THE RELATIONSHIP BETWEEN THE USE OF TECHNOLOGY FOR DATA-DRIVEN DECISION-MAKING AND STUDENT ACHIEVEMENT IN HIGH SCHOOL MATHEMATICS

by

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ABSTRACT

The extent to which Montana school leaders of high school mathematics use technology to examine student assessment results and affect instructional and curriculum change is not known. Specifically, it is not known to what degree mathematics school leaders use technology in assessment analysis, and if that analysis is related to student achievement in mathematics.

Educators and math students in Montana "AA" high schools are the studied population in this research. Math instructional personnel and building leadership were administered a data-driven decision-making (DDDM) diagnostic to determine their capacity for using technology in the process of DDDM. Educators from 10 of the 13 "AA" high schools participated in the survey. One hundred twenty-five educators in the 10 high schools responded to the survey, 90 math instructors and 35 administrators. The DDDM diagnostic was secured from Dr. Scott McLeod of the University of Minnesota's School Technology Leadership Initiative. Dr. McLeod is conducting extensive research on the DDDM capacity of 11,000 educators in the state of Minnesota using the DDDM instrument. Five different mathematics student assessment indicators over a two-year time frame for each of the 10 participating schools were gathered from the high school principal in each of the schools. The composite scores from the assessment indicators in each school were correlated to the use of technology for DDDM capacity in each school to determine if a relationship existed between the two variables.

Although this study utilized descriptive and correlation methodologies, it also resulted in apparent differences between teachers' and administrators' perceptions of their collective capacity for using technology for DDDM. Calculated means for each category of the DDDM survey instrument resulted in a higher average in every category for administrators than for teachers. This difference between teachers and administrators has implications for leadership and increasing the capacity for DDDM in Montana schools. There appears to be no significant relationships between student math assessment outcomes and using technology for DDDM capacity of educators. The research indicates that Montana "AA" educators are not using technology for DDDM to the degree that a positive relationship exists between student results and DDDM capacity. The study concludes that a closer examination of relationships between the use of technology for DDDM capacity and teacher-created formative assessments should be considered.

CHAPTER 1

INTRODUCTION

Montana educators face critical decisions related to the No Child Left Behind (NCLB) Act, as NCLB challenges educators to ensure that students meet proficiency levels on state mandated testing. The No Child Left Behind Act requires accountability. Principals are to direct teachers to use professional wisdom and empirical evidence in implementing evidence-based education (McLeod, D'Amico, & Protheroe, 2003). Evidence-based education relies on scientifically based research, empirical evidence, and the judgment that individuals acquire through professional wisdom and experience. Adjusting instructional methods to address student needs will require the most efficient use of information for making data-driven decisions. Technology tools have the potential to serve as a platform for evidence-based education and the basis on which educators make decisions.

The NCLB Act requires Montana educators to base decisions on what is best for student learning as ultimately indicated by student achievement. Proven instructional methods, delivery, curriculum, and strategies must be implemented to comply with NCLB so that students will become academically proficient according to state standards. "Through the implementation of the NCLB Act, teaching and learning will improve by providing better information to teachers and principals" (Paige & Hickok, 2004, p. 2). Test information is required to be collected, stored, and aggregated, so that educators, counselors, and administrators have information to make decisions—in order to more

effectively serve students. In the publication entitled "A Toolkit for Teachers," former Secretary of Education, Rod Paige (2004) states, "We have included valuable information on special education, English language learners, scientifically based research, using data to inform instruction, and examples of interesting initiatives to improve teaching and learning" (p. v). Using data as evidence for implementation of instructional programs is fundamental to the NCLB Act.

The U.S. Department of Education (DOE), Office of Educational Technology (2004) has outlined seven major action steps and recommendations for the future of education as educators consider technology. Among the seven recommendations, the DOE recommends the integration of data systems. The recommended integrated system includes online technology-based assessments, as well as centralized information that can be easily accessed and utilized; enabling educators to adjust instruction and personalize education for students, thus improving student performance. Technology tools have the potential to assist educators in the implementation of NCLB and in achieving Adequate Yearly Progress (AYP). Every school must demonstrate AYP as defined by state standards for academic achievement and is fundamental in accountability within NCLB. This research is predicated on the premise that technology is essential for student improvement. Technology systems have the potential to provide information in real time, allowing educators the opportunity to address student deficiencies immediately. This real time informational response can potentially empower educators to make proactive changes to address student academic needs. The U.S. DOE (2004) provides the following

recommendations when considering centralized and uniform information management systems for states, districts, and schools:

- Establish a plan to integrate data systems so that administrators and educators have the information they need to increase efficiency and improve student learning.
- Use data from both administrative and instructional systems to understand relationships between decisions, allocation of resources, and student achievement.
- Ensure interoperability. For example, consider School Interoperability Framework (SIF) Compliance Certification as a requirement in all RFPs and purchasing decisions.
- Use assessment results to inform and differentiate instruction for every child (p. 44).

The current ubiquitous use of technology by the educational community seems to enable educators to address individual deficiencies as well as grade level needs, while acting as a catalyst to engage educators in a state of continuous, consistent, positive change. Technology will assist in compiling results and aggregating information so that diagnostic analysis of student assessment and progress will uncover previously unexamined and/or ignored conditions. Educators will have the ability to seek answers in real time that technology assistance can provide in meeting AYP of NCLB.

Due to NCLB, the Montana Office of Public Instruction (OPI) has imposed responsibility on local school district educators to improve student performance on standardized assessments and demonstrate student proficiency on criterion-referenced exams. Under the NCLB Act for example, Title I schools not meeting AYP are required to allow students to attend neighboring, higher performing schools (McLeod, D'Amico, & Protheroe, 2003). Seven of the 13 "AA" high schools in Montana are designated Title

I schools, i.e., they receive federal funding for targeted assistance programs (Montana OPI, 2004). In a relevant example to this study, educators at Billings Senior High, a Title I school, sent information home on December 20, 2004, inviting parents to select another district high school for their students as a result of not meeting AYP for two consecutive years (Anderson, 2005). School leaders are responsible for students performing at an acceptable level, meaning all students (including Title I school students) must achieve at proficiency or above by the year 2014. The close examination of student achievement and making the necessary adjustments in order for students to meet proficiency will be paramount to Montana educators. Understanding proficiency, and the changing target for proficiency that Montana educators have faced for the past five years, is the first step in the process of meeting the imposed 2014 goal of all students meeting proficiency or above.

The level of proficiency for 2001-2003 is defined by the OPI in Montana as the 40^{th} percentile or higher on the Iowa Test of Educational Development (ITED). The ITED is a standardized exam based on student norms in the year of 2000. Beginning in the spring of 2001, this exam has been required in grade 11 and has been used in determining AYP from 2001-2003. For the years 2001-2003, 75 to 78 percent of Montana grade 11 students measured proficient in either reading or math using the ITED as the determiner for proficiency (Montana OPI, 2004). Measured Progress Testing was contracted by the Montana Office of Public Instruction to consult with Montana educators, for the purpose of designing a criterion referenced test (CRT) to be administered for reading and math in grade 10 for the first time in the spring of 2004.

The Measured Progress test was designed based on Montana State Standards in math and reading. Proficiency levels have just recently been determined for the CRT. Current and future AYP will be based on the results of the Measured Progress testing. In short, Montana changed the measure of proficiency from a standardized norm-referenced test (NRT) to a criterion-referenced (CRT) exam in 2004. Changing the target for AYP in the fourth year of the state-mandated testing may increase the challenge for educational leaders to utilize historical achievement data to improve instruction while attempting to meet the mandates of the NCLB Act.

Recognizing the responsibility of Montana educators to be accountable for meeting AYP of the NCLB Act, this study investigated how instructional leaders are using data for decision-making and its relationship to mathematics achievement. Although this study considered the principal as one of the instructional leaders, instructional leadership is not necessarily limited to the principal. Instructional leadership is demonstrated in central office personnel such as a superintendent, assistant superintendent, directors of curricula, technology department directors, and by individual teachers. How instructional leaders are using available tools to analyze data as it relates to student progress in Montana is not totally understood. In fact to date, there is no evidence that educators in Montana high schools are using technology to analyze and use the results to maximize the effect on student learning and achievement. An article published by e-School News, Hickey (2002) details five key processes for building the capacity to make standards-driven reform work, standards like those detailed in the

Montana Mathematics Standards (Montana OPI, 2004). The following relates to monitoring individual student progress from Hickey (2002):

> The jargon of public education is replete with references to "individualized instruction" in a multitude of forms. Like so many other concepts of the profession, individualization is yet another area where we fail, for the most part, to "walk the walk." What emphasis on the individual student that does occur is more often than not on the input (teaching) side, rather than on the output (learning) side. In other words, most teachers in most schools fail to monitor individual student progress effectively against the indicators being assessed, focusing instead on grading an assignment—whether or not it is related to the indicators and whether or not it reflects actual student learning (as opposed to simply meeting the requirements of the assignment). Additionally, what data are collected are rarely used to inform instruction and to make adjustments responsive to the needs of individual learners, nor are the results shared with other staff to enrich dialogue and reflection and contribute to making the school a true learning community (p. 48).

Hickey suggests using available data more responsibly to influence change in student performance as we diagnose individual student needs. Adjusting instructional practice based on available information will enhance the learning experience for all students. Hickey believes that the emphasis while analyzing data should be on the learner and learner outcomes, not unlike that which is required by AYP of the NCLB Act. Adequate yearly progress considers the achievement growth of the learners. In accordance with the NCLB Act and the consequences of AYP, this study examined the capacity and practice of Montana mathematics school leaders to diagnose the learning growth of students, using the available technology and data, and in consequence, necessary changes to curriculum and instruction.

Problem

The extent to which Montana school leaders of high school mathematics use technology to examine student assessment results and affect instructional and curriculum change is not known. Specifically, it is not known to what degree mathematics school leaders use technology in assessment analysis, and if that analysis is related to student achievement in mathematics.

For the years 2001-2003, Montana grade 11 high school students' proficiency in mathematics has been measured by the ITED exam. State results on the exam varied from 75 percent proficient to 76 percent of the students proficient (Montana OPI, 2004). This difference in percent proficient does not indicate a substantial change from one year to the next. This test has been administered to grade 11 students each year from 2001-2003 and serves as the only measure of performance that was consistent in all high schools throughout Montana during that time frame. Each year distinct cohorts of grade 11 students have been administered the exam and have demonstrated like results. The above scores cause educators to conclude that the performances of Montana students from one year to the next are comparable on the standardized ITED exam. This research focused on mathematics leaders and their use of technology as it relates to student performance.

Purpose

The purpose of this descriptive and correlational study was two fold. First, the research was to identify the use of technology for data-driven decision-making by

mathematics instructors and administrators in 10 Montana "AA" high schools. The second reason was to determine the relationship between the use of technology for data-driven decision-making and student achievement. This researcher investigated whether the use of technology to make data-driven decisions has the potential to influence student achievement.

Questions

The Measured Progress criterion referenced mathematics exam was first administered in the spring of 2004. State, district, school, and individual results were available during the 2004-2005 school years. Proficiency levels were established and school leaders were given the opportunity to examine mathematics performance by their school, subgroups, and individual students. Questions that guided this study included:

- To what extent do educators use technology to improve student learning in mathematics?
- Do educators use technology to formulate data-driven decisions related to instruction and student achievement?
- What relationship exists between data-driven decision-making (DDDM) and student achievement in mathematics?

Theoretical Framework

Continuous improvement involves more than the examination of a single assessment. School leaders need to use technology to conduct frequent student checks

for understanding of Montana standards for mathematics. Hickey (2002) concluded that frequent assessment throughout each school year more accurately indicates student understanding of Montana mathematics standards. Data from frequent checks for understanding can be stored, examined, and aggregated through the use of technology.

Culp, Honey, and Mandinach (2003), researched the past 20 years of educational technology and the evolution of educational technology policy as it relates to the field of education and educators. Their research concludes that educators have not necessarily implemented technology to foster inquiry, collaboration, or to reconfigure relationships among students and teachers. Instead, educators have used technology tools to present information, manage data to improve their existing practices, and sometimes have implemented student-driven or inquiry-oriented instructional practices. Culp, Honey, and Mandinach further conclude that the NCLB Act will induce educators to use technology for management of data and analysis of educational progress. As assessment and accountability continue to be of immediate, urgent relevance to educators, educational technology will prove to be vital in accountability measures and school improvement efforts. Educational leaders realize the immediate necessity to incorporate educational technology for the purpose of meeting the mandates of the NCLB Act.

The National Council of Teachers of Mathematics (NCTM) provides guidelines for mathematics educators entitled “Principles of School Mathematics” (Carpenter, Gorg, & Martin, 2000). Decisions aligned with the “Principles of School Mathematics” by mathematics educational leaders have an effect on student success. The following are the principles as defined by NCTM:

- Equity. Excellence in mathematics education requires equity—high expectations and strong support for all students.

- Curriculum. A curriculum is more than a collection of activities: it must be coherent, focused on important mathematics, and well articulated across the grades.

- Teaching. Effective mathematics teaching requires understanding what students know and need to learn and then challenging and supporting them to learn it well.

- Learning. Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge.

- Assessment. Assessment should support the learning of important mathematics and furnish useful information to both teachers and students.

- Technology. Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning (p. 11).

The alignment of educators to the "principles of school mathematics" has the potential to impact student achievement. Implementing data-driven decision-making (DDDM) by Montana mathematics educators will more likely have an effect on student achievement, if data-driven decisions are aligned with the "principles of school mathematics" as defined by NCTM.

Definitions of Terms

The following terms and concepts are used throughout this study and are therefore defined here. Additional terms and concepts are defined in the context of the narrative.

- **Accountability**, subject to giving an accounting: answerable or explainable (Webster, 1977, p. 8). In this research, accountability was more closely related to the definition offered by Reeves (2004, p. 6) and that related to student-centered accountability in which he refers to not only a system that includes academic achievement but also specific information on curriculum, teaching practices, and

leadership practices. Reeves (2004, p. 6) intends a "balance of quantitative and qualitative indicators—the story behind the numbers," in his definition of student-centered accountability. **Accountability** defined by the CEO Forum on Educational Technology is simply "holding people and institutions responsible for their, or their institution's performance in meeting defined objectives" (2001, p. 32).

- **AYP, Adequate Yearly Progress,** defined in the No Child Left Behind Act of 2001 signed into law on January 8, 2002. "All states are required to develop and implement an accountability system that defines student proficiency in the attainment of their academic standards, with adequate yearly progress expectations for every school in the state" (Mcleod,…2003, p. 15).

- "**Correlational Research** involves collecting data in order to determine whether, and to what degree, a relationship exists between two or more quantifiable variables" (Gay, Airasian, 2000).

- **CRT, criterion-referenced test**, is a measurement of achievement of specific criteria or skills in terms of absolute levels of mastery. The focus is on performance of an individual as measured against a standard or criteria rather than against performance of others who take the same test, as with norm-referenced tests (Dietal, Herman, & Knuth, 1991). The Criterion-referenced exam developed by Measured Progress for Montana is designed to measure knowledge of content standards and is administered to all sophomore level students beginning 2004, in the spring semester.

- **DDDM, Data-Driven Decision-Making,** for the purpose of this study was defined as Montana mathematics leaders' quotient for making data-driven decisions as determined by a data-driven decision-making diagnostic (McLeod, 2005).

- **Educational Technology** is the method and material used to achieve an educational objective. This can include more traditional education technologies such as blackboards and pencils, or the full range of tools, voice, video, data, digital, network, and information systems available (CEO Forum on Educational Technology, 2001, p. 32). For the purpose of this study, educational technologies were those technologies associated with data-driven decision-making.

- **ITED, Iowa Test of Educational Development**, is a norm-referenced exam administered to all junior level students in Montana from 2001-2005 in the spring semester.

- **Interoperability, School Interoperability Framework (SIF),** is a system in which all data tools will interact as one system; data that are entered into one of

the data tools will be entered into the other tools automatically (Bernhardt, 2005, p. 69).

- **Leaders of School Mathematics** can include but are not limited to teachers, administrators, policymakers, higher-education faculty, curriculum developers, researchers, families, students, and community members (Carpenter, Gorg, & Martin, 2000, p. 380). For the purpose of this study, the practices of school mathematics leaders in the high school were examined—specifically teachers, administrators, policy makers, curriculum developers, and technology specialists connected to the delivery of the high school mathematics program.

- **Measured Progress** is the testing company designing customized, criterion-referenced assessments contracted by the State of Montana to design an exam for grades 10, 8, and 4 aligned with Montana Curriculum Standards, specifically in mathematics and reading.

- **NCLB, No Child Left Behind Act of 2001**, was signed into law on January 8, 2002 by President George W. Bush. NCLB is the reauthorization of the Elementary and Secondary Education Act of 1965 but serves to define a significantly different role for the federal government in education (Mcleod,…2003, p. 15).

- **NRT, Norm-Referenced Test**, is an objective test that is standardized on a group of individuals whose performance is evaluated in relation to the performance of others; contrasted with criterion-referenced test (Dietal, Herman, & Knuth, 1991). The ITED exam is the NRT selected by Montana Office of Public Instruction and administered to all junior level students from 2001-2005.

- **Student Mathematics Achievement**, was determined by a composite score for each of 10 "AA" high schools that included the following multiple measures over two academic years: 1) grade 10 Measured Progress math results for 2004 and 2005, 2) grade 11 ITED total math results for 2004 and 2005, 3) percentage of grade 12 students enrolled in a fourth year of mathematics for the year 2004 and 2005, 4) ACT math scores for 2004 and 2005, and 5) SAT math scores for 2004 and 2005.

- **Technology** is that which will allow educators to better align with the requirements of NCLB as related to accountability for data-driven decision-making. Technologies included: data collection and analysis tools of educational organizations and the use of appropriate software and databases to collect, manage, analyze, and report school information (School Technology Leadership Initiative, 2004).

Limitations and Delimitations

Limitations and delimitations to the study are detailed in the methodology of this study. However, there are five items that can be considered limitations or delimitations to the study that will be addressed in Chapter 3: 1) The examined population of thirteen Montana "AA" high schools was limited in size although the population represents 45 percent of all Montana high school students. Of the thirteen "AA" high schools, only ten of the high schools were included in the results. Two of the thirteen principals chose not to participate and Billings West High School was not included in the results, as the researcher is the current principal; 2) A delimitation to this study is whether or not this study will be generalizable to other settings and subjects; 3) This study was limited to the examination of use of technology for the purpose of data-driven decision-making and the relationship to student performance. There are other influences on student performance outside of the use of technology, such as instructional leadership and professional practice. Instruction is a complex act as is learning a complex behavior; 4) Data collection, survey instruments, and respondent reliability were considered as a limitation; and 5) The limitations of descriptive and correlational studies are presented.

Significance of Study

With an ever-growing bank of assessment data available to Montana educational leaders, there is a need to utilize the data to affect instructional change. Examining the technology practices of the mathematics leaders in Montana's largest high schools had the potential of uncovering a technological system of analysis that would have suggested

best practice in order to affect result-driven instruction. This initial study of Montana mathematics educators' use of technology to make data-driven decisions may have revealed evidence that justified future studies to determine a causal relationship between technology use and student achievement. The study determined to what extent mathematics leaders in the "AA" high schools engage in data-driven decision-making (DDDM) and to what extent the use of technology for making data-driven decisions is related to student achievement in mathematics. This study examined the current status of technology use for DDDM among Montana mathematics leaders, as recommended by the DOE Office of Education Technology.

