057	0.10	0.571	–0.043	0.11	0.690	–0.902	14.92	0.952	–0.225	0.30	0.450
Block 3												
Intercept (control)	–0.324	0.10	0.003	–0.835	0.15	<.0001	256.830	13.05	<.0001	1.163	0.21	<.0001
Impact: eMINTS—control	0.133	0.07	0.057	0.112	0.07	0.124	–0.424	9.31	0.964	–0.082	0.19	0.672

Parameter	MAP Math *z*-scores			MAP Communication Arts *z*-scores			21st Century Skills Scores			Student Engagement Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Pretests												
Spring 2011 MAP mathematics z-scores	0.768	0.01	<.0001	—	—	—	18.611	1.12	<.0001	0.096	0.03	0.000
Spring 2011 MAP comm. arts z-scores	—	—	—	0.721	0.01	<.0001	–5.280	15.94	0.742	0.192	0.24	0.422
Spring 2011 school mean MAP mathematics z-scores	–0.005	0.08	0.950	—	—	—	26.277	1.15	<.0001	0.057	0.03	0.038
Spring 2011 school mean MAP comm. arts z-scores	—	—	—	0.145	0.09	0.113	10.467	15.97	0.515	–0.074	0.28	0.793
Student Demographics												
Grade: Grade 8—Grade 7	0.000	0.02	0.986	0.000	0.02	0.991	9.363	1.48	<.0001	–0.171	0.04	<.0001
Free or reduced-price lunch: Eligible—ineligible	–0.085	0.02	0.000	–0.080	0.02	0.001	–1.964	1.58	0.218	–0.041	0.04	0.280
Race/ethnicity: White—nonwhite	0.048	0.04	0.288	0.131	0.05	0.008	3.428	3.29	0.305	–0.148	0.08	0.070

Parameter	MAP Math *z*-scores			MAP Communication Arts *z*-scores			21st Century Skills Scores			Student Engagement Scores		
	Estimate	**Standard Error**	***p*-value**	**Estimate**	**Standard Error**	***p*-value**	**Estimate**	**Standard Error**	***p*-value**	**Estimate**	**Standard Error**	***p*-value**
Disability status: Yes—no	–0.286	0.03	<.0001	–0.292	0.04	<.0001	–2.379	2.57	0.358	0.160	0.06	0.014
Limited English proficiency status: Not proficient—proficient	0.016	0.11	0.890	0.318	0.09	0.001	–11.541	10.35	0.327	–0.407	0.18	0.036
Gender: Male—female	0.011	0.02	0.594	–0.039	0.02	0.078	–7.186	1.53	<.0001	–0.193	0.04	<.0001
Teacher Demographics												
Gender: Male—female	–0.068	0.03	0.072	–0.069	0.05	0.176	—	—	—	—	—	—
Graduate degree: With—without	0.077	0.03	0.020	–0.039	0.03	0.246	—	—	—	—	—	—
Years Teaching experience	–0.004	0.00	0.053	0.002	0.00	0.263	—	—	—	—	—	—

* Statistically significantly different from zero at the .05 significance level.

Note: The analytic regression models adjusted for clustering of students within schools, block effects, and baseline student and school characteristics. For the analysis of MAP mathematics and communication arts scores, baseline teacher characteristics also were included as covariates.

Appendix H.
Estimated Regression Coefficients for the Teacher Survey Analysis

Table H-1. Estimates of Regression Coefficients for the Analyses of Impact of eMINTS on Teacher Survey Outcomes in Implementation Year 1, 2011/12

Parameter	Community of Learners Logit Scores			Inquiry-Based Learning Logit Scores			High-Quality Lesson Design Logit Scores			Technology Integration Logit Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Block 1												
Intercept (control)	3.217	1.46	0.030	–0.441	0.30	0.150	0.118	0.43	0.787	–0.176	0.20	0.370
Impact: eMINTS—control	–0.159	0.92	0.863	0.136	0.19	0.481	0.226	0.27	0.409	0.775	0.12	<.0001*
Block 2												
Intercept (control)	2.545	1.38	0.068	–0.459	0.29	0.117	0.486	0.42	0.247	–0.087	0.19	0.639
Impact: eMINTS—control	–1.017	0.80	0.207	0.067	0.17	0.696	–0.015	0.24	0.950	0.408	0.11	0.000*
Block 3												
Intercept (control)	2.242	1.51	0.139	–0.538	0.31	0.087	0.238	0.44	0.594	0.036	0.20	0.860
Impact: eMINTS—control	–0.470	0.83	0.571	0.087	0.18	0.621	–0.077	0.25	0.754	0.403	0.11	0.000*