This study was intended to identify a best practice of technology use with respect to the analysis of student information, assessment, instructional management, and the interoperability of existing technology systems, as defined by the DOE Office of Educational Technology in 10 of the 13 "AA" high schools in Montana. This study is both descriptive and correlational. In utilizing the "correlational research" design, the researcher attempted to identify an existing relationship between two or more variables (Gay & Airasian, 2000). Ten of 13 "AA" high schools' mathematics leaders and educators were administered a self-assessment regarding 1) their use or plans for the use of integrated data systems, 2) their use of data and instructional systems to understand relationships between decisions, existing data, allocation of resources for instruction, and student achievement, 3) their priorities for ensuring interoperability between data systems, and finally 4) their use of assessment results to inform and differentiate instruction for every child (DOE, 2004). From this thorough investigation and

correlational analysis, the researcher described the current use of technology for data-driven decision-making and attempted to determine if a relationship existed among the alignment of educators to the DOE recommendations for the use of technology and student outcomes.

Summary

Continuous school improvement requires ongoing assessment and analysis of student outcomes. All Montana schools are required to implement plans for continuous school improvement, and the tracking of school improvement relies on accurate and accessible student achievement data. This researcher attempted to determine whether or not "AA" schools in Montana are using technology to analyze student results in order to make curriculum and instructional changes that benefit student learning. Schmoker in his book entitled Results states, "You cannot fight what you cannot see" (1999, p. 44). In terms of education, Schmoker means that teachers and educational leaders must analyze and interpret data accurately in order to understand what instructional changes will combat student deficiencies. This researcher contends that, through the use of technology, school leaders and teachers will better see what student assessment data presents, and in consequence, will be able to change instruction to improve student achievement.

In a study conducted by Manpower Demonstration Research Corporation (MDRC) for the Council of the Great City Schools (2001) the following hypotheses were formed:

- Providing achievement data to teachers at regular intervals beginning early in the academic year, training teachers and principals in the diagnostic use of these data, and helping them develop instructional responses may improve instructional practice and increase student learning and achievement.

- Assessment data may also be used as an effective tool for increasing the equity of the placement process (assigning students to curricular options) and representation of disadvantaged and minority students in AP and college preparatory classes (p. 69).

The research conducted by MDRC was a case study of three large urban school districts that had shown significant improvements in student achievement. Each of the districts improved their technological system for managing data, and the three districts viewed the use of data as an effective tool for improving instruction (p. 69). Does a technological system for managing data exist in Montana that will allow school leaders to diagnose achievement problems resulting in improvements to mathematics instructional strategy? This researcher attempted to prove through the study of Montana "AA" high schools that a positive correlation exists between effective use of technology as described by the U.S. DOE (2004) and student performance indicators on state-wide mathematics assessment.

CHAPTER 2

REVIEW OF LITERATURE

Problem Description

Leaders of mathematics instruction and learning, in Montana high schools, have an ongoing responsibility to improve instruction that will ultimately result in learning gains for students. Through the use of technology tools, educators have an increased likelihood of improving instruction and learning from the examination of assessment results (Noyce, Perda, & Traver, 2000). In the 13 Montana "AA" high schools, the extent to which school mathematics leaders use technology to examine student assessment results and affect instructional and curriculum change is not known. The examination of this problem requires attention to three educational correlates. First, and most important to this study, the practice of using technology as a tool to warehouse data and the capacity of technology to integrate the use of data in decision-making to inform instruction will be investigated. Second, mathematics assessment practices implemented, information available regarding implemented assessments, and educator accountability related to implemented assessments will be discovered. In short, the degree to which assessment and accountability are present will be observed. Third and finally, the structure, roles, and duties of mathematics instructional leadership as it relates to data-driven decision-making (DDDM) in each school was considered. This study explored the extent to which these three educational correlates—leadership constructs, assessment accountability, and use of technology tools—integrate in each "AA" Montana high

school environment. A positive correlation between the use of technology tools for DDDM, and math assessment results is expected to emerge through this study.

Technology is the Fundamental Component of the Problem

The essential standard of this study is that all "AA" Montana high school leaders use technology in some fashion to inform decision-making, or at very least, have the resources to implement the use of technology for decision-making. Operating from this premise, the author examined the current literature related to the use of technology for decision-making to facilitate instructional practice. The use of technology tools in decision-making, for the specific purpose of this study, was related to mathematics instructional practice. As a way of framing the problem in the proper context, the review of literature will focus on technology as an essential tool to inform instruction pertaining to high school mathematics. The literature review reflected that other subjects could very well utilize technology tools in the same manner.

The U.S. DOE (2004) provides the following recommendations when considering centralized and uniform information management systems for states, districts, and schools:

- integrate data systems to provide efficiency in an effort to improve learning
- use various data systems to formulate decisions about student achievement, instruction, and the allocation of resources
- ensure the use of tools that are School Interoperability Framework (SIF) compliant and
- use results to address the learning needs of individual students.

The above four components will provide the framework for addressing the questions of this study, and the authoritative literature review addressed each component.

Integrate Data Systems

The first component of the framework states that integrated data systems are utilized so that administrators and educators have the information they need to increase efficiency and improve student learning. To illustrate integrated data systems, consider what has become known as Total Information Management (TIM).

Total Information Management (TIM) has been implemented in Poway Unified School District located in the suburbs of San Diego. This model of information management is advocated by the U.S. Department of Education (2004) in its report, "Toward a New Golden Age in American Education." The report outlines various advantages to educators through the use of technology. TIM is particularly advantageous to states and districts working to comply with NCLB and achieving AYP. Using the TIM concept, districts and state departments of education have a central database that allows them to analyze, manipulate, and aggregate information, tying together data systems that normally stand alone. Connecting district-wide and state-wide student demographic and assessment data pertaining to human resources, transportation, special education, finance, food services, and libraries will enhance the information known about student assessment used for decision-making. The TIM system in San Diego has the capability of sharing data among educators, parents, and the public in readable and understandable formats in meeting standards-driven reform (p. 24-26).

The data in the TIM system allows information specialists to instruct educators in how to easily access information pertaining to the district and the individual students they instruct. Accurate knowledge of students based on demographic and assessment data

provides opportunity for differentiated instruction for individual as well as groups of students. Decision-making based on accurate student information ultimately improves student learning and academic achievement in a time of results-oriented outcomes.

Other initiatives similar to the TIM system have been implemented, such as the Idaho Student Information Management System, or ISIMS Project (U.S. DOE, 2004). Idaho State legislation requires that all Idaho schools use the ISIMS to full availability in reporting and recording student information beginning in 2004. Idaho, in partnership with the Governor, State Board of Education, Idaho legislature, and the J.A. and Kathryn Albertson Foundation have invested $35 million in a state-wide student information management system. The project was developed as a result of a 13 school district pilot that allows for collection of information and web-based resources and tools for education stakeholders (p. 32).

Use Various Data Systems to Formulate Decisions

The second of four essentials, from the DOE (2004) pertaining to the use of technology, states that school personnel use data from both administrative and instructional systems to understand relationships between decisions, allocation of resources and student achievement. Noyce, Perda, and Traver (2000) suggest ways to structure the utilization of data within each school for decision-making. In a data-driven school culture, a few knowledgeable staff members along with a supportive administrative team need devise a system to collect, retrieve, and report data in order to inform decision makers. This can be accomplished using a variety of technologies—technologies as simple as paper and pencil, and as sophisticated as statistical software

installed on personal computers and networked and accessible to the entire school. The choice and knowledge of technological assistance should be a team decision and of comfort to the data team. Through the use of technology and the appropriate data, decision makers become more informed and confident about the progress and impact of instructional interventions, initiatives, and program implementation.

New technologies allow schools and school leaders not only to accurately collect data but also to use the data to improve efficiencies in a number of areas, from teacher quality to administrative procedures (Murray, Branigan, & Pierce, 2003). Collecting data for the sake of data collection is not productive use of a school leader's time. A close examination of data in different configurations should be conducted. Glenn (1999) states that in preparing schools and school systems for the 21st century, "there are several essential aspects of technology that educators should consider incorporating in schools, among them: up-to-date technology to build management systems that can track individual student progress…" among other uses. School systems in the 21st century need to rely on technology-based management systems to enhance planning, develop schedules, simulate possible changes, as well as ensure accountability (Glenn). The modern school leader must use technology to assist in decision-making and to ensure accountability.

Understanding the impact of curriculum adoption requires a school to be data conscious, relying on numbers to suggest the effectiveness of the initiative. Examining results of assessments before and after the implementation of new curriculum or new instructional strategies will provide information about the efficacy of the adoption.

Differences in assessment results, even if the measures are from distinctly different cohort groups, should suggest a hypothesis of the effectiveness of the intervention.

Noyce, Perda, and Traver (2000) suggest the following checklist for establishing a data-driven school culture:

> What does the district want to know?
> - Current district goals.
> - Patterns in data.
> - Upcoming district decisions.
> - Questions raised by teachers, administrators, or the community.

> How will the district find out?
> - Form a data team.
> - Conduct inventory of data currently compiled in the district and determine format.
> - Assess technological capacity of the district to manage and analyze data.
> - Determine the extent to which personnel in the district have time, skills, and willingness to engage in data-driven projects.
> - Identify indicators of input, process, and outcome variables related to goals.
> - Determine which additional data are reasonable to collect.
> - Train staff to collect and use data.
> - Analyze and disaggregate data.

> What does the district do next?
> - Establish benchmarks and measure progress toward goals over time.
> - Develop action or school improvement plans.
> - Communicate findings (p. 54).

Noyce, Perda, and Traver (2000) cite an example of an urban school implementing an electronic data information system in which teachers have ready access to student information. Previously, this urban district had no formal system in which teachers had the opportunity to retrieve data on individual students unless there was time to produce hard copies of the information and sort through mountains of disconnected student information. On the other hand their current electronic information can be sorted, manipulated, and disaggregated in order to analyze information student-by-student and

group by group in real time. Real time refers to responding to the needs of students in order to perform timely and appropriate instructional interventions. Noyce, Perda, and Traver (2000) believe that:

> Teachers can research areas of difficulty for various students. At weekly meetings, these teachers can target classwide areas of weakness and adjust their classroom instruction to address these problems. At the same time, teachers can address individual problem areas with those students through one-on-one instruction. We have found that making this connection between [software] in the lab and the regular in-class instruction has been very powerful for our students (p. 55).

Without the assistance of technology in the above example it would not be possible to know whom to identify for the use of the instructional software. Not only does technology allow us to assist students individually, but it allows us to better identify the needs of students in real time.

Ensure Interoperability—School Interoperability Framework (SIF)

The third item in the framework posed by the DOE is to ensure interoperability. The school information system shall be School Interoperability Framework (SIF) compliant and that any requests for proposal or considerations for purchase of information technology (IT) shall include SIF. The sharing of information from one system to another is critical to using data to full capacity. Bill Graves, Senior Vice President for Academic Strategy at SunGard Colleges was recently interviewed by James Morrison, Editor and Chief for Innovate magazine pertaining to IT. Graves stated that "bringing order (management, integration, reliability, and support) to rapidly changing technologies may be the chief information officer's role…..and high performance educational organizations and programs will accept the challenge, link their investments

in IT to their highest academic and service performance priorities, and monitor and report the results against the expectations and metrics of the society they serve" (Morrison & Graves, 2004). Graves addresses the need for high performing learning organizations to have systems that are able to easily share information and data. The faculty and administrators are then allowed the opportunity to report accurate and reliable information and formulate decisions to foster continued growth. Graves advocates a framework of interoperability and data-sharing ease between and among systems to realize greater insight into the available information.

Bernhardt (2005) believes that while considering technology tools, the educator must consider the ability of the tools to talk, communicate with one another. Do they possess School Interoperability Framework (SIF)? SIF compliant tools have the ability to operate as one system. In a SIF-compliant tool, the entering and exchange of data pertaining to individual students is automatic. Separate data tools work as one system enabling educators to better understand the achievement of each student and disaggregate groups of students. The purchase and ultimate implementation of data tools is critical to the most effective use of available information. As well as tool interoperability, Bernhardt suggests the following: 1) be clear on what you are looking for; 2) build a data team with diverse expertise in the educational process; 3) research possible vendors—and have them come to you; 4) don't automatically go with the lowest bidder; and 5) talk with current users. This advice is essential in selecting and implementing effective products that will meet school improvement needs and ensure interoperability. Selecting, implementing, and utilizing effective data tools will directly enhance the instructional

strategies for teachers, which in turn will improve the learning opportunities for the students.

Use Results to Address the Needs of Students

The fourth guideline from the DOE (2004) suggests that assessment results be used to inform and differentiate instruction for every child. Schmoker (2000) supports the standards movement and the proven catalyst that standards represent for change. As an advocate for results-oriented initiative, Schmoker cites several authorities (Lemann, Marzano, Kendall, AFT president Sandra Feldman, NEA president Bob Chase, and others), asserting that standards, along with structures driven to meet standards, will produce results-oriented change. Schmoker mentions improved results in state-mandated testing in Texas as well as documented gains in the National Assessment of Educational Progress (NAEP) scores that accompanied the state-mandated results in Texas. The focus of standards-driven reform in successful schools is simple, as cited in Schmoker (2000), (Barth et al., 1999; Darling-Hammond, 1997; Marzano & Kendall, 1996: Reeves, 2000; Schmoker, 1999):

They are:

- Set measurable goals for reaching academic standards and do not regard demographic differences as insurmountable obstacles.
- Analyze data to identify and address areas of weakness, relative to assessed standards.
- Collaborate and assess regularly—at least monthly—to adjust efforts and to learn more effective ways to teach the most difficult standards.
- Presume that any skill, however sophisticated, can be learned by virtually any student in their system if teachers deliberate, invent and refine strategies, and monitor their impact (p. 57).

The above principles have several implications for the use of technology by staff, administration, and teacher leaders. All educators can benefit from the use of technology in the critical analysis of data. Using technology to store, analyze, and communicate results will assist educators in accomplishing standards-driven improvement as outlined by Schmoker. Technology tools are capable of assisting in any of the processes implemented by successful schools. This researcher contends that the successful implementation of technology to assist the school will produce evident and substantial results.

Accountability

Sparks and Hirsh (1997) advocate a model of staff development that examines student needs and learning outcomes. Educators must realize that through the examination of student-learning outcomes, deficiencies can be addressed and staff training is necessary to address deficiencies in student achievement. The implementation and continuation of staff development addressing the needs of student learning is systemic according to Sparks and Hirsh. A systematic approach is critical to the implementation of a staff development program that addresses the needs of students. The entire organization takes on responsibility for individual outcomes and results. Sparks and Hirsh mention four examples of systematic approaches to staff development addressing the needs of students. "The Lawrence Public Schools in Kansas, the Adlai Stevenson High School District in Illinois, the Jefferson County Public Schools in Kentucky, and the Teachers Academy for Mathematics and Science in Chicago provide

examples of an approach to staff development that focuses on student needs and learning outcomes" (p. 41). In each of the cited schools and systems, examining data through the use of technology tools is critical to the implementation of the staff development program. Student needs are discovered through close examination of results using data systems that allow educators to analyze, interpret, and diagnose student outcomes. As a result, the system addresses the needs of students.

The school improvement process implemented in the four examples cited by Sparks and Hirsh follow a school improvement model that is results-oriented, and the improvement is measured by student outcomes. Accountability in each of these schools focuses on improving learning and is judged by the assessed gains that students make. Technology tools and the analysis of available data are a constant as goals are adjusted and refined continuously. The needs of students, identified through data analysis, are addressed in the staff development program, allocating resources appropriately. Rick Dufour, superintendent of Adlai Stevenson High School District in Illinois (Sparks & Hirsh, 1997), states that teachers no longer view instructional improvement as staff development but simply as "the way we do things around here" (p.46). Dufour quotes from one of his favorite books, Charles Garfield's Peak Performers: "Peak performers in all walks of life find out what they need to learn to advance to their next goal and then set out to learn it" (p. 46). Becoming a first-class learning organization requires the examination of student results and addressing student needs so that teachers have the knowledge and skill to attack deficiencies, thus being accountable for learner outcomes.

With the implementation of NCLB, each Local Education Agency (LEA) is required to report and disseminate information generated by state-mandated testing. Every school and district is to publish results of the testing and proficiency levels of its total population and disaggregated subgroups. Fast (2002) provides a guide to accountability reporting. Fast suggests formats for presenting school total results with the companion subgroups as required by NCLB. Subgroups required by NCLB include but are not limited to: male, female, African American/black, Hispanic, white, Asian/Pacific Islander, American Indian/Alaskan Native, students with and without disabilities, limited English proficiency students, migrant students, and economically disadvantaged and non-economically disadvantaged students. This disaggregated data provides information that may or may not have been available to schools and districts prior to the enactment of NCLB. Fast suggests providing an easy to read format so that parents, students, and the general public, not to mention educators, are able to decipher the data. This is an excellent place to begin for mathematics school leaders as they attempt to identify populations that need assistance and/or remediation. Again, this is only the beginning stages of investigation in an attempt to identify who, where, and how remediation should be implemented. Identifying and diagnosing weaknesses is one of the first stages of implementing needed curriculum and instructional change to improve achievement results.

Constructive data analysis, according to Reeves (2004), provides a comparison of cohort groups to themselves, not to other cohort groups. The following are questions that Reeves suggests about the constructive use of data:

- "What percentage of a group of students is proficient now compared to a year ago?"
- "What percentage of our students have gained one or more grade levels in reading (mathematics) when we compare their scores today to their scores a year ago?"
- "Of those students who were not proficient a year ago, what percentage are now proficient?"
- "Of those students who were proficient a year ago, what percentage are now advanced?" (p.70).

Do the leaders in Montana mathematics ask the above questions when analyzing data? Do the technologies available have the capability to provide answers to the above questions, or is it difficult to compile information on cohort groups to study improvement based on interventions that may have been initiated on the cohort group?

Montana mathematics leaders must study common assessments and evaluate the weaknesses of students in order to make real-time decisions about delivery and instruction. Where are the weaknesses? Immediate feedback is necessary in goal setting and correcting deficiencies. O'Neill (2000) developed SMART goals where SMART is an acronym specific to goals that are strategic, measurable, attainable, results-oriented, and time-bound. "Setting goals that connect to the classroom and focus on student learning helps educators see, learn from, and communicate their results" (p. 46). Goals are set according to student needs as determined by assessment results. These goals are established in terms of improving outcomes and to be accomplished within a specific time frame. Schmoker (1999) reinforces goal setting through a results-oriented approach to using data in his book, Results: "clear, measurable goals are the center to the mystery of school's success, mediocrity, or failure" (p.18).

Accountability in Montana

Linda McCulloch (2003b), Montana Superintendent of Public Instruction, in her memo dated July 2, 2003, outlined the critical educational performance areas for the Montana Statewide Accountability System for Education (MTSASE). Student academic success in the areas of reading and math, as well as student graduation rates for high schools, were two of the three critical accountability factors as defined in MTSASE. This study will focus on academic success in math for high school students. The researcher will assume that graduation rates in high school are affected by high school student academic success in math. From McCulloch's memo, it is ascertained that NCLB provides for the establishment of goals that states, districts, and schools must meet in order to ensure the continued flow of Title I allocations. McCulloch goes on to state that:

> The accountability system for some states is a modification of an existing system or it may need to be created from scratch, as was the case for Montana, as our current accountability system—our accreditation system—is not based upon student results (p. 1).

Since the time of this memo from McCulloch, Montana has implemented a Criterion Referenced Test (CRT) based on Montana State Mathematics Standards. The MTSASE includes provisions for meeting proficiency on the state-mandated mathematics exam. Based on the testing administered in the spring of 2004, schools must demonstrate 40 percent of all students and 40 percent of students within subgroups numbering 40 or more are proficient in mathematics. High schools must also demonstrate graduation rates of 80 percent or better (McCulloch, 2004a). Montana is in the infancy of its MTSASE and has for the first time connected accountability with demonstrated student results.