Parameter	Community of Learners Logit Scores			Inquiry-Based Learning Logit Scores			High-Quality Lesson Design Logit Scores			Technology Integration Logit Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Pretest												
Spring 2011 teacher survey logit scores	0.567	0.11	<.0001*	0.766	0.08	<.0001*	0.752	0.11	<.0001*	0.891	0.08	<.0001*
Teacher Characteristics												
Gender: male—female	0.173	0.69	0.803	0.010	0.14	0.943	0.070	0.21	0.734	0.019	0.09	0.840
Graduate degree: with—without	0.724	0.49	0.142	0.046	0.10	0.656	0.017	0.15	0.908	0.054	0.07	0.421
Years teaching experience	–0.022	0.03	0.508	–0.006	0.01	0.416	0.011	0.01	0.249	–0.008	0.00	0.078
Grade(s) taught: Grade 8—both grades	–0.043	0.70	0.951	–0.210	0.14	0.143	–0.326	0.20	0.109	–0.028	0.09	0.766
Grade(s) taught: Grade 7—both grades	–0.087	0.75	0.908	–0.047	0.16	0.768	–0.261	0.23	0.251	0.011	0.10	0.917
Subject(s) taught: comm. arts—both subjects	–0.362	0.85	0.670	–0.126	0.18	0.475	–0.161	0.25	0.519	–0.103	0.11	0.365
Subject(s) taught: math—both subjects	0.483	0.90	0.591	–0.070	0.19	0.712	–0.759	0.27	0.005*	–0.034	0.12	0.779

Parameter	Community of Learners Logit Scores			Inquiry-Based Learning Logit Scores			High-Quality Lesson Design Logit Scores			Technology Integration Logit Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Student Demographics												
Percentage of students with free or reduced-price lunch	0.228	1.53	0.882	0.454	0.31	0.150	0.786	0.44	0.077	0.264	0.21	0.208
Percentage of nonwhite students	4.094	3.14	0.195	–0.178	0.65	0.785	–0.394	0.93	0.672	0.523	0.42	0.220
Percentage of students with disability	0.610	2.01	0.762	0.126	0.41	0.761	–0.505	0.59	0.390	–0.169	0.27	0.532
Percentage of students with limited English proficiency status	–2.176	5.91	0.713	–0.607	1.22	0.620	–3.638	1.74	0.039	–1.257	0.79	0.115
Percentage of male students	0.077	1.99	0.969	–0.385	0.39	0.326	–0.450	0.56	0.422	–0.375	0.27	0.165
Classroom mean MAP mathematics *z*-score	0.253	1.12	0.822	0.382	0.24	0.120	0.419	0.34	0.222	0.099	0.15	0.517
Classroom mean MAP communication arts *z*-score	–0.175	1.19	0.884	–0.315	0.24	0.198	–0.249	0.34	0.471	–0.102	0.16	0.527

* Statistically significantly different from zero at the .05 significance level.
Note: The analytic regression models adjusted block effects and baseline teacher and classroom characteristics.
Source: Authors' analysis based on Year 1 (2011–12) data from the study districts and the MO DESE.

Appendix I.
Estimated Regression Coefficients for the Classroom Observation Analysis

Table I-1. Estimates of Regression Coefficients for the Analyses of Impact of eMINTS on Classroom Observation Outcomes in Implementation Year 1, 2011/12

Parameter	Community of Learners Logit Scores			Inquiry-Based Learning Logit Scores			Technology Integration Logit Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Block 1									
Intercept (control)	2.161	0.63	0.001	–0.290	0.88	0.744	–1.173	0.38	0.002
Impact: eMINTS—control	–0.132	0.38	0.727	0.512	0.54	0.340	0.282	0.23	0.213
Block 2									
Intercept (control)	1.867	0.64	0.004	–0.218	0.91	0.811	–1.739	0.38	<.0001
Impact: eMINTS—control	0.059	0.39	0.881	0.044	0.55	0.936	0.759	0.23	0.001*
Block 3									
Intercept (control)	1.428	0.61	0.022	–1.257	0.87	0.150	–1.355	0.37	0.000
Impact: eMINTS—control	1.150	0.36	0.002*	1.468	0.51	0.005*	0.737	0.21	0.001*
Pretest									