Montana was recently declared by the Princeton Review (2003) as the least accountable test taking state in the Union. Recognized by Superintendent McCulloch, Montana's OPI has been less than desirable in its test taking accountability. In her State of Education address, February, 11, 2005, Superintendent McCulloch (2005a) stated the need to delineate within the definition of a quality education, that the state will provide assessments making sure our children are succeeding. Along with providing quality assessments, McCulloch detailed the essential for the definition of a quality education to address the needs of Native American children, low-income children, at-risk, and special needs students—both challenged and gifted. The laws of NCLB have required states to take a lead role in assessment accountability. The Princeton Review (2003) makes it clear that through their study of accountability of testing, what they measured is not necessarily a reflection on the educational system of a state but only a measure of the state's effort to be accountable to assessment. Whether Montana's definition of a quality education addresses the requirement to assess all children to ensure learning accountability, or that the definition calls for subgroups of students to be supported appropriately so that each subgroup population achieves proficiency, data management tools will assist educators in meeting the need to provide a credible and efficient accountability system. Through this study of Montana "AA" high schools, the OPI of Montana may gain insight on assessment accountability systems.

NCLB requirements have changed the way we think about analyzing results of testing. Most K-12 educators have been concerned about results in the past but to a lesser degree; we are now realizing that results have major implications for funding and

continued support. e-School News reports that the NCLB law has caused increased spending on accountability software. Through e-School News, Quality Education Data Inc. reports that student information systems software purchases are estimated between $350 million to $400 million this year (Murray, 2003). Considering the mobility of Montana students and some of the subgroup populations, will Montana legislators address the need for the state to provide a comprehensive testing plan and eventually invest in a system that better follows students and their achievement progress across the state?

Educators are continually hearing about how states are not accountable to testing, and that the states' reporting systems need upgrading, as previously noted in regard to Montana. Education Week reports that according to analysis recently conducted by the National Center for Educational Accountability only 21 states are tracing individual student performance with a so-called "student identifier" that records achievement across a pupil's K-12 career (Hoff, 2003). The report goes on to claim that unless a state has a way to track achievement, student-by-student, it will struggle to comply with the mandates in NCLB. Montana schools have not implemented an automated data management system for tracking student achievement as students relocate across the state.

Montana's Statewide Accountability System of Education (MTSASE) is a work in progress. The legislature's definition of a quality education will rely on an accountability system that is data-rich and results-oriented. Measuring progress toward goals and objectives relies on a technology system of data tools that will provide

information to determine the success of the education system. How are students performing and are they receiving a quality education as indicated by results? Mathematics curriculum, instruction, and assessment are a major component in the accountability of an educational system. Superintendent McCulloch (2005a) addressed the state legislators in her plea to improve our educational programs:

> We are proud of our Montana students and their test scores. Montana kids continue to score near the top in the nation in reading, science, and math. That's great. But that's not good enough, because now our kids are competing internationally. They're competing with students from South Korea and South Vietnam as much as they're competing with students from South Dakota and South Carolina. Kids from other states and countries that invest in education are catching up to us or passing us. Working together we need to make sure this trend doesn't continue. Your work this session is vital to these efforts.

Accountability and a system that will allow the careful scrutiny of the achievement and progress of students will help to provide answers to the educational needs of the children in Montana. Data tools will assist the endeavors of Montana educators in their obligation to provide superior education for our children so that they may remain competitive in a global society as Montana's state superintendent of public instruction has suggested.

Role of Leader as it Relates to the use of Technology

The Interstate School Leaders Licensure Consortium (ISLLC) (Marockie, Cody & Bartman, 1996), standards call for school administrators to advocate, nurture, and sustain school culture and instructional programming so that students will learn and staff will have the opportunity for professional growth. Administrators responding to the standard

of the ISLLC will understand curriculum design, implementation, evaluation, and refinement. The administrator will understand and continue to acquire knowledge of measurement, evaluation, and assessment strategies and will know the role of technology in promoting student learning and professional growth. This standard advocates using technology to assist in the development of curriculum, instructional strategies, and improving student opportunity for growth, learning, and understanding. The ISLLC standards promote use of technology for staff and student development. The ISSLC school administrator will use technology to assist in the storage, retrieval, and analysis of available test data to promote staff development and student learning.

Instructional leadership, as defined in one of the seven correlates of effective schools researched by Lezotte (1997), calls for the principal to be the leader of the school. The principal is the leader, and in the effective school, the principal becomes the leader of leaders rather than the leader of followers. All of the adults in the learning community, especially the teachers, become actively engaged in leadership and learning. The researcher will attempt to provide insight through the literature that the concept of shared leadership will prevail in the effective implementation and utilization of technology tools (Smith, 2005). The construct of shared leadership requires the contribution of all adults in the learning community.

In this study of the current use of technology tools, the school principal; central office personnel such as a superintendent, assistant superintendent, directors of curricula, and technology department directors; and most importantly by individual teachers, whether they are department heads or first-year instructors will be considered

instructional leaders. In his book, Results, Schmoker (1999) states that systemic change requires teamwork, teamwork and leadership that is present in a first-class learning organization demonstrated throughout the school system. Consider the use of technology tools to affect curriculum and instructional change as systemic. Teamwork and leadership must be present at all levels of implementation and technology use. Each adult, from superintendent to first-year instructor, must lead and be data oriented in order for the implementation to be successfully driven by results.

Educational leaders in Montana should implement components of transformational leadership as described by Bass (2000). Bass states that learning organizations, including schools, should employ components of automation. Bass believes that new technology can provide opportunities for learning, revision, and adaptation by the organization, its leaders, and members. Using technology tools to examine test results can assist in the decision-making process regarding curriculum and instruction. Examination of data from state-wide testing is critical in making decisions about school improvement. Do Montana educational leaders use state-wide testing data to make decisions? The best data for curriculum-based decisions in Montana are not yet available. The spring of 2004 was the first attempt to administer state-wide criterion-referenced exams. This shouldn't prevent individual schools from examining their own results of testing procedures. Unfortunately, schools have not consistently practiced examining results. Schmoker (1999) claims that schools have more potential for improvement than most other organizations because schools have a history of being goal-averse and data-phobic. The current availability of data is considerably different than in

the past. Through the formation of a best-practice model for the use of technology tools, this data-phobic trend will change.

In Danielson's Framework for School Improvement (2002), she suggests that if we are truly committed to school improvement, we must focus the interdependent relationships of each component of schools, inside and out, that affect student learning. She begins by explaining that a continuous analysis of data through the use of technology tools should exist. When teachers disaggregate end-of-course assessment results, they gain insight into their teaching that may not have been available previously (Danielson, 2002). The use of technology allows us to disaggregate assessment information and analyze it more thoroughly. Teachers should also interpret state assessment data regarding how students are performing and how their performance relates to the school's curriculum standards (Danielson, 2002). In Montana, it has been difficult to check student progress as it relates to state curriculum standards. Montana educators have administered only two statewide assessments based on Montana curriculum standards. Test administration was conducted in the spring of 2004 and 2005 to grades 4, 8, and 10 in math and reading. Danielson also advocates that all teachers be involved in data collection and analysis. This ubiquitous understanding is critical to a team approach to school improvement. Finally, Danielson states that data analysis is not a "one shot" affair. Her belief is that data analysis and collection should take place continuously. Data collection should not be limited to student achievement, dropout, and attendance rates but should also include information from several sources such as student, teacher, and parent attitudes; the condition of the physical plant; and activities with the local

community. This approach to school improvement requires significant analysis of the entire school program and how it affects student learning. Through the use of technology tools, a better analysis of information and decision-making processes can be conducted.

Marsh (1999) examines the culture of schools and how that culture causes slow growth implications for school reform and improvement. Her position is that teachers are the key to school reform, but inherently the culture of top-down leadership has stifled the role of the teacher in school improvement. Teachers have been isolated or conditioned to do their work in isolation. Marsh contends that little time has been provided for teachers to collaborate with colleagues to examine student results and determine best instructional practice. In a reform effort the magnitude of NCLB, teachers must be empowered to take on leadership roles of analyzing and examining data available through the use of technology tools. Decisions about curriculum and instructional changes will emerge from the critical review and examination of available data.

King (1999) suggests using a spiral feedback model that continually points toward student achievement as a focus (Costa & Kellick cited in King, 1999). This model is contingent on constant feedback. Inquiry, action, reflection, and inquiry continually cycles as an analytical improvement process is implemented. Throughout the entire system, leaders are collaboratively and constantly monitoring progress, checking results, providing feedback, and adjusting instruction based on student achievement. The collaborative leadership model is fostered by a principal, superintendent, and school board that allow teacher leadership to flourish. Teacher analysis of available data using

technology tools will provide a significant opportunity for change while addressing student achievement.

Smith (2005) believes it is necessary to redefine leadership. He states in his model of shared leadership that, "the belief that a single person called a leader or manager can lead us to successful future is a myth" (p. 1). Effective leadership is shared and acted on by the organization. The organization becomes accountable for actions, decisions, and most importantly, results. Decision-making is too complex in schools to rely on a single leader, the principal, to make all decisions. Gabriel (2005) presents transformational leadership as a way to share responsibility and empower teacher leaders. Administrators subscribing to the concept of transformational leadership do not feel threatened by the expertise and knowledge of teacher leaders. These administrators call on the individual strengths and potential of department heads as well as informal teacher leaders to influence positive change and school improvement. Often the collective intelligence of key staff members is a more powerful agent of change than any administrator could provide. Given the latitude for decision-making and influence on colleagues, the teacher leader may often inspire and encourage innovative programs that will promote significant leadership for learning. Through the use of technology tools, the teacher leader is affirmed using data as the basis for decisions.

Through a shared leadership model, the use of technology tools is much more likely to become ubiquitous throughout the school organization. Understanding data tools will provide an opportunity to utilize information and consequently implement programs that will strategically address learner needs. To quote from Murphy and Doyle

(2001) in their article addressing the need to redesign the operating environments in schools:

> In many cases, the rush to create high-stakes tests frustrates principals and teachers. In our quest for excellence we must have an assessment system that accurately measures what has been learned and helps teachers and principals help students. The testing bottom line is conceptually straightforward: How well are students learning? To answer this fundamental question, we need diagnostic measures that give teachers insights into student needs and evidence of progress (p. 3).

To allow efficient decision-making capability, all adults in the school system require access to student information and the diagnostics that technology tools will provide. Educational leaders will be far better equipped to answer and act on questions of accountability if they are empowered and exposed to how well students are learning. The information and diagnostics that data tools can provide are crucial to school improvement and meeting the challenges of NCLB.

Overview of Effective Use of Specific Data Tools

Ash and Persall (2000) formulate a leadership model that labels the principal as Chief Learning Officer (CLO) of a school. This model is grounded in the belief that educators are not only responsible for the learning of students but for adults as well. Principal leaders acting as the CLO facilitate the following within the school: "examining shared beliefs; asking questions; collecting, analyzing, and interpreting data; and engaging faculty in meaningful conversation about teaching and learning are all formative leadership behaviors" (p. 16). Formative leadership by the CLO enhances the opportunities for adult learners to engage in meaningful decision-making. The use of technology to collect, analyze, and interpret data will foster the formative leadership

model, allowing the CLO to better facilitate adult and student learning. Ash and Persall support the role of CLO as building "an organizational climate that encourages and supports leadership throughout the school" (p. 19). Using technology as a tool to engage educators in meaningful decision-making has the potential to assist in the formation of adult learning communities.

Earl and Katz (2005) believe that in order for school leaders to engender a data-rich world, leaders need "to develop an inquiry habit of mind, become data literate, and create a culture of inquiry" (p. 18). The Technology Standards for School Administrators (TSSA), written by a diverse team of educators throughout the country, specifically address the role of technology for administrators in assessment and analysis practices (Knezek, Rogers & Bosco, 2001). Standard five addresses the use of technology in assessment and evaluation. Standard five (b) specifically states that the school administrator "use technology to collect and analyze data, interpret results, and communicate findings to improve instructional practice and student learning." Principals are called to "promote and model the use of technology to access, analyze, and interpret campus data to focus efforts for improving student learning and productivity" (p. 12). This study of Montana "AA" high schools is based on the above fundamental standard as well as the ISLLC standard promoting the use of technology. The TSSA Collaborative Standards and the ISSLC Standards endorse the use of technology in assessment and analysis in order to address improved curriculum and instruction. This study investigated the "AA" mathematics school leaders' use of technology tools to enhance instruction.

According to Earl and Katz (2005), developing an inquiry habit of mind requires the school leader to 1) value deep understanding, 2) reserve judgment and have tolerance for ambiguity, and 3) take a range of perspectives and systematically pose increasingly focused questions. Educational leaders must operate from a perspective that allows the continual pursuit of truth. As facts are uncovered, more questions are triggered. Making quick judgments and jumping to conclusions through the use of data may create misinterpretation more prevalently than with continued focus study. Close examination of data will open minds and bring leaders closer to authentic inquiry and understanding.

How do educational leaders become data literate? Leaders identify what data is necessary for certain decisions. Appropriate information is used for the decision at hand. Leaders rule out irrelevant data. Educational leaders recognize what is sound, valid data and what information should be discarded and purged. Leaders have a sound understanding of statistical terms, measurement, and how to apply statistics to decision-making. Data is used to formulate hypotheses, challenge beliefs, and ask additional questions. Finally, educational leaders consider the audience and their need to know, and do not confuse or present data that will be misunderstood by the audience. Becoming data literate is a work in progress for most educational leaders. Earl and Katz (2005) offer, "Data do not provide right answers or quick fixes, but data offer decision makers an opportunity to view a phenomenon through a number of different lenses, to put forward hypotheses, to challenge beliefs, and to pose more questions" (p. 19).

Paramount to all educational leaders is creation of a culture of inquiry. All teachers strive to create an environment of inquiry in their classrooms. Leaders are

charged with teaching the teachers and creating a thirst for knowledge and truth. Helping others to become inquiry-minded and data literate is the mission of every educational leader. The educational leader facilitates, mentors, and convinces others to become more engaged with available information. The leader develops an interest by allowing time and energy to be expended in the viewing, analysis, and interpretation of the meaning of the collected and available data.

Earl and Katz (2005) state, "There really is no choice; the twenty-first century is the information age and technology has made knowledge available in raw and unedited forms in a range of media" (p. 20). Technology is our friend and should be used to our advantage in storing, editing, analyzing, and interpreting available information to make the best decisions about our instructional practices; instructional practices that will positively affect learner outcomes.

"If a school wants to improve student learning, it has to use data. Using data effectively requires data tools—particularly student information systems, data warehouses, and instructional management systems" (Bernhardt, 2005, p. 66). Victoria Bernhardt contends that all three data tools—student information systems, data warehouses, and instructional management tools—are essential in the best practice of school improvement. Bernhardt believes that teachers require real-time information on students and instructional effectiveness. Her vision of "data-smart" schools requires technology systems that allow educators information on demand to serve the immediate needs of students. Bernhardt further states that excellent tools are now available to educators, but the difficulty is deciding what tools are needed, how data tools perform,

and which tools are needed first. She offers information on the three data tools: information management, data-warehousing, and instructional effectiveness. This study will examine all three as utilized by educators in mathematics leadership roles in Montana's "AA" high schools.

Bernhardt defines the following data tools:

- A **database** is a system of organized information that is easily retrievable—preferably electronically. Telephone books and dictionaries are common databases that are organized alphabetically to make information easy to find.

- **Student information systems** are databases that electronically collect and organize data concerning characteristics of the student population and school processes. Such a system makes it easy to collect and consolidate data about many factors, such as student attendance; discipline referrals; number of students of a certain gender, ethnicity, or family income; student course assignments and schedules; and specialized school programs.

- **Educational data warehouses** allow the manipulation and integration of multiple databases connected to one another through individual student and teacher identification numbers, and through class schedules that link students to teachers. An excellent educational data warehouse will link together student demographic and grading data from your student information system to standardized student test scores that might come from a testing company. One could access these different types of data for an individual student without needing to reenter the basic student information each time. Data warehouses allow longitudinal and comprehensive data analyses with multiple variables from multiple sources.

- **Instructional management systems** help teachers align lessons to standardized learning objectives, provide instructional resources and assessments, and measure student performance on learning objectives (p. 69).

"Gathering student-assessment data is not enough. Administrators and teachers must learn to analyze the data and apply this information in the classroom" (Nichols & Singer, 2000, p. 34). Two initiatives were implemented in Nichols and Singer's district to enable this phenomenon of analysis and application to classroom instruction. One, data notebooks were introduced, and two, a data mentor program was initiated. Each of

the district interventions had an impact on the practical application of data within each district school building, and most importantly, within each district classroom. In following Bernhardt's (2005) directions for the use of data tools, the implementation of data notebooks and data mentors enhance the use of tools.

The introduction of data notebooks provided each building with a format for controlling and using collected information (Nichols & Singer, 2000). A district team organized, assembled, and distributed the data notebooks. The notebooks included results of student performance with comparisons to local, state, and national outcomes. Principals were no longer responsible for the collection of data but for analysis, interpretation, and action. The organization and information in the data notebooks remained the same from year to year so that school leaders were left to analyze and interpret, as opposed to gathering information. This organized approach to the collection of data allows administrators and teachers the opportunity to develop action plans, instead of spending valuable time gathering and crunching numbers.

The data mentors employed were a group of administrators and teachers that were trained in the use and understanding of numbers representing percentiles, normal curve equivalent, mean, median, and mode, in order to communicate the meaning of the data notebooks in each building (Nichols & Singer, 2000). Understanding the numbers connected to the terms and their relevancy to student performance is critical to making instructional changes to positively affect results. The data mentors in each building provided an opportunity for each building to analyze results specific to their building.

Increased communication resulted within departments and across curriculums among high school teachers. The data became alive as a result of the work of the data mentors.

Community of Learners

Dufour (1998) states that professional learning communities must be results oriented. In order for continuous improvement to occur, the professional learning community must systemically examine results and not intentions. Dufour goes on to remark that, "Unless initiatives are subject to ongoing assessment on the basis of tangible results, they represent random groping in the dark rather than purposeful improvement." (p. 29). Montana "AA" high schools will be better environments for learning as adult learners embrace collective wisdom within their own ranks to continually improve student results. The industrial model of education where teachers work in isolation as independent contractors will not produce the desired proficiency in high school mathematics students. Technology tools provide a platform for the examination of results so that a professional learning community of adults will collaborate to enhance student learning opportunities.

An adult community of learners, in this research, school mathematics leaders, must be willing to endure temporary discomfort, deal with a certain amount of ambiguity, celebrate discoveries, as well as be action-oriented (Dufour, 1998). This community of learners will respond to data by utilizing information and adjusting instruction so that students will benefit and learn content and process. Close examination of results through the use of technology tools will motivate adults to redirect, change, and improve the

learning environment for the sake of the students. The uncertainty will subside as this community of learners studies results, knowing what is behind and in most cases beyond the numbers. Through the study of Montana "AA" high schools, adult learning communities will be discovered as the use of technology tools for data-driven decision-making (DDDM) increases and school mathematics leaders in Montana believe in the collective capacity to create a better future.

Sergiovanni (2000) believes that in successful, results-driven schools, adults experience personal responsibility for the work and are personally responsible for the outcomes. Understanding a sense of ownership, meaningful existence in the professional work place does not occur in isolation. Adults must experience collaboration, collegiality, and a sense of belonging to the community to truly feel connected as learners and determiners of destiny. Creating this connection is a challenge. Technology used to make data-driven decisions will assist in providing this environment as adult learners embrace the learning community model and abolish the industrial design of working in isolation as independent contractors. "Responsive to unique situations, professionals take their cues from the problems they face and the students they serve. They draw on the wealth of knowledge and technology available to them as they create professional knowledge in use in response to student needs" (Sergiovanni, 1995, p. 253).