Parameter	Community of Learners Logit Scores			Inquiry-Based Learning Logit Scores			Technology Integration Logit Scores		
	Estimate	**Standard Error**	***p*-value**	**Estimate**	**Standard Error**	***p*-value**	**Estimate**	**Standard Error**	***p*-value**
Spring 2011 teacher survey logit scores	0.090	0.09	0.318	0.120	0.10	0.227	–0.007	0.02	0.711
Teacher Characteristics									
Gender: male—female	–0.146	0.29	0.615	–0.177	0.41	0.664	–0.321	0.17	0.064
Graduate degree: with—without	0.249	0.21	0.242	0.310	0.30	0.306	–0.016	0.13	0.899
Years teaching experience	–0.017	0.01	0.260	–0.022	0.02	0.290	–0.004	0.01	0.670
Classroom Characteristics									
Grade observed: Grade 8—both grades	–0.335	0.30	0.262	–0.034	0.42	0.936	–0.202	0.18	0.255
Grade observed: Grade 7—both grades	–0.135	0.28	0.635	–0.046	0.40	0.909	0.007	0.17	0.968
Subject observed: Grade 8—Grade 7	0.141	0.20	0.486	–0.031	0.29	0.915	0.137	0.12	0.258
Percentage of students with free or reduced-price lunch	0.961	0.65	0.144	1.547	0.93	0.097	1.012	0.39	0.010*
Percentage of nonwhite students	–0.663	1.44	0.645	0.615	2.01	0.760	0.148	0.86	0.863

Parameter	Community of Learners Logit Scores			Inquiry-Based Learning Logit Scores			Technology Integration Logit Scores		
	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value	Estimate	Standard Error	*p*-value
Percentage of students with disabilities	0.257	0.80	0.749	0.605	1.10	0.584	0.301	0.46	0.517
Percentage of students with limited English proficiency status	3.816	2.48	0.127	3.650	3.50	0.298	0.413	1.48	0.780
Percentage of male students	1.268	0.80	0.115	0.972	1.13	0.390	–0.509	0.48	0.293
Classroom mean MAP mathematics *z*-score	0.376	0.48	0.433	0.434	0.67	0.522	0.375	0.29	0.192
Classroom mean MAP communication arts *z*-score	0.070	0.53	0.895	0.302	0.73	0.679	–0.108	0.31	0.724

* Statistically significantly different from zero at the .05 significance level.

Note: The analytic regression models adjusted for block effects and baseline teacher and classroom characteristics.

Source: Authors' analysis based on Year 1 (2011–12) data from the study districts and the MO DESE.

Appendix J.
Attrition Rates

Table J-1. Attrition Rates on Student Outcomes

Outcome	Group	Number of Students			Attrition Rate (Percentage)	Chi-Square Test of Equality of Rates
		Observed	Missing	Total		
MAP 2012 mathematics *z*-scores	Overall	3,430	180	3,610	5.0	$\chi^2 = 1.9$, df = 1, *p*-value = .166
	eMINTS	2,558	142	2,700	5.3	
	Control	872	38	910	4.2	
MAP 2012 communication arts *z*-scores	Overall	3,430	180	3,610	5.0	$\chi^2 = 1.5$, df = 1, *p*-value = .223
	eMINTS	2,557	143	2700	5.3	
	Control	873	37	910	4.1	
21st century learning skills scale scores	Overall	2,739	871	3,610	24.1	$\chi^2 = 38.1$, df = 1, *p*-value < .0001*
	eMINTS	2,118	582	2,700	21.6	
	Control	621	290	910	31.8	
Student engagement scores	Overall	2,386	1,224	3,610	33.9	$\chi^2 = 45.1$, df = 1, *p*-value < .0001*
	eMINTS	1,868	832	2,700	30.8	
	Control	518	392	910	43.1	

* Difference statistically significantly different from zero at the .05 level

Table J-2. Attrition Rates on Teacher Outcomes

Outcome	Group	Number of Students			Attrition Rate (Percentage)	Chi-Square Test of Equality of Rates
		Observed	Missing	Total		
Teacher Survey[a]						
Community of learners/ technology integration	Overall	151	40	191	20.9	$\chi^2 = 0.9$, df = 1, *p*-value = .344
	eMINTS	103	31	134	23.1	
	Control	48	9	57	15.8	
Inquiry-based learning/ high-quality lesson design	Overall	154	37	191	19.4	$\chi^2 = 1.0$, df = 1, *p*-value = .309
	eMINTS	105	29	134	21.6	
	Control	49	8	57	14.0	
Classroom Observation[b]						
Community of learners/ inquiry-based learning/ technology integration	Overall	161	21	191	15.7	$\chi^2 = .04$, df = 1, *p*-value = .844
	eMINTS	112	11	134	16.4	
	Control	49	10	57	14.0	

[a]There are four outcomes from the teacher survey. The analytic samples for the inquiry-based learning and high-quality lesson design outcomes are the same, and the analytic samples for the community of learners and technology integration outcomes are the same.

[b]There are three outcomes from classroom observation. The analytic samples for all three outcomes are the same.

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