Summary

Bartles (2000) asks the question, "What data do you have to show that technology is being used and is making a difference in student achievement?" This is a fair and

appropriate question to Montana “AA” high school leaders as they consider the use of technology tools to store, analyze, and interpret student results. Bartles claims, “We don’t know for sure. Research on school technology suggests that the answers might be buried in a variety of studies that have addressed specific uses of technology in specific instances but have not been synthesized to produce more useful generalizations.” This study will consider the literature that points toward the use of technology tools to gather, store, analyze, and interpret results. The U.S. DOE outlines four critical components for the use of data tools to improve student achievement: 1) integrate data systems to provide efficiency in an effort to improve learning; 2) use various data systems to formulate decisions about student achievement, instruction, and the allocation of resources; 3) ensure the use of tools that are School Interoperability Framework compliant; and 4) use results to address the learning needs of individual students. It is in the best interests of Montana educational leaders of mathematics to understand whether or not their practice of using technology tools is proven effective in addressing the learning needs of students. It was expected that through the study of the 12 “AA” high schools, a positive correlation will appear for schools that more closely align to the components of technology use as outlined by the U.S. DOE, for those schools indicating alignment with the leadership principles for school mathematics, and for those schools that are realizing higher achievement in mathematics.

CHAPTER 3

RESEARCH METHODOLOGY

Introduction

In determining what relationship exists between the use of technology tools for decision-making and assessment results of Montana mathematics students, was intended to provide Montana educators a basis for decisions about the most effective use of technology tools for data analysis. This examination of the correlation between technology usage for decision-making by school mathematics leaders and student assessment results could potentially influence every school in Montana as well as the Office of Public Instruction and the Montana State Legislature. This study attempted to provide evidence specific to the existing use of technology for decision-making and the potential to improve student mathematics achievement. Connecting technology use as a basis for decision-making and assessment results can potentially result in increased technology resource allocation by the Montana legislative body and the Office of Public Instruction. Ultimately, if additional resources are allocated for the use of technology to make informed instructional and curricular decisions, the results could be that student achievement will be positively affected.

As Montana educators become increasingly more accountable for student growth and improvement, it is imperative that they utilize the most efficient technology tools to satisfy the urgent need to improve. All Montana schools are expected to prove and

maintain student proficiency incrementally until the year 2014, when all students are expected to perform at or beyond proficient in compliance with NCLB.

Answers to three specific research questions are discovered in this research pertaining to the practice of technology tools utilization by Montana mathematics leaders for decision-making based on guidelines set forth by the U.S. DOE (2004). The first research question, "To what extent do educators use technology to improve student learning in mathematics?" This question was addressed in a data-driven decision-making (DDDM) diagnostic self-assessment instrument (Appendix A, B) that each "AA" high school's mathematics leaders was asked to complete. The U.S. DOE (2004) recommendations for technology use include the use of integrated data systems in order to expedite feedback and increase rate of change based on student needs. In nonexperimental research, as is the case in this study, the researcher relied on feedback from the survey participants in order to accurately describe current use of technology and data by mathematics leaders. The variables in the research, technology and data, were not manipulated or controlled by the researcher, therefore nonexperimental. This research attempted to determine the current practice of Montana mathematics educators (Johnson, 2005a) in examining data through the use of integrated data systems.

The second research question, a related and more complex question the research addressed was, "Do educators use technology to formulate data-driven decisions related to instruction, and student achievement?" This question was also addressed through the DDDM diagnostic. Based on the data collected the researcher formulated a description

of the extent to which decision-making regarding mathematics curriculum and instruction is actually being conducted through the use of technology.

Using the data collected through the DDDM diagnostic and common student assessments, the researcher determined whether or not a correlation existed between DDDM utilizing technology tools and student performance. This addresses research question three, "What relationship exists between DDDM and student achievement in mathematics?" In other words, does a relationship exist between the use of data systems for decision-making as defined by the DOE and student outcomes on various achievement assessments?

All of the preceding questions may be considered independent, but they possibly intertwine, as they all have implications to the overriding question: whether or not technology assistance in decision-making is related to higher student achievement in mathematics. In other words, are there indicators of success, higher achievement, in schools where technology and DDDM has been implemented to examine mathematics assessment results and change instructional strategies?

Research Design

Gay and Airasian (2000) describe correlational research as determining if a relationship exists between two or more variables. This study considered school mathematics leaders' quotient for DDDM and multiple measures of student performance. First, the study considered technology tools as utilized by Montana "AA" high school leaders in mathematics. The extent to which data and technology tools are being utilized

by Montana high school mathematics leaders in schools classified as “AA” was measured through a self-assessment of their implemented and current practices. The data and technology tools variable is defined by the U.S. DOE (2004) as recommended practice for technology use to improve student learning.

Multiple indicators of student achievement will be gathered through the utilization of common student assessments and math achievement characteristics present in all Montana “AA” high schools. The following measures were used as indicators of student achievement: 1) grade 10 Measured Progress math results; 2) grade 11 ITED total math results; 3) percentage of grade 12 students enrolled in a fourth year of mathematics; 4) ACT math scores; and 5) SAT math scores. A composite of the various indicators of student achievement in mathematics will be collected for each individual “AA” high school.

The researcher calculated the correlation coefficient between the variables—use of technology tools for DDDM and the various student assessment indicators. Causal relationships will not be inferred from this descriptive and correlational research although some researchers believe that limited causal relationships can be established through nonexperimental correlational research (Johnson, 2005b). This researcher believes that both technology tools and the implementation of math principles can and do have an effect on student results; but further research will be necessary to discover a cause and effect relationship. This is the beginning of research to establish what relationships exist between the use and implementation of data and technology tools for decision-making

and student outcomes in mathematics. Through this study of 10 "AA" high schools, the study discovered the relationship that exists between the variables.

Population

The population in this study consisted of the Montana "AA" high schools. Teachers in each of the math departments, principals, assistant principals, curriculum directors, technology directors, technology integration specialists, and district superintendents for every "AA" high school were asked to respond to a DDDM diagnostic. The teacher survey (Appendix A) was administered to determine the technology use and readiness for DDDM to help improve student learning. The administrator survey (Appendix B) mirrors the teacher survey but is written addressing the perspective of the administrator (McLeod, 2005). Dr. Scott McLeod, University of Minnesota, director of the School Technology Leadership Initiative (STLI) in Minnesota designed the instrument to assess educators' capacities for DDDM through the use of technology. This instrument has been utilized by University of Minnesota researchers to survey 11,000 K-12 Minnesota educators (S. McLeod, personal communication, December 30, 2005).

Excluding Billings West High School, the 12 remaining "AA" high schools intended to be included in the study employs one principal, three to four assistant principals, and approximately ten full-time equivalents (FTE) in the math department. The Office of Public Instruction for Montana (2005) has registered 121.668 FTE math teachers for the school year 2004-2005 in "AA" high schools. This provided

approximately 13 to 14 possible respondents from within each individual school building. Along with the responses from the building level, each of the following central office personnel was asked to respond: superintendent, curriculum director, assistant superintendent for instruction, technology director, and technology integration specialists (Rud, 2004). Understanding that each district level supervisor may have responsibilities in more than one school, the district level administrator was asked to respond to one survey per high school in the district. For example, the Missoula central office personnel was asked to respond to three separate surveys, one for each of the three district high schools—Hellgate, Big Sky, and Sentinel. There were approximately three to four potential district level personnel that were asked to respond on behalf of each school, this would bring the total number of possible respondents for each "AA" high school to between 16 and 18. After receiving little response from district level personnel to participate, it was determined that there would be insufficient numbers of central office personnel to be included in the study.

Among the 13 "AA" high schools in Montana, West High School was deselected and used as a pilot site for the survey instruments. The total number of possible mathematics leader respondents to each of the surveys for all of the "AA" high schools was potentially 204. Each individual within the research population was asked to sign an agreement to participate (Appendix C). The agreement provided the consent to participate, as well as a pre-survey indication of the actual number of participants. The researcher used his own high school, Billings West, personnel to pilot test the survey instruments and are not included in the results of the study. Table 1 figures were secured

from the Montana OPI website which indicates full time equivalents (FTE) for teacher and administrative personnel attained from information on the October accreditation reports for the 2005 school year. Given that two of the 12 intended schools chose not to participate and that the central office rate of participation was insufficient, table 1 illustrates the population of the 12 intended participating "AA" high schools. Table 3 in Chapter 4 provides the adjusted population and actual survey participants from the 10 participating schools.

Table 1. Number of potential respondents representing the twelve "AA" high schools in Montana including district central office, and technology specialists.

School	FTE Math Instructional	Building Admin	Instructional Central Office	Building Technology Specialist	Total Respondents
School A	8.6	4	3		16
School B	9.4	4	3		17
School C	13.6	6	2		22
School D	10.4	5	5		21
School E	8.6	4	3	1	17
School F	6.9	3	3	1	14
School G	6.4	4	3		14
School H	5.6	4	3		13
School I	6.5	4	3		14
School J	9.2	2	2		14
School K	13.7	4	3	2	23
School L	9.5	4	3	2	19
Total	114*	48	34	6	204*

* FTE is rounded to the nearest whole number. (Montana OPI, 2005)

The 204 individuals in the intended population are charged with the responsibility of instructing approximately 20,000 math students of the approximate 48,000 public high school students registered in the state of Montana for the 2004-2005 school year (Montana OPI, 2005). This represents almost 42 percent of the public high school

population in the state of Montana. The study provided knowledge about the surveyed population regarding 1) educator practice and implementation of using data tools for decision-making and 2) the correlation of mathematics achievement to "data-driven decision-making" by Montana mathematics educators. The following (Table 2) illustrates the student population served by the 204 intended respondents to the survey instruments.

Table 2. Number of students served by mathematics leaders in Montana "AA" high schools according to 2004-2005 school year enrollments.

School	Grade 9	Grade 10	Grade 11	Grade 12	Ungraded	Total
School A	632	483	412	403	29	1959
School B	516	408	358	362	20	1664
School C	620	654	590	602	0	2466
School D	506	515	494	442	0	1957
School E	400	408	406	389	12	1615
School F	378	372	347	335	0	1432
School G	436	341	336	325	0	1438
School H	281	289	232	303	0	1105
School I	372	331	282	268	0	1253
School J	413	357	375	350	59	1554
School K	604	425	422	427	0	1878
School L	442	422	353	333	38	1588
Total	5,600	5,005	4,607	4,539	158	19,909

(Montana OPI, 2005)

Results of common student math assessments and characteristics were gathered from the sample population of 42 percent of the high school students in the state of Montana. Each of the results was indicated by school and not by individual. The following are the common assessments and characteristics that were quantified by individual school, protecting the confidentiality of individual students: 1) grade 10 Measured Progress math results for 2004 and 2005; 2) grade 11 ITED total math results

for 2004 and 2005; 3) percentage of grade 12 students enrolled in a fourth year of mathematics for the year 2004 and 2005; 4) ACT math scores for 2004 and 2005; and 5) SAT math scores for 2004 and 2005. Each of the above assessments and characteristics are common among "AA" schools and represent the math achievement by each individual high school. It was not intended for this study to examine individual student results, only to rank assessment by school through a composite scoring for all of the various indicators of mathematics achievement.

Data Collections Procedure

Two survey instruments were used to collect data from mathematics leaders and instructional personnel in "AA" high schools in the state of Montana one addressed to classroom teachers the other for school administrators. The other source of data was common assessments and characteristics of "AA" high school math students in 10 "AA" high schools in the state. Results from the state mandated assessments (Measured Progress for grade 10 and ITED for grade 11) were obtained from the Montana Office of Public Instruction. The other common assessments and characteristics were gathered from the individual schools. As previously stated, the survey instruments measured the degree to which mathematics leaders are using data tools for decision-making. Each school was ranked based on responses to the surveys and results of various student assessments in order to perform correlational statistics between the two variables.

The degree to which Montana mathematics leaders are using data tools for decision-making was collected through an instrument created by Scott McLeod,

University of Minnesota, to assess school's or district's progress in DDDM to help improve student learning (Appendix A, B). The survey was administered to approximately 140 "AA" high school teachers and administrators. The 140 surveyed were subdivided according to individual high schools. There were 6 to 19 members in each subgroup. A mean score was determined for each participant subgroup of the 10 "AA" high schools. The composite mean score was used for a ranking of the 10 schools, indicating their self-perceived progress in DDDM.

Ten measures of student math assessment results and characteristics of mathematics achievement were collected from the Montana Office of Public Instruction and the individual "AA" high schools. A combination of results was utilized, so that the ranking of the 10 schools' performances was determined from multiple measures. Five different measures over a two-year time frame were considered: 1) grade 10 Measured Progress math results for 2004 and 2005; 2) grade 11 ITED total math results for 2004 and 2005; 3) percentage of grade 12 students enrolled in a fourth year of mathematics for the graduating years 2004 and 2005; 4) ACT math scores for 2004 and 2005; and 5) SAT math scores for 2004 and 2005. These results were used to determine 10 different composite scores for each school derived from 10 measures of student performance over a two-year time frame.

Survey Instruments

Survey instruments constructed by University of Minnesota professor, Scott McLeod, were utilized to collect DDDM characteristics from personnel in 10 "AA"

Montana high Schools. Dr. McLeod conducted a state wide effort in Minnesota measuring similar attributes in K-12 schools throughout Minnesota. The instrument utilizes a Likert scale incorporating a rating with the following descriptions: strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree, and strongly agree. The instrument was available in a paper-pencil format as well as through a web-based surveyor. Participants were encouraged to utilize the web-based version as it saved time in completing the diagnostic as well as saved time in compiling results.

Analysis

The researcher collected descriptive data on educators' use of technology for the purpose of DDDM and determined the correlation between use of technology for DDDM and student assessment results in mathematics. The researcher hypothesized that "using technology tools for decision-making" would reveal positive correlations to student mathematics achievement.

Mathematics educator's DDDM characteristics are complex variables given the guidelines of the U.S. DOE for the use and implementation of technology tools for decision-making. These characteristics, inherently complex, as is the essence of teaching and learning, the characteristics were difficult to quantify accurately. Nonetheless, obtaining actual responses from participants constitutes the first step in acquiring knowledge of present practice. The survey instrument contained descriptors of behaviors that were measured through a self-assessment instrument that administrators and mathematics educators completed. Each of the participants was their own judge, and

they did not rely on any special skills or training to determine their school "use of technology tools to make decisions." Other than that of their own day-to-day perceptions and experience, the participant's relative level of DDDM and technology tools expertise may have been limited. There was a possibility that the participants would judge their own behaviors erroneously regarding the variables studied, given their limited knowledge of where they individually rank among the larger population.

The potential 140 participants, Montana mathematics leaders and instructors, were subdivided into 10 groups representing the 10 participating "AA" high schools. Each group will contained 6 to 19 members. Survey results from each group were tabulated and a correlation was calculated according to group ranking. Group ranking was determined by mean scores related to the survey. In addition to the group ranking, each school was ordered according to student results. Student results were gathered for approximately 20,000 high school math students enrolled in Montana "AA" high schools. Among the variables a rank difference correlation was calculated using a Spearman rho test of correlation. When a small number of groups, less than 30 (n = 10), are ranked, the Spearman rho produces accurate results. The results were similar to the one that would be obtained had a Pearson r been calculated (Gay & Airasian, 2000). This research provided for 10 groups to rank. As stated earlier, the researcher's school personnel were not included in the results, only used as a pilot test for effectiveness and understandability of the survey instruments. Two of the remaining 12 schools chose not to participate. The correlational statistical tests were calculated using SPSS.

Limitations and Delimitations

Population

This study was limited to "AA" high schools in the state of Montana. Limiting the study to "AA" high schools makes the study difficult to generalize to other settings and populations. Thirteen "AA" high schools are unique among 175 public Montana high schools. The "AA" schools in Montana serve 21,988 of the 48,338 public high school students in Montana (Montana OPI 2003-2004 enrollment data, 2003). Each "AA" high school serves between 2,495 and 1,162 students. The remaining 162 public high schools in Montana serve between six students at Flaxville High School and 845 students at Columbia Falls High School (Montana OPI, 2003). The study of larger Montana Schools is difficult to generalize to smaller schools.

Generalizability to Other Settings and Subjects

The degree to which this study is generalized to smaller schools in Montana and other settings is limited. If in fact the hypothesis is proven or "null" that a positive correlation exists between the two variables (DDDM through the use of technology tools, and student achievement in mathematics), it will be necessary to replicate the study in other settings in order to verify the same result exists. Even though replication of the study is necessary in other settings, the proof or disproof of the hypothesis is evidence to continue study. Consideration of a cause and effect relationship between the use of technology tools for decision-making and student achievement deserves continued examination. How generalizable this study is to other subject areas is also in question.

Replication of the study would be necessary to prove a relationship exists, say for example, between the use of technology tools for decision-making and student achievement in English. This research was intended to be a foundation of further research considering the causal relationship between the use of technology tools for decision-making and student achievement in other core and elective subjects.

Influences Outside of the Use of Technology

The mathematics leader and instructional personnel variables measured, "use of technology tools for DDDM and student achievement in mathematics," are complex in nature. The survey instruments are intended to discover the capacity and degree to which mathematics leaders perceive their alignment with guidelines set forth by the U.S. DOE (2004) for technology use and DDDM. Alignment with the best practices of teaching is inherently difficult to self analyze, as is the degree of alignment with the use of technology. To illustrate the difficulty, consider the three major categories that comprise decision-making in teaching, as described by Madeline Hunter (1982): 1) what content to teach next; 2) what the student will do to learn and to demonstrate learning has occurred; and 3) what the teacher will do to facilitate the acquisition of that learning. Making these decisions is a multifaceted task often done simultaneously. Self analysis of the capacity and ability to make these decisions is even more complex and to a certain extent intangible. While making judgments about their usage of technology for DDDM, mathematics leaders and instructors will be considering the multifarious acts of instruction and leadership. Inherently, it is difficult to single out factors from among the multitudinous processes of instruction that affect learning outcomes. There is an error

factor in the responses to the surveys by the participants, and the error factor limited the reliability of the research. An experimental study focused on only the use of technology tools creates an opportunity to screen out the multitude of other variables that could have possibly affected student achievement. Experimental research of this type would probably be unrealistic given the cost to create the conditions necessary to factor out a single variable.

Each of the 10 examined "AA" Montana High Schools has one principal who is supported by varying administrative configurations in each high school building, in addition to varying central office administrative services, and individual personnel teaching in math departments unique to each school. The supporting administrative organization may or may not have an effect on mathematics achievement or school improvement in mathematics, just as the principal and teacher leaders may or may not have an effect on mathematics achievement or school improvement. This study attempted to determine the relationship between the use of technology to examine assessment results and mathematics achievement when all school leaders, not necessarily only the principal, utilize data tools. This study recognized the leadership styles or traits of individuals but focused on the presence and utilization of technology tools for DDDM that may or may not have been influenced by leadership throughout the district. The research attempted to reveal that through the use of technology to examine assessment results, proactive instructional change can occur, resulting in positive gains in achievement. Varying individual leadership traits and characteristics within each "AA" high school district had an effect on the extent to which technology is utilized. This

study will recognized leadership skills that influence the use of technology by all educators within each high school district, but did not measure the effect of these leadership skills.

Data Collection Procedures

This study relied on the full cooperation of 10 different high schools and approximately 140 respondents. Non-response or partial data from any of the 10 limited the validity and reliability of the study. It was critical that the response for the requested data was timely and accurate. The researcher took precautions in order to ensure the timeliness of reporting and collection. The researcher sent a written notice and agreement to participate (Appendix C) to each district office participant, building principal, and mathematics instructor prior to the survey and collection of data. The preliminary contact requested participation and was addressed to the principal (Appendix D), survey instruments (Appendix A, B), and the research problem, purpose, and questions. A personal contact was made with each building principal as a follow-up to the request for participation. The building principal was provided a data check list of items to be gathered and returned by November 1, 2005 (Appendix E).

There was a time lapse of 6 to 18 months in the collection and administration of the survey and the student assessment results used for the statistical correlations. Student assessment occurred during the 2004 and 2005 school years while the survey was administered post assessment of students in the fall of the 2006 school year, November 1, 2005. Participant response to the DDDM survey was impacted by the 6 to 18 month time discrepancy post student assessment administration.

The survey instruments were pilot tested at Billings West High School and each of the instructional personnel and building administrators had an opportunity to complete the surveys and respond to the effectiveness and understandability of each of the instruments. Adjustments were made to each item in order to provide clarity to the respondent. Billings West was not included in the results, as the researcher was the principal during the timeframe of the research. The Billings West response to the survey was only used to provide feedback for making adjustments to the survey instruments.

Descriptive and Correlational Study

This study included descriptive statistics of the current capacity for DDDM through the use of technology of a sample of Montana educators. The description of the use of technology for the purpose of DDDM is limited to building administrators and math instructional personnel in Montana "AA" high schools.

This research intended to discover a relationship between the use of technology tools for decision-making and student assessment results. Even with the discovery of a relationship between the practices of "AA" mathematics leaders and student results, no cause and effect was attempted to be established. As previously discussed, any number of a wide range of potential variables could have positive or negative affects on student achievement. However, whatever correlation or absence of a relationship was determined; the result could justify further research. Gay (2000) remarks that variables found highly related to achievement will continue to be studied, as achievement is a complex variable. Because of this complex variable, achievement, the study was limited as to any claims that are made about a direct relationship.

Correlational studies cannot establish cause and effect relationships (Gay & Airasian, 2000). A significant correlation however, justifies further investigation of the relationship for a causal connection. This initial descriptive and correlational study revealed information that generates interest in research pertaining to the effect of technology tools for DDDM by mathematics leaders and instructional personnel on student achievement.

Timeframe for Research

After the researcher attained approval from Montana State University, which was September 2005, the invitation for participation (Appendix D) was sent to each of the 12 "AA" high school principals and the affiliated school districts. Collection of student results of state mandated testing were made through the Montana OPI in October 2005. The survey instruments were distributed to high school principals for dissemination in November 2005 with a return date of December 1, 2005. Each of the survey instruments was to be completed by pencil or there was an option for electronic response created by Scott McLeod of the University of Minnesota. Schools not reporting by December 1, 2005 received notification and follow-up communication as a prompt to respond in a timely manner. Data sorting and statistical calculations were completed by December 20, 2005. In January 2006, results of the research findings were recorded and conclusions reported.

Summary

The following is an excerpt from Chapter One of the Principles and Standards for School Mathematics (Carpenter, Gorg & Martin, 2000):

> Imagine a classroom, a school, or a school district where all students have access to high-quality, engaging mathematics instruction. There are ambitious expectations for all, with accommodation for those who need it. Knowledgeable teachers have adequate resources to support their work and are continually growing as professionals. The curriculum is mathematically rich, offering students opportunities to learn important mathematical concepts and procedures with understanding. Technology is an essential component of the environment. Students confidently engage in complex mathematical tasks chosen carefully by teachers. They draw on knowledge from a wide variety of mathematical topics, sometimes approaching the same problem from different mathematical perspectives or representing the mathematics in different ways until they find methods that enable them to make progress. Teachers help students make, refine, and explore conjectures on the basis of evidence and use a variety of reasoning and proof techniques to confirm or disprove those conjectures. Students are flexible and resourceful problem solvers. Alone or in groups and with access to technology, they work productively and reflectively, with the skilled guidance of their teachers. Orally and in writing, students communicate their ideas and results effectively. They value mathematics and engage actively in learning it. (p. 3).

Consider the reality of the above actually occurring in schools across the state of Montana. This research served as an initial conduit for creating classrooms, schools, or even districts that embody the characteristics of the described learning environment. Making progress and implementing the changes necessary to accomplish such a learning program requires self-study, reflection, and the opportunity to continually monitor progress and results. More and more data is being collected and stored daily about how students are performing, their demographics, and behaviors. In order to utilize this information to its fullest extent, educators must become data aware and proficient in the

use of technology tools. Decision-making about the most important aspects of instruction can be made easier through the effective use of data tools.

Through the analysis of current educator practices and the existing common assessments among all of the "AA" high schools in the state of Montana, a foundation was established of how data and technology tools are being used and whether or not there is a relationship with student achievement. The students in the state of Montana, school mathematics leaders, the Office of Public Instruction, and the Montana State Legislature will all benefit from this research that discovered what relationship exists between the uses of data and technology tools for decision-making and student results. The state of Montana has committed to making progress toward the mandates of NCLB. This study validates that academic progress, and the requirement of making research-based decisions on instructional practices, is actually happening in the state. Montana educators are committed to excellence and student progress toward learning outcomes and results.

CHAPTER 4

RESULTS

This study examined the DDDM status through the use of technology of Montana "AA" high school mathematics teachers and administrators, the leaders of high school mathematics curriculum and instruction throughout the state. Those responsible for educating approximately 20,000 of the 48,000 Montana public high school mathematics students are making data-driven decisions through the use of technology (Montana OPI, 2005). This researcher investigated the degree to which those decisions are being made with technology assistance and whether or not decisions are related to results. The extent to which high school mathematics instructors and administrators use technology to examine student results and affect instructional and curriculum changes has been examined. The data collection and analysis resulted in the framing of the response to the following research questions:

- To what extent do educators use technology to improve student learning in mathematics?
- Do educators use technology to formulate data-driven decisions related to instruction and student achievement?
- What relationship exists between data-driven decision-making and student achievement in mathematics?

This study examined 10 of the 13 "AA" high schools in the state of Montana, excluding the researcher's home high school as the researcher is the current principal.

For different reasons, educators in two of the 12 potential studied high schools chose not to participate in the study. An assistant principal at one of the high schools reported tension within the math department regarding work load of teachers and the principal chose not to request that his instructors respond (personal communication, December 2, 2005). The other principal was not convinced that the survey would be appropriate for the staff of her high school (personal communication, December 4, 2005). Survey responses, as well as student mathematics assessment results, were gathered from the 10 remaining participating schools. The researcher's home high school mathematics teachers and administrators were utilized to pilot the DDDM survey instrument and are not included in the study results.

Overview of Data Collection

The DDDM survey instrument was intended to be administered to central office leadership personnel in each of the six districts that serve the 10 cooperating "AA" high schools with principals who agreed to participate in the study. After initial contact with the high school principals, the rate of response indicated by the district level central office personnel, as reported by the school principals, resulted in an insufficient number of central office personnel to be included in the study. Participating principals returned minimal to no response from central office district administrators on the consent to participate form (Appendix C). As a result of this participation indicator from the central office personnel, the researcher deselected central office leadership from survey participation. The survey instruments specifically addressed teacher and building

administrators' perceptions and behaviors regarding DDDM. The technology specialists at school and district levels were omitted from the population, as each school varied in the specifications of their technology specialist's job description. The elimination of district level administrators and technology specialists decreased the anticipated survey population from 204 respondents to 162. Table 3 illustrates the anticipated number of respondents and actual number of respondents.

Table 3. Number of potential and actual respondents representing the twelve "AA" high schools in Montana, excluding district central office and technology specialists, who were deselected in the survey process.

School	Potential Math Instructional Respondents	Actual Math Instructional Respondents	Potential Building Admin Respondents	Actual Building Admin Respondents	Actual Total Respondents
School A	8.6	3	4	3	6
School B	9.4	12	4	4	16
School C	13.6	14	6	5	19
School D	10.4	12	5	3	15
School E	8.6	3	4	4	7
School F	6.9	5	3	1	6
School G	6.4	9	4	3	12
School H	5.6	8	4	4	12
School I	6.5	No response	4	No response	0
School J	9.2	No response	2	No response	0
School K	13.7	12	4	4	16
School L	9.5	12	4	4	16
Total	114*	90	48*	35	125

*FTE is rounded to the nearest whole number and was secured from Montana OPI, 2005

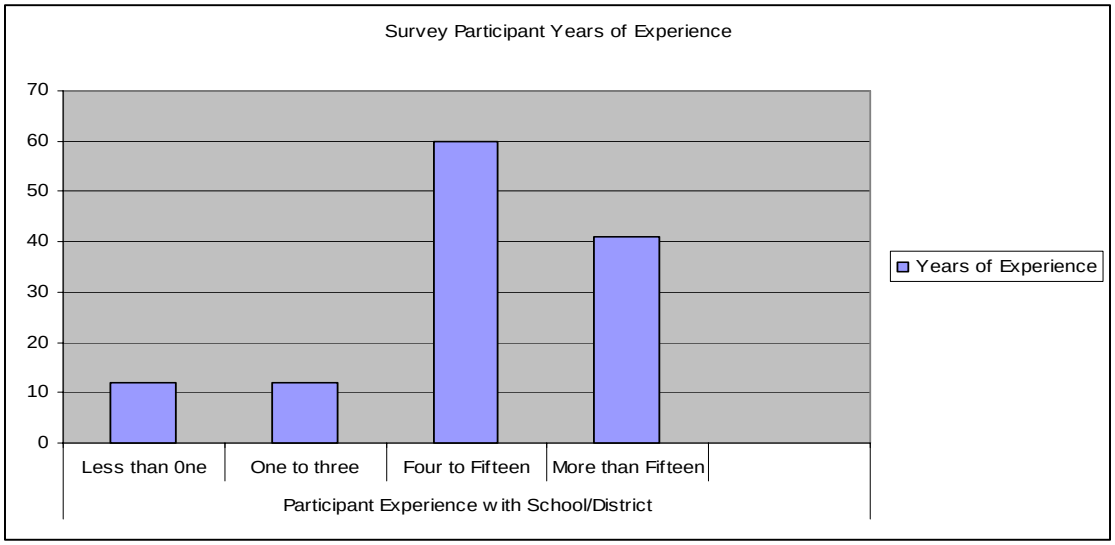
The personnel in School I and School J were not examined in the survey, resulting in a survey population of 98 teachers and 42 administrators. Of the 98 teachers, the researcher received 90 surveys (92%), and from the 42 administrators, 35 surveys were

received (83%). The response from 125 Montana educators represents 90% of the potential 140 respondents from the 10 schools examined in the study. A response rate of 90% in a population of 140 is sufficient sample size to realize 5% or less sampling error (Suskie, 1996).

School A and School E demonstrated low teacher response comparatively, and School F demonstrated low principal response comparatively. This low teacher response could possibly account for higher means for School A and School E, as the administrator mean response for all schools was greater than that of teacher mean response from all schools. Likewise, the low administrator response in School F could possibly account for lower means for School F. A lower teacher or administrator response rate having the potential to affect the means from an individual school is problematic when attempting to discover relationships through the correlations performed for research question #3. A Spearman rho statistical ranking of means was used in determining the correlations.

Of the 125 respondents to the DDDM survey, 12 of the participants stated that they had experience of less than 1 year with their school or district, 12 responded with 1 to 3 years with their school or district, 60 responded with 4 to 15 years with their school or district, and 41 responded to having more than 15 years of experience with their school or district (Figure 1).

Figure 1. Survey participant years of experience.



Of the 125 respondents, 101 of them indicated having at least four years experience with their school or district. There appears to be sufficient knowledge, background, and employment experience from within the survey participants at each school to assess the DDDM tendencies and the use of technology within each school.

Survey participants were asked to rate their own technology fluency and personal capacity for DDDM. On a descriptive scale of 1 to 4: 1 = Novice, 2 = Nearing Proficient, 3 = Proficient, and 4 = Advanced; the mean technology fluency was 2.78 (*SD* = .76) and the mean capacity for DDDM was 2.19 (*SD* = .87). Perceived technology fluency resulted in a mean slightly higher than the perceived DDDM capacity. The means indicate that the survey respondents collectively believe they are very close to proficient in their technology fluency and slightly beyond nearing proficient in their DDDM capacity. A significant positive correlation resulted in a Pearson *r* statistical test conducted between perceived technology fluency and perceived DDDM capacity, $r(123)= .57$, $p<.001$. These mean responses are an indicator that the surveyed population

has sufficient knowledge and background to analyze their own technology use and DDDM tendencies and have a relationship to one another.

The survey collection was made easier for the principals by posting the instrument electronically on a website surveyor. Dr. Scott McLeod (2005) and his research assistants at the University of Minnesota constructed the website surveyor. The majority of surveys were collected via the web surveyor: 106 of 125, 85% of the surveys. The remaining paper copies of the survey were entered by the researcher into the website surveyor so that all research data was in a single data base for the purpose of analysis and to be shared with the University of Minnesota. Throughout the data collection process, Dr. McLeod sent three separate Excel spreadsheets of the data, an initial spreadsheet after 15 surveys had been completed, one midway through the collection, and a final spreadsheet at the completion of data collection. Each of the spreadsheets was checked and rechecked for the integrity of the raw data. There were internal checks conducted to ensure the consistency of each respondent.

The collection of student achievement and assessment indicators required continual follow-up and verification with principals in order to attain accurate measures. Measured Progress and Iowa Test of Educational Development testing for grades 10 and 11 were verified through composite score reports on the Montana OPI web site. Clarification was necessary with principals on the following data sets: ACT and SAT math results for each school, and percentages of seniors who were engaged in a fourth year of math during the senior graduation years of 2004 and 2005.

Student Achievement and Assessment Indicators

For the purpose of this study, common student achievement and assessment indicators were gathered from the 10 participating schools. Each building principal was requested to submit 10 separate student achievement and assessment indicators: 1) grade 10 Measured Progress math results for 2004 and 2005, 2) grade 11 ITED total math results for 2004 and 2005, 3) percentage of grade 12 students enrolled in a fourth year of mathematics for the year 2004 and 2005, 4) ACT math scores for 2004 and 2005, and 5) SAT math scores for 2004 and 2005. The student achievement indicators were correlated with the results of the DDDM survey diagnostic for teachers and principals.

ACT and SAT results generally indicate the math ability of the college bound student. The entire school population is not included in the ACT and SAT results. Measured Progress, grade 10, and Iowa Test of Educational Development, grade 11, are assessments of every student in the respective class. The grade 12 percentage of students enrolled in a fourth year of high school mathematics includes every student who has progressed into their respective school's senior class. The 2004 SAT results were incomplete from each school and therefore, were not utilized in the correlations with the DDDM survey. Normally the number of test takers for the SAT is less than half of the graduating classes in the schools participating in this study. SAT test takers for 2005 numbered 1,217 of the 3,921 graduates representing the 10 participating high schools. SAT and ACT scores are not the best indicator of total school performance, as these exams are normally taken only by the college bound student.

Survey Instrument for Data-Driven Decision-Making

The survey instrument for DDDM was made possible through Dr. Scott McLeod of the University of Minnesota, project director for the university's School Technology Leadership Initiative (STLI). In his white paper document addressing DDDM, Dr. McLeod (2005b) states that a few innovative schools had adopted a data-driven orientation as early as the 1980s, but most school districts started to incorporate DDDM principles into their organizational and instructional practices as a result of the requirements of NCLB. In response to this urgent need to satisfy the requirements of NCLB, Dr. McLeod and his associates at the university's STLI have designed an instrument to survey educators' DDDM capacity. The survey is a comprehensive instrument measuring up to 12 individual factors in relationship to DDDM. His survey was distributed to 11,000 educators across the state of Minnesota in January of 2006. Dr. McLeod granted permission for the researcher to utilize the DDDM instrument for the purpose of answering the intended questions of this research project (personal communication, October 5, 2005).

The survey contains 71 separate items that request a Likert scale response of strongly disagree, moderately disagree, slightly disagree, slightly agree, moderately agree, and strongly agree, with a value assigned from 1 to 6 respectively for each response. Separate and collective mean responses were tallied for administrators and teachers. The survey was adjusted to address the perspective of the teacher (Appendix A) and the perspective of the administrator (Appendix B), as both responded to how they

perceive DDDM in their schools. After the data was collected, the coefficient alpha for the DDDM diagnostic was found to be high (alpha = .95).

Purpose of the DDDM Survey

A limitation of this research is that the DDDM survey has not had a factor analysis conducted. A factor analysis will be conducted by the Minnesota researchers after administration of the DDDM survey to the 11,000 educators in Minnesota (personal communication, Dr. Scott McLeod, December, 30, 2005).

The descriptive nature of this research study resulted in the reporting of how Montana educators perceive their technology use along with their capacity for DDDM. The results of this research include correlations that resulted after conducting the statistical analysis of DDDM factors with Montana student performance in mathematics.

The following are the 12 individual factors that are surveyed within the DDDM instrument:

1. Section 1-4 Assessments, yearly state, other yearly, teacher periodic, other periodic
2. Section 5 Data Transparency and Visibility
3. Section 6 Acting on Data
4. Section 7 Goal Setting
5. Section 8 Professional Learning Communities (PLC's) or Teacher Teams
6. Section 9 Data Systems and Technology
7. Section 10 Alignment for Results
8. Section 11 Support for Alignment
9. Section 12 Beliefs
10. Section 13 Data Safety
11. Section 14 Leadership
12. Section 15 Culture

In consultation with Dr. Scott McLeod (personal communication, January 5, 2006) given the absence of a factor analysis for the Montana study, the researcher has clustered

factors with rationale that assisted in addressing the research questions in the study of Montana educators. Given that McLeod's study of Minnesota educators included a factor analysis of the survey instrument, the clustering of factors in the Minnesota study may look different than how factors are clustered in this study of Montana educators. Because of themes contained within and among the 12 individual factors that connect one another, the following factors were grouped or clustered for the purpose of this study in order to perform correlational statistics and describe the current practice of Montana mathematics educators' data systems and technology use to improve student learning. Each number identifies the cluster of factors that are referred to as cluster 1-6 in the results and data analysis. Refer to the surveys in Appendix A and Appendix B for the sections and individual items related to the factors within each cluster contained in the DDDM survey.

1. Data Systems and Technology—Survey Section 9
2. Beliefs, Culture, and Leadership—Survey Sections 12, 15 &14
3. Assessment—Survey Sections 1-4
4. Data Transparency/Visibility and Data Safety—Survey Sections 5 & 13
5. Alignment for Results and Support for Alignment—Survey Sections 10 & 11
6. Goal Setting, Acting upon Data, and PLCs—Survey Sections 7, 6 & 8

The above factors have been clustered for their alignment and relationship to one another as determined by the researcher. The clusters were analyzed and factors within each cluster correlated to determine if relationships existed among the clustered factors for the purpose of addressing the research questions. Within the response to each of the research questions, a rationale and evidence of positive correlations are provided for the clustering of factors. The positive correlations resulting from statistical analysis on the

clustered factors is reported as supportive data for the researcher's rationale for clustering.

Results of Data Analysis

Data analysis is reported as it relates to each of the three research questions of this study. Each cluster of factors contained in the DDDM diagnostic survey is examined and results are reported as they relate to the research questions. Research question #1 is addressed by the responses to cluster 1, data systems and technology.

Research question #2 is presented in the analysis of clusters 2-6. Cluster 3, assessment, and cluster 4, data transparency/visibility and data safety, will be examined together in the data analysis. Clusters 3 and 4 are interrelated. Cluster 3, assessment, measures educator perceptions on the use of assessment and the resulting student performance data. Cluster 4 measures educator perceptions of the visibility/transparency of student performance data and to what degree student performance data is safe to engage in discussion. Further correlational relationships between cluster 3 and cluster 4 are presented in the results.

Research question #3 considered all six clusters and the relationship to student achievement in mathematics. A ranking of cluster means for each of the 10 examined schools will be used to determine a Spearman rho correlation coefficient with the ranking of composite assessment results for the 10 participating schools.

Research Question #1: To what extent do educators use technology to improve student learning in mathematics?

The DDDM survey section 9, cluster 1, data systems and technology, addresses answers to research question #1. The first item in the DDDM survey section 9, cluster 1, educators were asked to indicate specific data tools that are utilized to collect and/or analyze student performance data.

Educators indicated that each of the options for data tools is implemented by at least one educator in every school. Table 4 indicates the number of each of the 125 respondents who checked "yes" to utilization of a specific tool. The classification of "other" was not distinguished or given the option of indicating what "other" meant to the survey participant.

Table 4. Use of data tools reported by survey respondents.

	Vendor Ware	District Ware	SIS*	Access FileMaker	Excel Spread	Assess Software	Other Tools	None
n =	36	29	52	20	52	24	15	31
% =	29%	23%	42%	16%	42%	19%	12%	25%

*SIS, student information system

Student information systems software (SIS) and spreadsheet software are the most popular data systems and technology from the given choices. Fifty-two educators, 42%, reported using student information management systems and 52, 42%, reported using spreadsheets for data collection and analysis of student performance data. Educators in the ten schools reported using four different student information software systems; educators in two schools reported using Zangle, educators in two schools reported using SASI, educators in three schools reported using PowerSchool, and

educators in three schools reported using SchoolMaster. The choice of a specific spreadsheet application is not known by school or by individual participant. Thirty-one, or 25% of educators surveyed, responded that they are not using any data systems to collect or analyze student performance data. Ninety-four, or 75% of educators surveyed, responded that they are using at least one option of information technology for data collection and analysis of student performance data.

Of the 125 respondents, several individuals reported using multiple data systems and technology to collect and analyze student performance data (Table 5). Sixty-five, or 52% of the 125 respondents, reported using more than one tool for collecting and analyzing student performance data. For those individuals who reported using multiple data tools, the composite mean response was 3.99 (*SD* = 1.41) for their DDDM capacity. For those individuals who reported using one or no tools, the composite mean response was 3.61 (*SD* = 1.43) for their DDDM capacity.

Table 5. Individuals reported using multiple data tools.

# of tools	0	1	2	3	4	5	6
N=	31	29	30	15	10	6	4
%=	25%	23%	24%	12%	8%	5%	3%

Examination of Cluster 1 Subcategories: Design of
Technology Systems and Access to Technology Systems

Cluster 1 of the DDDM survey, data systems and technology, also addresses the educator's opportunity for input into school and district data management analysis strategies, data elements, and reports; this input is also referred to by the researcher as the "design of technology systems." From this section, questions pertaining to "design of

systems" produced a mean response of 2.98 (*SD* = 1.45), on a scale of 1 to 6 (1 = strongly disagree and 6 = strongly agree) from the 125 educators responding to the survey. This indicates that Montana educators disagree that they have the opportunity to "provide input" into the design of analysis strategies, data elements captured into data systems, and reports that are created by those technology systems in their school or district. The mean teacher response (*n* = 90) for "design of systems" was 2.51 (*SD* = 1.27) and the mean administrative response (*n* = 35) for the "design of systems" was 4.18 (*SD* = 1.16). Teachers disagree that they have input into the design of systems; administrators, agree that they have input into the design of information technology systems.

Cluster 1, data systems and technology, also measures the respondents perceived access, understanding, and the degree to which educators have technology systems that are being utilized in Montana schools for DDDM. The researcher refers to this measure as the "access to technology systems." All educator responses produced a mean of 4.05 (*SD* = 1.35), in terms of access to, understanding of, and actual systems in place. Educators in Montana agree that they have "access to technology systems" to examine data that impact student learning. In the "access to technology systems" items the administrator mean was equal to 4.60, (*SD* = 1.19) and teacher mean equaled 3.83, (*SD* = 1.34). This mean difference between administrators and teachers in perceived "access to technology systems," although not as dramatic as the mean difference between administrators and teachers in the perceived input into "design of technology systems," illustrates the collective difference in perceptions between teachers and administrators.

Educators agree that they have access, understanding, and actual technology systems available in schools and they disagree that there is opportunity for input into the design of data management analysis strategies, data elements, and reports created by the technology systems that are actually being utilized. The Pearson *r* correlation coefficient between the subcategories, access to systems and design of systems, is significant, $r(123) = .44$, $p<.001$. This medium correlation and relationship of subcategories indicates that Montana educators' confidence is greater in the systems that they have in place to access and examine data than is their confidence in the opportunity to have input into the design of these systems.

In the analysis of the entire cluster data systems and technology, considering subcategories "design of technology systems" and "access to technology systems," the mean score for all educators was 3.60 ($SD = 1.48$). This mean score included a mean score of 3.27 ($SD = 1.47$), for teachers and a mean score of 4.42 ($SD = 1.19$), for administrators.

Research Question #2: Do educators use technology to formulate data-driven decisions related to instruction and student achievement?

Research question #2 was addressed through the examination of responses provided by the research participants to the DDDM diagnostic survey. Clusters 2, 3, 4, 5, and 6 of the DDDM diagnostic are considered in the formation of responses to question #2. Discovering answers to how educators use technology to formulate data-driven decisions related to instruction and student achievement are imbedded throughout the survey instrument. The researcher considered how building administrators responded to

this question as opposed to how teachers reported their practices. The clusters are examined in the following order:

2. Beliefs, Culture, and Leadership—Survey Sections 12, 15 &14
3. Assessment—Survey Sections 1-4
4. Data Transparency/Visibility and Data Safety—Survey Sections 5 & 13
5. Alignment for Results and Support for Alignment—Survey Sections 10 & 11
6. Goal Setting, Acting upon Data, and PLCs—Survey Sections 7, 6 & 8

Beliefs, Culture, and Leadership as a Cluster

In the examination of cluster 2, which includes sections 12, 15, and 14 of the DDDM survey, educators responded to the beliefs and established culture of their school or district as it pertains to DDDM based on student achievement and results. Educators were asked to consider the influence of district and building leadership regarding the influence and expectations that leadership had established for the use of technology and DDDM within the school and district. The researcher examined these three factors as a cluster based on the result produced by statistical correlations between the three factors (table 6).

When considering beliefs, culture, and leadership in regard to technology use for DDDM of the surveyed Montana educators, the mean score indicates educators agree that beliefs, culture, and leadership is present with respect to DDDM capacity. The mean resulted in a score of 4.25 (SD = 1.29), in this cluster of factors and is a greater mean than any of the other clusters examined in the research. The mean responses for the factors beliefs, culture, and leadership on a scale of 1 to 6 (1 = strongly disagree and 6 = strongly agree) were (M = 4.19, SD = 1.35), (M = 4.24, SD = 1.18), and (M = 4.31, SD = 1.32) respectively. The researcher selected these three connected factors to comprise a cluster

as they demonstrate a strong relationship with one another. Using the Pearson *r* statistical test for correlations table 6 shows that three out of three correlations were statistically significant and were greater than or equal to .48. In general, the results of this Pearson *r* statistical correlation suggested that when a participant of the survey reports one of three factors as agree, that survey participant reports the other two factors agree, as well.

Table 6. Correlations among beliefs, culture, and leadership factors (N = 125).

	Beliefs	Culture
Culture	.49**	
Leadership	.48**	.80**

**p<.001

When these three factors are combined for all of the respondents, building administrators respond with a mean result of 4.70 (SD = 1.14) and teachers respond with a mean result of 4.06 (SD = 1.31). When considering both teachers and administrators combined, a cluster mean of 4.25 (SD = 1.29) is produced for beliefs, culture, and leadership. Both building administrators and teachers agree that there is the practice of, or capacity for DDDM in the cluster of factors including beliefs, culture, and leadership.

Assessment—Yearly State, Other Yearly, Teacher Created Periodic, and Other Periodic as a cluster; and Data Safety and Transparency/Visibility as a cluster

The lowest cluster mean scores resulted in cluster 3, assessment, and in cluster 4, data transparency/visibility and data safety. Assessment survey items allowed participants to respond to questions regarding four categories of assessment; yearly state assessment, other yearly assessment, teacher created common periodic assessment, and other periodic assessment. All of the assessment items directed educators to consider the

monitoring of student progress based on results and how those results are interpreted and acted upon. If survey participants did not use one of the four categories of assessment, they were directed to go to the next section and not answer those questions pertaining to that category of assessment. As the survey progressed through the four assessment categories, there were fewer participants engaged in each of the categories of assessment. The highest mean reported within the four categories of assessment was in the assessment category, teacher created common periodic assessments section. Refer to table 7 for the number of respondents in each category of assessment and the resulting mean.

Table 7. Respondent means for categories of assessment (N = 125).

	State Yearly Assess	Other Yearly Assess	Teacher Created Periodic	Other Periodic Assess	Composite for Assessment factor
n =	113	97	78	28	N = 125
% =	90%	78%	62%	22%	100%
M =	3.35	3.11	4.05	3.85	3.50
SD =	1.32	1.33	1.34	1.20	1.37

The mean of 4.0 in the category of teacher-created periodic assessments suggests that of the educators that responded, 62%, the mean response indicates that they agree that using teacher-created periodic assessments are adequate enough to inform teacher instruction, that the assessments provide schools with needed information to improve learning gaps, that teachers make changes based on results from these common assessments, and that educators have adequate training to interpret and act upon these results. Results from this factor, referred to in the concluding chapter as common periodic teacher-created assessment (formative assessment), are critical to improvement. The composite mean for the assessment factor (M =3.50, SD = 1.37) indicates a neutral

response from educators, neither agreeing nor disagreeing that using assessment data will result in adequate details to inform teacher instruction, provide schools with needed information to improve learning gaps, allow teachers to make changes based on results, or whether educators have adequate training to interpret and act upon assessment data.

In addition to the cluster 3 indicator resulting in a composite mean of 3.50 (*SD* = 1.37), cluster 4 comprised of the factors data transparency/visibility and data safety resulted in a similar composite mean (*M* = 3.51, *SD* = 1.49). In a Pearson *r* correlational analysis of these two clusters, a significant correlation resulted between assessment and data transparency/visibility and data safety, $r(123) = .46$, $p<.001$. This correlation indicates that a medium positive relationship exists between the assessment cluster and the cluster, data transparency/visibility and data safety.

Cluster 4, data transparency/visibility and data safety, survey sections 5 and 13 respectively, indicate the degree to which information is disclosed, discussed, and communicated among the various stakeholders in the school. These factors also indicate how safe or non-threatening the culture is in regard to the analysis of data and subsequent discussions. The Pearson *r* correlation analysis of the factors that comprise cluster 4, data transparency/visibility and data safety, resulted in a significant positive correlation, $r(123) = .45$, $p<.001$. The sample population produced a mean score of 3.51 (*SD* = 1.49) which indicates a neutral mean response; neither agreement nor disagreement with the safety of data and a tradition of transparency and visibility exists, in terms of close examination of data and results. The means of section 5 and 13 as a cluster resulted in building administrators (*M* = 4.09, *SD* = 1.35) and teachers (*M* = 3.28, *SD* = 1.48).

The mean for section 5, data transparency and visibility, for all survey participants was 3.08 (*SD* = 1.39), as compared to a mean of 4.20 (*SD* = 1.38), for data safety, section 13 of the survey. The item contained within data transparency and visibility, section 5, that asked educators if they felt parents and community members understand how their school's adequate yearly progress (AYP) status is tied to assessment scores resulted in a mean score of 2.44 (*SD* = 1.32). The mean for this item produced the lowest mean score of all the items in cluster 4.

Alignment for Results and Support for Alignment

Cluster 5, survey sections 10 and 11, contained items related to educators' perceptions of how student achievement and results are aligned with school and district initiatives. This cluster also examines educator perceptions of district and school support for aligning student results to instruction, school improvement initiatives, and state standards.

In the responses of the 125 participants, a large positive correlation was indicated between the factors, alignment for results and support for alignment, $r(123) = .55$, $p<.001$. The alignment factor, section 10 of the survey, considers whether or not student achievement data is used in alignment to school, district, and state standards. The support factor, section 11 of the survey, inquires of survey participants to what degree their school and district is using data for alignment to school improvement and state standards support them. The composite ($M = 3.86$, $SD = 1.31$) for the cluster of the two factors, indicated educator agreement that they are aligning the use of data to standards and are supported by their schools to improve based upon these standards, ultimately

resulting in better schools. The administrator mean response for support and alignment is 4.44 (*SD* = 1.23) and the teacher mean response is 3.66 (*SD* = 1.28).

Goal Setting, Acting Upon Data, and PLC's as a Cluster

Cluster 6 pertains to three different factors within the DDDM diagnostic—goal setting, acting upon data, and teacher teams or professional learning communities (PLC's). Goal setting, section 7 of the survey, inquired of educators to what degree goals are set within their school based on student assessment data. Acting upon data, section 6 of the survey questioned educators to what degree subgroups of students and individuals are identified for instructional interventions based on data. Section 6, acting upon data, also inquired of educators the degree to which their school is significantly improving as a result of data-driven practices. Teacher teams or PLC's, section 8 of the survey, questioned educators about the time, resources, and professional approach to collaboration among educators occurs when considering student data and the subsequent discussions.

Cluster 6, goal setting, acting upon data, and professional learning communities, sections 7, 6, and 8 of the survey respectively, all indicate positive correlations with each other (table 8). These factors were clustered based on their relative relationship to working in teacher teams, setting goals and objectives, and taking action steps toward student and school improvement.

Table 8. Correlations among acting on data, goal setting, and teacher teams (N = 125).

	Goal Setting	Teacher Teams (PLC's)
Acting on Data	.66**	.41**
Teacher Teams (PLC's)	.43**	

**p<.001

The composite (M = 3.8, SD = 1.51) for cluster 6 is above the midpoint of 3.5. Educators agree they are practicing goal setting, and acting upon data, and disagree that they are practicing professional learning communities/teacher teams in relationship to DDDM. In the examination of the response means for each section of cluster 6, goal setting and acting upon data are approximately 1.0 higher than that of the mean for teachers working in teams/PLC's (table 9).

Table 9. Means for cluster 6 factors in survey sections 7, 6, and 8 (N = 125).

	Factors			
	Goal Setting Section 7	Acting on Data Section 6	Teacher Teams (PLC's) Section 8	Cluster 6 Section 7, 6, and 8
M =	4.11	4.20	3.15	3.80
SD =	1.21	1.39	1.62	1.51

Table 9 represents the means and standard deviations for the factors in cluster 6. There is an indication that educators disagree with the actions taken within teacher teams as they relate to technology use for DDDM and educators agree with goal setting and acting upon data as they relate to technology use for DDDM. The actions of teacher teams according to the survey instrument include but are not limited to: 1) meeting at least 4 to 6 times per year with other teachers to look at student data and devise instructional strategies and interventions, 2) when teachers have professional meetings,

their discussions focus on student learning outcomes and results rather than on procedural, political, or social matters, 3) teachers are given adequate time for collaborative planning, and 4) teachers have sustained conversations about teaching practices. This lower mean score for teacher teams indicates that although educators believe that goal setting and acting on data are occurring, goal setting and acting on data are less likely to occur within teacher teams or professional learning communities and are more likely being done in isolation.

The composite mean for teachers in cluster 6 is 3.62 (*SD* = 1.49), as compared to a composite mean of 4.24 (*SD* = 1.46) for building administrators. Teachers' response to goal setting, acting on data, and professional learning communities is neutral and administrators agree to goal setting, acting on data, and professional learning communities as a cluster

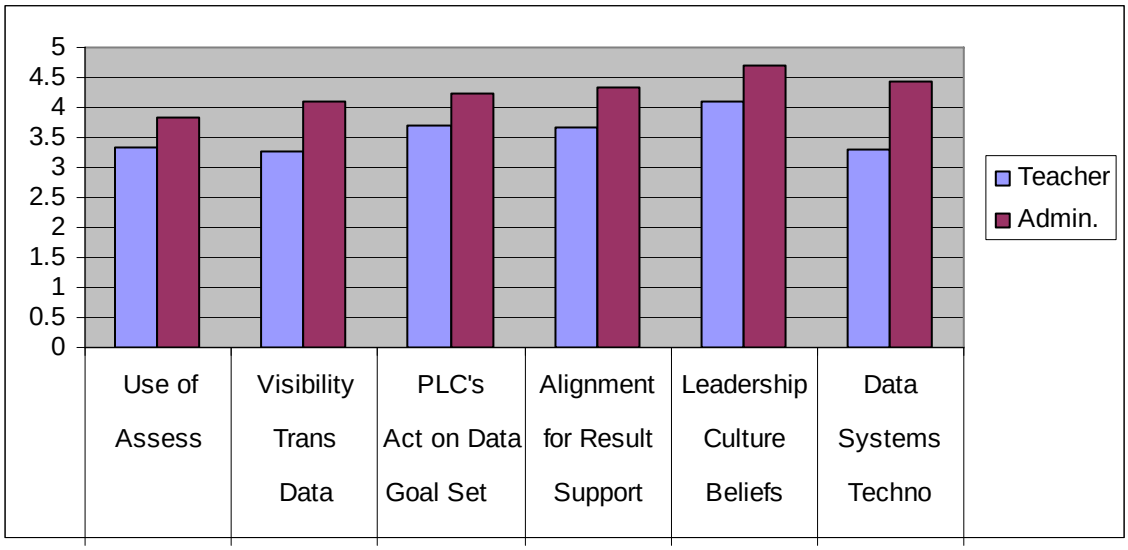
Examination of Means in each Cluster for Teachers and Administrators

An examination of mean differences between teachers and administrators was not an anticipated outcome of this research, but nonetheless it presents opportunity for discussion. Each of the mean scores for administrators from each cluster was greater than the mean scores for teachers in each cluster (table 10, figure 2).

Table 10. Means for teachers (n = 90) and administrators (n = 35) within each cluster.

	Cluster					
	Use of Assessment	Data Trans Visib	Goal Set Act on Data PLC's	Alignment for Results Support	Beliefs Culture Leadership	Data System Techno
Teacher						
M =	3.35	3.28	3.62	3.64	4.06	3.27
SD =	1.42	1.48	1.49	1.28	1.31	1.47
Admin						
M =	3.85	4.09	4.25	4.44	4.70	4.42
SD =	1.33	1.35	1.46	1.23	1.14	1.19

Figure 2. Teacher and administrator means for each cluster.



Composite Means for the DDDM Survey

A mean score for the entire survey was calculated to determine the composite score for Montana mathematics educators' collective DDDM capacity. The following table 11 illustrates the composite means of the survey for teachers, administrators, and all respondents.

Table 11. Composite means for the DDDM diagnostic survey.

Teach		Admin		Composite	
M	*SD*	*M*	*SD*	*M*	*SD*
3.61	1.42	4.30	1.31	3.81	1.43

The composite (M = 3.81, SD = 1.43) for all respondents indicates agreement with DDDM capacity for Montana educators. The consistent difference of means between teachers and administrators may suggest that administrator's alignment to DDDM factors is greater than that of teachers. There will be more discussion about this discovered difference in the conclusion of the research.

Research Question #3: What relationship exists between data-driven decision-making and student achievement in mathematics?

Correlational statistics were performed to determine whether or not a relationship exists between educators' DDDM capacity and student achievement. A Spearman rho correlational test was utilized to see if relationships exist between each of the clustered factors from the DDDM survey and with student results on various achievement indicators. Table 12 illustrates the cluster means for each of the ten schools participating in the research. A number as opposed to the previous letter identification identifies each school. The student population demographics illustrated in table 2 may reveal the school's identity by enrollment figures; therefore a random number identity was assigned as opposed to a letter identity to ensure the confidentiality of research results.

Table 12. DDDM cluster composite by individual school.

	Cluster composite means for each school						
School	Transparency Safety	Act on data PLCsGoal	Support Alignment	Culture Beliefs	Data Systems	Assess	Composite
1	3.16	3.72	3.50	3.99	3.38	2.79	3.52
2	3.85	3.97	4.12	4.48	3.82	3.87	4.08
3	3.64	3.80	3.91	4.41	3.52	4.05	3.98
4	3.84	3.95	3.98	4.14	3.74	3.41	3.85
5	3.89	4.40	4.30	4.60	4.12	3.87	4.23
6	3.63	3.72	3.83	4.25	3.46	3.33	3.76
7	3.70	4.70	4.74	4.92	4.54	3.66	4.39
8	2.59	2.94	3.23	3.66	3.31	2.83	3.14
9	3.11	3.43	3.76	3.99	3.37	3.41	3.57
10	3.45	3.36	3.41	3.94	3.06	3.19	3.47
M =	3.51	3.80	3.86	4.25	3.60	3.50	3.81
SD =	1.49	1.51	1.31	1.29	1.48	1.37	1.43

Each of the 10 principals from the participating schools submitted composite scores of various testing and assessments that are common in all Montana high schools. Table 13 illustrates the collection of assessment data from each of the high schools.

Table 13. Test and assessment composites for participating schools.

	Test and assessment data									
School	MP 04	MP 05	ITED 04	ITED 05	ACT 04	ACT 05	SAT 04	SAT 05	SR 04	SR 05
1	58	56	76	77	21.6	21.9		558	65	70
2	72	59	76	82	21.7	21.6		567	52.5	48
3	73	68	81	82	23.6	23.9	577	569	57	45
4	64	66	77	76	22.1	23.2			55	60
5	63	55	79	83	22.0	22.2		565	51	68
6	70	69	76	77	23.1	23.7	540	537	39	49
7	63	48	80	82	21.3	22.4		565	60	62
8	64	62	72	72	23.5	22.5		551	62	69
9	60	54	66	71	21.1	21.0	540	517	64	60
10	69	63	85	80	22.8	23.6	532	565	82	65

Five different assessment indicators over the course of a two-year time frame were collected from the 10 participating “AA” Montana high schools. The five different

assessment indicators over the two-year time frame, school years 2004 and 2005, resulted in nine individual indicators (table 13) to analyze with each of the six DDDM clusters and the DDDM composite (table 12) for each of the 10 participating schools. The 2004 SAT composite scores were secured for only four of the 10 schools—thus the nine assessment indicators instead of 10. Each of the five assessment indicators for each year, 2004 and 2005, has been rank correlated using a Spearman rho statistical test for correlations. The correlations for each of the five assessment indicators are reported in the following paragraphs.

Measured Progress Math Testing for 2004, 2005

Measured Progress is the criterion reference state mandated test that is administered to every grade 10 student in Montana high schools. Measured progress testing has been administered in Montana for only the 2004 and 2005 school years. In conducting a rank correlation using the Spearman rho statistical test for correlations, there were no significant correlations between any of the clusters or the composite of DDDM for either year, neither 2004 nor 2005, of the Measured Progress testing. This indicates that DDDM and results from Measured Progress testing appear to be independent.

ITED Math Testing for 2004, 2005

ITED testing is a norm-referenced exam that is administered to every grade 11 student in Montana high schools. The ITED exam has been a mandated exam in Montana for the past five years. The result of a Spearman rho test of statistical

significance resulted in no significant correlations between the 2004 math portion of the ITED exam and the cluster means, nor the composite mean of the DDDM survey. On the other hand, the 2005 math portion of the ITED exam resulted in positive correlations with each of the cluster means and the composite mean of the DDDM survey (table 14).

Table 14. Correlations between ITED Math 05 and cluster and composite means of the DDDM survey (N = 10).

	Correlations of Clusters with ITED Math 05						
Spearman rho	Transparency Safety	Act on data PLCsGoal	Support Alignment	Culture Beliefs	Data Systems	Assess	Composite
ITED 05	.76*	.71*	.67*	.79*	.67*	.65*	.73*

*p< .05

Senior Enrollment in Math for Graduation Years 2004 and 2005

Each of the 10 participating school principals submitted their percentage of math enrollment for each of the graduating classes of 2004 and 2005. This percentage of seniors enrolled in math with cluster and composite means for the DDDM survey were correlated using the Spearman rho statistical test. The correlation resulted in three negative correlations of clusters with the senior class of 2004 and a single negative correlation of one cluster with the senior class of 2005. When cluster 3, assessment, is correlated with the senior class math enrollment for 2005, a significant negative correlation resulted, $r(8) = -.70$, $p<.05$. Table 15 illustrates the significant negative correlations between 2004 senior math enrollment and three separate cluster means of the DDDM survey.

Table 15. Significant negative correlations between 2004 senior math enrollment and cluster means of the DDDM survey.

	Correlations of Clusters with 2004 Math Enroll						
Spearman rho	Transparency Safety	Act on data PLCsGoal	Support Alignment	Culture Beliefs	Data Systems	Assess	Composite
SR 04	-.68*			-.64*	-.65*		

*$p < .05$

Table 15 illustrates negative correlations between 2004 senior enrollment in math and the DDDM cluster means for data transparency/visibility and data safety, beliefs/culture/leadership, and data systems and technology. This negative correlation indicates that the higher the enrollment in senior math for 2004, the lower the mean scores for DDDM capacity.

ACT Math Assessment for 2004 and 2005

ACT math composite scores for each of the 10 participating schools were obtained from the building principal in each of the schools. The extreme composite scores collected were 21.0 as the low and 23.9 as the high (table 13). The number of test takers at the 10 schools varied from a low of 77 to a high of 243 in the two years, 2004 and 2005, of test data. The ACT is generally taken by college bound students. Unlike the Measured Progress math and ITED math, the ACT is not required of all students.

When a Spearman rho correlation statistical test was conducted between ACT Math for 2004 and 2005 with each of the DDDM clusters and composite mean scores, there was no significant correlation with either year of the ACT results. The Spearman rho calculations result in correlation coefficients based on the rankings of the variables.

No relationships were indicated for the rankings of ACT results in 2004 or 2005 with the DDDM cluster or composite means for each school.

SAT Math Assessment for 2004 and 2005

The 2004 SAT scores are incomplete for the 10 participating schools. Six of the principals were unable to locate composite scores for their schools. There was a modification in reporting scores from SAT for 2004, and this score reporting change caused difficulty for principals in locating their school composite. School 4 (table 13) did not report a score for 2005. The Spearman rho correlation for 2005 was conducted for only 9 of the 10 schools. The correlation resulted in one significant correlation between SAT 2005 test scores and cluster 4 data transparency/visibility and safety, $r(7)=.68$, $p<.05$.

Summary of Results

Several statistical correlations and results have been presented in relationship to the questions of this research. The analysis of the DDDM survey that was completed by teachers and building instructional leaders in mathematics provided evidence to respond to the first two research questions. The analysis also provided a knowledge base for future study of the use of technology for the purposes of DDDM. The first two research questions pertained to the current practice of Montana mathematics educators' use of technology for DDDM in regard to student results and instructional strategies. Data collected from the DDDM survey was sufficient to respond to the practices of Montana educators' capacity for the use of technology to formulate data-driven decisions and to

consider assumptions about the future, which will be presented in the final chapter of this dissertation.

The third research question required correlational statistics to be performed between the DDDM collective capacity of Montana “AA” high school math instructional personnel and student assessment indicators. The six clusters and a composite mean of the DDDM survey for each of the 10 participating schools were correlated with nine composite scores of common assessments to determine if relationships exist between the use of technology for DDDM and various student assessment indicators. The results of the correlations indicated little or no relationship exists between the student assessment results and technology use for DDDM. This apparent independence between these variables is further discussed in the conclusions of this research.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Problem and Purpose

Montana mathematics educators practice the analysis of student information and assessment results through the use of technology to some degree. The purpose of this study was two fold. First, the research was to identify the use of technology for data-driven decision-making (DDDM) by mathematics leaders in 10 Montana "AA" high school; descriptive in nature. Second, a correlational study was conducted to determine the relationship between "AA" educators use of technology for DDDM and student achievement. In other words, this study was conducted for the purpose of assessing the degree to which technology is used for DDDM in mathematics instruction among Montana "AA" high school educators. Through the utilization of a survey instrument created by University of Minnesota researcher, Scott McLeod, Montana educators were asked to respond regarding their capacity for DDDM through the use of technology. This research is the first of its kind conducted in Montana high schools, and the described and studied population was comprised of "AA" high school math instructors and building administrators. Student assessment results that are common mathematics measurements in all Montana high schools were gathered from the 10 participating schools. The assessment was used for the purpose of correlational study of student results with the DDDM capacity of educators from each of the 10 schools that participated in the study,

in order to determine if a relationship exists between the DDDM quotient of educators and student achievement.

Discovering answers to the degree to which educators use technology for DDDM and DDDM capacity of educators in relationship to student results has provided baseline data to consider further investigation into the use of technology for DDDM. The results of the research have also provided a reason to further study the potential of professional learning communities using technology tools to assist in making decisions based on the available data. There are leadership implications for knowing the perceived capacity of educator's DDDM capabilities in association with technology fluencies. There are also instructional implications for knowing the capacity of educators to utilize technology for the purpose of analyzing student results and adjusting instruction to address student needs and deficiencies. Discovering the practices of mathematics educators and building administrators provides incentive to consider the relationship of DDDM for high school educators in disciplines beyond mathematics instruction.

Methodology

The use of technology by Montana educators for the purpose of examining student results and making data-driven decisions is an assumption of this research. The study was conducted in order to assess to what degree technology is used to assist in data-driven decisions by Montana high school mathematics instructors and administrators. Scott McLeod, director of the School Technology Leadership Initiative, at the University of Minnesota, contributed significantly to this research by providing a survey instrument

for the purpose of data collection. The survey participants included math teachers and building administrators from 10 of the 13 “AA” high schools in Montana.

The survey instrument provided answers directed at the three questions that guided this research. The data collected from the research supplied information to describe the current practices of Montana educators’ use of technology to inform DDDM. This description allowed the researcher to formulate answers to questions #1 and #2 of the research, which are descriptive in nature. The survey instrument provided the researcher with a description of the DDDM capacity of Montana educators. This descriptive quotient of DDDM was utilized in the description of technology use for DDDM that was posed in questions #1 and #2 of the research. The quotient was also utilized in correlations conducted in answering question #3 of the research.

Question #3 of the research necessitated that the researcher collect student assessment data that is common to all Montana schools. Five different indicators of student performance were collected over a two-year time frame from each of the participating schools. These student assessment indicators were correlated with various individual factors and clusters of factors contained in the DDDM survey results. The research provided results of correlational statistics performed on the resulting means of educator DDDM capacity with student assessment results that are common in all Montana high schools.

Conclusions

Educators in 10 of the 13 “AA” Montana high schools participated in the research involving the use of technology for DDDM in mathematics curriculum and instruction. The researcher is the current principal at one of the “AA” Montana high schools, Billings West, and that high school was deselected from the researched population. The principals in two of the other 13 schools chose not to participate in the study. The studied population was short of the expected total but produced adequate results to address the research problem, purpose, and questions. Nonetheless, the results would have been more reliable had all of the 12 selected schools participated. As a member of the “AA” principal’s state organization, the researcher has interests for school improvement in common with each of the 12 other school principals. These common interests undoubtedly influenced the 10 principals in their decision to participate in the study. The researcher made every attempt to include all 12 of the “AA” high schools in the results, knowing that full participation would better validate any results and conclusions that have been made upon completion of this study. For those participating educators at the 10 “AA” high schools, 90% rate of return was indicated through the collection of surveys via a web surveyor and paper pencil instrument.

Technology Fluency versus DDDM Capacity

Less than 20% of the survey respondents had 0 to 3 years of experience in their current school or district. Slightly more than 80% of the survey respondents indicated having four or more years of experience in their current school or district. The survey

population experience is adequate enough to provide an accurate perception of their use of technology and DDDM capacity.

This surveyed population reported that their self-perceived technology fluency is greater than their capacity for DDDM. The researcher's assumption is that less time and emphasis has been placed on DDDM with this survey population than has the use of technology. It stands to reason that perceived technology fluency is greater than that of perceived DDDM capacity, as DDDM is a relatively new concept for educators, while the use of technology has been integrated into teaching and instruction for over the past two decades. Unfortunately, schools have not consistently practiced examining results. Schmoker (1999) claims that schools have more potential for improvement than most other organizations because schools have a history of being goal-averse and "data-phobic." Technology tools provide a platform for the examination of results so that a professional learning community of adults can collaborate to enhance student learning opportunities. Montana mathematics educators need to utilize their technology fluency more effectively to incorporate DDDM, in order to realize improved student results. Through the use of technology, educators will become better decision makers and elevate their level of DDDM capacity to match their technology fluency.

Factors within the DDDM Survey

Several factors were examined in the DDDM survey. Each factor has relevance in addressing the research questions. The factors were clustered based on positive relationships, as a result of correlational analysis with one another. The following are the clusters formed from the factors presented in the DDDM survey instrument:

1. Data Systems and Technology—Survey Section 9
2. Beliefs, Culture, and Leadership—Survey Sections 12, 15 &14
3. Assessment—Survey Sections 1-4
4. Data Transparency/Visibility and Data Safety—Survey Sections 5 & 13
5. Alignment for Results and Support for Alignment—Survey Sections 10 & 11
6. Goal Setting, Acting upon Data, and PLCs—Survey Sections 7, 6 & 8

Each of the above clustered factors has implications for answering the survey questions. Conclusions will be presented based on the analysis of each of the above clusters of factors.

Data Systems and Technology, Cluster 1

The use of data systems and technology to analyze student results is present in Montana schools by mathematics teachers and building administrators. Several software and technology systems options were given as choices for survey participants to indicate which software or systems they have used for student information analysis. Seventy-five percent of the educators surveyed responded to using at least one of the options in their choices for the analysis of student results (Table 5). An alarming indicator was that 25% of educators surveyed reported that they utilize no technology tool to conduct DDDM. That does not assume that these 25% are not involved in DDDM, but they have indicated that they do not use technology for analysis or DDDM. The collective technology fluency was reported as higher than that of DDDM capacity for Montana educators. It is concerning that 25% of all educators surveyed reported using no technology system for analysis of student results. One may conclude that mathematics instructors and building administrative leaders of mathematics instruction would be some of the most frequent implementers of the use of technology, as technology is one of the pillars of NCTM

principles for school mathematics. Technology is essential in teaching and learning mathematics; it influences the mathematics that is taught and enhances students' learning (Carpenter, Gorg, & Martin, 2000). If all mathematics teachers and building administrators were to implement some system of technology to gather, analyze, and make decisions based on student results, would their collective capacity for DDDM increase to the level of their technology fluency?

Student information systems and spreadsheet software are the most utilized data systems by Montana educators in the analysis of student results and assessment. The utilization of student information systems that are reportedly present in each of the 10 schools, accompanied by some version of spreadsheet application, appears to be the most likely vehicle for increasing the capacity for DDDM. Every educator reports that a specific student information system is present in each of the schools. Zangle, SASI, Power School, and School Master were the student information systems in place in the 10 different schools. A closer analysis as to the capability of each of these systems could lead to conclusions regarding the relationships that student information systems have for increasing capacity of DDDM in the studied schools.

From the survey of data tools utilized for the examination of student results, there is evidence that 52% (Table 5) of the educators responded to using multiple technology tools. Twenty-five percent of all educators surveyed reported using no tools for the examination of student results. This indicates that a significant number are utilizing more than one tool than none at all. The composite mean for 52% of the respondent's DDDM capacity (those that use multiple tools for the examination of student results) was equal to

3.99 (*SD* = 1.41). For those that use no technology tools for the examination of results, (25% of the respondents) the composite mean resulted in 3.61 (*SD* = 1.43). This resulting mean discrepancy indicates that those using multiple tools have a greater capacity for DDDM than those that do not use any tools. Using multiple technology tools for the purpose of gathering, storing, and analysis of student results has the potential to increase the capacity of DDDM for educators.

There was a difference reported in the access and use of technology tools for examining student results versus the opportunity for input into the design of those tools and systems. Access and use of technology tools produced a mean result of 4.05 (*SD* = 1.35) for all respondents, and the input into the design of systems was reported as 2.98 (*SD* = 1.45). This mean difference indicates that educators have a greater opportunity for access than they have an opportunity for input into the design of technology systems. The results of this research indicate that a positive correlation exists between the input for design of technology systems and the access of those systems. The higher the capacity for input into design, the greater the access of those systems is reported by the survey participants.

The opportunity to design the systems could possibly affect the use of those technology systems. For example, if educators were able to design the systems so that input and output met their specific needs for student information, they may be more likely to utilize and access technology, as the information would be tailored to their particular needs. Noyce, Perda, and Traver (2000) suggest ways to structure the utilization of data within each school for decision-making. In a data-driven school

culture, a few knowledgeable staff members along with a supportive administrative team need devise a system to collect, retrieve, and report data in order to inform decision makers. Ownership into the design, access, and analysis of data systems is critical to successful implementation of a DDDM culture. This researcher expands Noyce, Perda, and Travers' perspectives, advocating that the more staff members involved in the system design, the more likely that the use of technology for the purpose of decision-making will become ubiquitous among those educators.

Beliefs, Culture and Leadership, Cluster 2

Beliefs, culture, and leadership have tremendous influence on individual practices pertaining to the use of technology and the capacity for DDDM. Montana educators indicated a higher mean capacity for the beliefs, culture, and leadership behaviors for DDDM capacity than in any other cluster of factors. It appears that the culture and belief system is ripe for the increased propensity for the use of technology for DDDM within the ranks of mathematics instructors and building administrators in "AA" high schools in Montana. Each of the individual factors within this cluster produced a relatively higher mean than other factors throughout the survey. All factors within this cluster were similar, which indicates the tendency for Montana educators to perceive that they are in a culture that promotes the use of technology; they believe in data driven behaviors, and they have confidence in leadership to promote the use of technology for DDDM as it relates to student results and assessment.

In his book, Results, Schmoker (1999) states that systemic change requires teamwork and leadership that is present in a first-class learning organization

demonstrated throughout the school system. Consider the use of technology tools to affect curriculum and instructional change as systemic. Teamwork and leadership must be present at all levels of implementation and technology use. Each adult, from superintendent to first-year instructor, must lead and be data oriented in order for the implementation to be successfully driven by results. Montana educators indicated that they believe in the leadership present in their schools to promote and foster the growth of using technology to increase the capacity of DDDM. In considering the culture of examining results and assessment, Montana educators report that a culture is present that will encourage the use of technology to examine results in creating DDDM within the schools. Montana educators believe in a DDDM environment. Using technology tools to assist in the DDDM climate will enhance DDDM capacity. This cluster of factors provides hope for an increased reliance on DDDM through the use of technology in Montana schools, and in particular in the examined population of "AA" mathematics instructors and building administrators.

Assessment, Cluster 3, and Data Transparency/Visibility and Data Safety, Cluster 4

A composite mean assessment, cluster 3, indicated a neutral response from educators in considering assessment as a factor of their capacity for DDDM. On average, the respondents neither agreed nor disagreed with the utilization of assessment in considering DDDM capacity. Four different types of assessment were presented to educators in the survey considering the following:

1. Will the use of assessment data result in adequate details to inform teacher instruction?

2. Does the use of assessment data provide schools with needed information to improve learning gaps?
3. Will the use of assessment data allow teachers to make changes based on results?
4. Do educators have adequate training to interpret and act upon assessment data?

In the overall rating of this assessment category, Montana math instructors and building administrators were on average neutral in their response resulting in a mean of 3.50 (*SD* = 1.37).

One category of assessment that produced a more than neutral response (*M* = 4.05, *SD* = 1.34) was the category associated with teacher-created periodic assessments often referred to as formative assessment. This is a promising result, as the literature indicates that assessment should be ongoing, frequent, and continuous in order to make effective changes in student performance. Only 62% of the educators responded to this category of assessment. Hickey (2002) concluded that frequent assessment throughout each school year more accurately indicates student understanding of Montana mathematics standards. Data from frequent checks for understanding can be stored, examined, and aggregated through the use of technology.

If a greater percentage of educators than the 62% who responded to utilizing teacher-created periodic assessment would utilize technology frequently for analysis of the periodic teacher-created assessments, Montana schools may potentially realize improved results associated with student performance. It is encouraging that those 62% reporting using the teacher-created periodic assessment also report that those assessments are more likely to 1) result in adequate details to inform teacher instruction, 2) provide teachers with needed information to improve learning gaps, and 3) allow teachers to

make changes based on results. A greater confidence is apparent in the teacher-created assessment over the other various assessments (state yearly, other yearly, and other periodic) in the response of mathematics educators and building administrators in the 10 studied Montana "AA" high schools.

Cluster 4, data transparency/visibility and data safety, which is closely related to cluster 3, assessment, received a similar neutral response by educators. The mean of cluster 4, 3.51 (*SD* = 1.49), was almost identical to the mean in cluster 3, 3.50 (*SD* = 1.37). Data transparency/visibility refers to the availability, publicity, and general knowledge of the information that relates to student performance data to all of the school stakeholders, school personnel, students, parents, and the general public. Do all of the stakeholders have a working knowledge of the student assessment data that is analyzed through the use of technology? There is a perception among the survey participants that not all stakeholders are exposed to and/or have a firm understanding of the available assessment information. For example, the survey item that addressed educator perceptions of the public knowledge of how adequate yearly progress (AYP) is tied to assessment scores resulted in a relatively low mean response of 2.44 (*SD* = 1.32) on this section of the survey. This indicates that educator's confidence in public understanding of AYP is not strong, or at very least questionable in the eyes of the surveyed population.

In addition to the transparency/visibility of student information, cluster 4 measures educators' perceptions regarding the safety of the environment in which the examination of data and results takes place. Are educators safe in exposing the performance information, or are they scrutinized for less than adequate results produced

from assessment information? Survey respondents, from the 10 participating schools, on average report a relatively safe, non-threatening environment for the discussion of results. This is an indicator that discussions of assessment results will continue to be viewed as safe for educators; they will reveal less than adequate or below proficient performance indicators without fear. Student performance indicators generally are not perceived to be used as evaluative of individual educators.

Alignment for Results and Support for Alignment, Cluster 5

Alignment for results inquires of educator's perceptions of the alignment of professional development activities with improvement efforts that focus on student achievement data. Support for alignment considers the effect of state standards, school and district support of teachers' use of data to improve instruction, and support for implementing district improvement initiatives. On average, educators reported that they tend to agree that professional development is aligned with the examination of student results and that there is support for that alignment. This response is encouraging, as the focus of school and district math instructional initiatives for school improvement tend to align with an analysis of student results. Curriculum standards are apparently the guiding force behind the analysis of data and decisions made about professional development and school improvement initiatives.

The extent to which DDDM is encouraged and supported in the future will rely on the attention given to curriculum standards and how students are demonstrating proficiency of those standards. In his book entitled Results, Schmoker states, "You cannot fight what you cannot see" (1999, p. 44). In terms of education, Schmoker means

that teachers and educational leaders must analyze and interpret data accurately in order to understand what instructional changes will combat student deficiencies. This researcher contends that, through the use of technology, school leaders and teachers will better "see" what student assessment data presents, and in consequence, will be able to change instruction to improve student achievement. Aligning staff development and school improvement initiatives to student achievement results is a critical step in addressing deficiencies in student learning. Montana "AA" math educators and administrators surveyed agree that alignment of school improvement and support of that alignment with technology assistance through DDDM is occurring in their schools and districts.

Goal Setting, Acting Upon Data, and PLC's, Cluster 6

Surveyed educators agree that student achievement data is utilized to formulate goals and to implement actions that address goals for school improvement. There is a tendency for educators to work in isolation while using data for goal setting and implementing actions to address those goals. Educators do not feel that those goals and actions are necessarily the result of teachers collaborating in teacher teams or professional learning communities. Their response to the formation and actions of PLC's is opposite to their perspective of using data for goal setting and the implementation of action plans. The Montana educators surveyed disagree that teachers are taking the following actions: 1) meeting at least 4 to 6 times per year with other teachers to look at student data and devise instructional strategies and interventions, 2) when teachers have professional meetings, their discussions focus on student learning outcomes and results

rather than on procedural, political, or social matters, 3) teachers are given adequate time for collaborative planning, and 4) teachers have sustained conversations about teaching practices.

The reluctance or lack of opportunity to formulate decisions within teacher teams or PLC's potentially will have adverse effects on the ability of Montana educators to fully appreciate DDDM capacity. Sergiovanni (2000) believes that in successful, results-driven schools, adults experience personal responsibility for the work and are personally responsible for the outcomes. Understanding a sense of ownership, meaningful existence in the professional work place does not occur in isolation. Adults must experience collaboration, collegiality, and a sense of belonging to the community to truly feel connected as learners and determiners of destiny. Creating this connection is a challenge. Montana educators must be committed to the time and energy that forming professional learning communities will require.

When surveyed educators were asked about whether or not teachers are given adequate time for collaborative planning, they responded on average with disagreement. This item produced the lowest mean score not only for the section addressing PLC's but for the entire DDDM survey instrument. This relatively low mean score for the instrument is worthy of consideration as to the perceptions and priorities of educators. Assumptions regarding time can be made based on reality, priorities, and/or what has been traditionally practiced in the comprehensive departmentalized high school. Regardless of the reasoning contributing to educators' perceptions that time is not available for collaborative planning, the reality is that educators' perceptions indicate that

the amount of time for collaborating is less than adequate. Overcoming this time obstacle is fundamental to establishing authentic PLC's in the high school setting.

Mean Differences between Teachers and Administrators throughout the Survey

In every cluster of factors created in the research, administrative response produced a higher mean score than teacher response. Granted there were almost three times the number of teachers (n = 90) responding to the survey as administrators (n = 35), but nonetheless, every cluster produced a mean by administrators greater than the mean by teachers. The means varied from .50 point greater to 1.15 points greater in the six clusters designed in this study. There are a number of assumptions that could be made about this apparent difference in perceptions between teachers and administrators, including but not limited to the following:

1. Administrators more frequently utilize technology for DDDM.
2. Administrators see the use of technology and DDDM through rose colored glasses.
3. Teachers do not have access to the data that administrators have readily accessible.
4. Technology systems available for administrators to exercise DDDM are not available for the classroom teachers to exercise DDDM.
5. Less time is available for teachers to implement DDDM on a daily basis than for administrators.
6. DDDM is less a priority or a developed habit of teachers.
7. Administrators have a different sense of reality when considering the day-to-day responsibilities and practices of teachers.
8. What administrators perceive as general practice of teachers for DDDM is more than what is the reality.
9. The daily practices of administrators cause them to think differently about DDDM than do teachers.

The above assumptions regarding the consistent mean difference will require further investigation as to why the difference exists. Because of the newly implemented

NCLB law, is there a sense of urgency among administrators that has resulted in a more intense DDDM attitude than teachers over the past five years? There are potentially as many assumptions about this mean difference as there are educators in "AA" high schools in Montana. It can be argued that this difference is only perceptual and nothing more, but this perception difference is real. Data aware leaders will adjust for the difference so that the dichotomy in thinking does not become a barrier for school improvement.

School Ranking of DDDM Cluster Means Correlated with Composite Achievement Results

Statistical tests using the Spearman rho ranked correlation were conducted between each cluster and the composite mean of the DDDM survey and each year of five assessment results were collected from the individual schools. The five assessment results included: 1) grade 10 Measured Progress math results for 2004 and 2005, 2) grade 11 ITED total math results for 2004 and 2005, 3) percentage of grade 12 students enrolled in a fourth year of mathematics for the graduating years 2004 and 2005, 4) ACT math scores for 2004 and 2005, and 5) SAT math scores for 2004 and 2005. The schools were ranked based on mean results of the DDDM survey, and those means were correlated with the composite results of reported math assessment in that school for the 2004 and 2005 school years.

The research revealed very few large correlations between DDDM capacity and student assessment results. Had there been consistent moderate to strong positive relationships discovered, there may have been reason to further investigate the cause and effect of those relationships. The only student assessment result that correlated positively

with each cluster and the composite of the DDDM diagnostic was the ITED math scores for 2005. The correlation was large and indicated a positive relationship (Table 14).

The researcher's hypothesis that more positive relationships between the use of technology for DDDM and student achievement results would be discovered was not realized. It raises questions about the use of technology for DDDM and whether or not the use of information systems for DDDM has any relationship with student results, and if it does not, why not? Consideration for the rejection of the hypothesis has implications for future practice and study of the use of technology for DDDM. Rationale for the rejection of the researcher's hypothesis is listed:

- Correlations between technology use for DDDM and the math portion of the 2005 ITED did reveal strong relationships with each cluster. This appears to be a relationship by chance but could be a possibility for the consideration of cause and effect.

- The measures of student achievement selected for this research were broad, distant, and not specific enough to be connected to the DDDM capacities of Montana mathematics instructors.

- Specific criterion assessment could be used as an indicator of relationship with DDDM. Frequent teacher created assessments were reported by educators as the most useful and informative to instruction. Correlational research chould be conducted on the relationship between the use of technology for DDDM and teacher created formative exams.

- Montana mathematics decision makers in the 10 examined schools are not different enough from one another to determine a relationship to student results. DDDM capacities from one school to the next are not different enough to realize a change in student results.

- Montana mathematics decision makers are neutral in exercising the use of technology for DDDM and therefore no significant relationship can be determined with student achievement data.

Response to the Research Questions

Question #1—To what extent do educators use technology to improve student learning in mathematics?

"AA" Montana mathematics teachers and building administrators are using technology for DDDM in order to improve student learning on a limited basis. When inquiring about the use of data systems in the analysis of student results, 25% of the educators reported using no systems for analysis. This fact alone reveals that although the majority of educators reported using technology systems, far too many are not using them at all, and those that are appear not to be using them consistently and with any sort of regularity. From the results of the survey, there is not significant use of data systems for the purpose of improving student results. Teacher perception of technology use for DDDM is reported as less than that of administrator perception of technology use for DDDM. Those educators reporting the use of multiple data tools for analysis of student results report a higher degree of technology use for DDDM than those reporting no use of data tools. This tendency reveals that those who use multiple tools realize a greater confidence in their technological DDDM capacity. This researcher believes that the extent to which Montana educators are using technology to improve student learning in mathematics is less than adequate to realize an effect on student results.

Question #2—Do educators use technology to formulate data-driven decisions related to instruction and student achievement?

Student results frequently are the byproduct of assessment instruments. As teachers and administrators responded to the use of assessment instruments, their

confidence in the results produced from these instruments was neutral. The only encouraging portion of the assessment cluster indicated that teacher-created periodic assessment instruments were reliable enough to adjust curriculum and delivery in order to improve student outcomes. The discouraging fact is that only 62% of the educators responded to utilizing this type of assessment. Educators reported an overall neutral response to the use of assessment results in addressing instructional change and improving student achievement. Therefore, the researcher concludes that technology is being used more as a function of collection and storage of information rather than in analysis and decision-making.

One of the most encouraging results was that educators reported a relatively strong belief system, cultural acceptance, and the existence of leadership that engenders the use of technology for DDDM. There appears to be a central core of beliefs that using DDDM and technology will enhance the opportunities for improved learning and student achievement. Montana educators, although not necessarily practicing the use of technology for DDDM, do believe that it should be practiced and that the culture is accepting of the practices of DDDM.

Educators reported a significant gap in their perceived DDDM capacity as opposed to their perceived technology fluency. Educators rated themselves higher from person-to-person in their technology fluency as compared to their DDDM capacity. High school math educators and building administrators in Montana have more confidence in their technology fluency than in their DDDM capacity. With time and staff development focused on DDDM through the use of technology, educators will become more confident

and capable of making data-based decisions about their instructional practice for the sake of their students' learning.

Educators reported the time for planning and collaborating with colleagues is inadequate. The lowest mean response of all 71 items on the survey appeared in response to having time for collaborative planning with other teachers. The formation of authentic professional learning communities primarily in response to a function of time is not occurring in "AA" Montana high schools. This lack of time phenomenon must be overcome in order to form a culture and environment of collegial learning. Educators reported engaging in goal setting and acting upon data, but these behaviors are being accomplished in isolation. Teachers working in teams have the potential to realize greater collective capacity for DDDM and influence on student results. Using technology for DDDM in teacher teams creates a greater likelihood for the achievement of goals, as interventions become focused for all, and thus goals become more attainable.

Question #3—What relationship exists between data-driven decision-making and student achievement in mathematics?

This research produced little evidence that a positive relationship exists between DDDM and student achievement in mathematics. The correlational statistics conducted between the ranked scores of DDDM by school and student mathematics achievement results by school produced few positive correlations. One student achievement measure, the ITED for 2005, resulted in a positive correlation for each of the six clusters of factors considering DDDM capacity of schools. In every cluster and the composite of DDDM for schools, the ITED mathematics achievement test for 2005 produced a strong positive

correlation. On the other hand the results of the same correlational tests produced no correlation between the 2004 ITED and the six DDDM clusters or the composite.

When only one of the ten measures of student performance produced a positive relationship, this is evidence that the relationship was a chance occurrence, thus the presence of a "null hypothesis." The results of the correlational research in this study produce little or no consistent evidence that relationships exist between the use of technology for DDDM and student achievement outcomes. Students in Montana are producing acceptable achievement results despite the DDDM capacities of high school mathematics instructors and building administrators. This absence of an evident relationship between DDDM and student results does not indicate that educators, instructional leaders, and the stakeholders in the schools should ignore the potential effects of increased DDDM capacity.

The absence of a relationship between technology use for DDDM capacities and student achievement results could perhaps indicate that DDDM does not influence achievement. The absence of the relationship may be a result of DDDM not being practiced by any school more than the next in order to affect student outcomes. The use of technology for DDDM may be totally unrelated to student outcomes. Other factors may have a greater influence on student learning and achievement. Utilizing technology for DDDM has the potential to uncover and assist in the analysis of those other factors. Teachers, administrators, and other stakeholders should be cautious of ignoring the use of technology for DDDM based on the lack of correlational evidence produced from this study. There are further implications to be consider from the results of this study.

Implications of the Findings

This research has raised several questions about the relationship of using technology for DDDM and the effect the various DDDM educator capacities have on student achievement. There are questions to ponder about the practical applications of the reported findings considering the limitations of this study. The following questions surfaced from this study and give reason to further investigate the use of technology for DDDM:

- Did this study serve the purpose to consider conducting further, more global advancements and sophistication in the study of technology for DDDM?
- Is there a cause and effect relationship between student assessment results and DDDM processes and capacities; possibly considering formative assessment practices?
- How are other subjects in the high school outside of mathematics affected?
- Is this study worthy of K-12 consideration, as opposed to the isolated study of high school mathematics decision makers?
- How does this study, a first of its kind, impact Montana mathematics decision makers and affect similar future studies?
- What are the implications of this study of Montana educators on the comprehensive study of 11,000 Minnesota educators that is being conducted by Scott McLeod through the University of Minnesota's School Technology Leadership Initiative (STLI)?
- Is examining the use of technology for DDDM worthy of continued study?

These questions and others will be the focus of implications of this study and future research potential.

Practical Outcomes of the Study

This study is the first of its kind to consider Montana educators' technology use for the purposes of DDDM and the relationship to student outcomes. This first time study, which incorporated the use of a data-collection instrument that is being used in a state-wide research of Minnesota educators, provides baseline information for future studies. This study provides foundational data and has also caused a segment of Montana educators to self-evaluate their own use of technology for DDDM practices within their school and district. The study results shared with educators in the participating schools has undoubtedly increased the DDDM collective consciousness of participating educators. Contribution to the study will cause educators to self-reflect and consider habits. This provides a foundation for addressing increased use of technology for DDDM for all Montana educators.

The findings from this study will be shared with the director, Scott McLeod, of the University of Minnesota's STLI. Dr. McLeod has requested a final draft of this dissertation (personal communication, December 30, 2005). Dr. McLeod intends to compare responses from the Montana study for the purpose of validating survey items and to conduct mean analysis of responses with the Minnesota results. A factor analysis will be conducted within the framework of the Minnesota research in which 11,000 Minnesota educators are invited to respond. The Montana research results, small in comparison, will have implications for the Minnesota findings. Through these comparisons and statistical analysis, each study will become more meaningful.

Mean differences between teachers and administrators are apparent in the responses throughout the results. This difference in perspective, either the stark reality of differences between teachers and administrators or only relative to the respective job factors, has practical implications for leadership. This difference could potentially become a barrier for school change. School leadership and instructional personnel should take proactive steps to overcome these differences in order to facilitate progress. These gaps in perspective could be insurmountable for educators in future opportunities to exercise increased technology use for DDDM. If not recognized and dealt with appropriately these incongruent means will prohibit us from meaningful connections between administrators and teachers. These are practical concerns for the future use of technology for DDDM in Montana "AA" high schools, not to mention the implications for the effect of school leadership on school improvement.

This study examined the importance of technology use for DDDM and school improvement. There appears to be reliance upon technology for the analysis of student information by most "AA" Montana math instructors and building administrators. Seventy-five percent of the educators surveyed are using some type of technology system or data base to examine student information. Technology utilization for DDDM is increasing and will continue, if educators realize a connection of DDDM to student outcomes. This research fell short of making any substantial connection, proof of relationship between technology use for DDDM and student results, but did establish potential possibilities for connections.

Impact on Future Studies

The data and conclusions drawn from this study will be useful in future studies, as this is the first of its kind conducted in Montana. The analysis of technology use and the impact on DDDM requires continued study, most importantly, for the impact on student performance. The use of technology for DDDM may have the potential to improve student performance. This study did not establish that those schools having a higher capacity for DDDM realized better student achievement results. There is more to study about the use of data than what this study failed to establish in a relationship between student results and technology use for DDDM. This study provides baseline data for further analysis and study of technology use and DDDM capacities of educators.

The difference illustrated in mean responses between teachers and building administrators is apparent. How much the mathematical difference represents is a critical question for future studies of technology and DDDM. Is this difference significant enough that the difference is actually an obstacle of improving schools, and more importantly, improving student results? No matter what the impact on student results, there appears to be a division in thinking between teachers and administrators pertaining to the use of technology for DDDM.

Limitations of this Study

Through the contributions of the director, Scott McLeod, of the University of Minnesota's STLI, a survey instrument assessing educator's technology use through gathering perceptions of DDDM capacities was employed to survey Montana math teachers and building administrators. McLeod's instrument will be disseminated to

11,000 educators across the state of Minnesota. His research will secure more data and be more comprehensive than what was conducted in this study. The Minnesota study will include a factor analysis of the various factors that comprise the survey instrument. The Montana project results and conclusions will be shared with Minnesota's STLI, and results will be compared. Without the factor analysis, results, and conclusions available from the Minnesota research, the Montana study has no previous information to compare and substantiate conclusions. At completion of the Minnesota study, the Montana collection of data may produce more credible conclusions.

As educators continue to study student information and analyze how to change practices, adjust curriculum, and alter instructional strategies, educators will benefit from the frequent practice of using technology for DDDM. In order to meet the requirements of the NCLB law, educators are mandated to use empirical evidence to implement changes in instructional practice to meet student needs. This study of using technology for DDDM has implications for continued study of schools and districts. If the instrument used in this research and the Minnesota study validates potential best practice for the use of technology in DDDM that result in a positive impact on learner outcomes, this study then would assist other schools and districts in the implementation of using technology for DDDM practices. This initial research, although conducted with known limitations, could have lasting impacts on future study of educators' technology fluencies and DDDM capacities. In order to meet the requirements of NCLB that mandate the use of researched based evidence, educators are obligated to be data-driven decision makers.

This study did not produce any significant evidence that using technology for DDDM results in positive relationships with student achievement. Using technology and implementing DDDM behaviors is certainly not limited to high school math instructors and building administrators. The fact that this study was limited to Montana "AA" math instructors and building administrators could be a reason for not producing multiple positive relationships with achievement. The measures of student achievement were broad composite strokes of a total school performance. The hypothetical claim stated that there is a relationship between technology use for DDDM and student results. It could be that the studied population of educators was too limited and should have included an entire system K-12, like in the Minnesota project. A full complement of participants from the 12 selected schools populations could also have produced more positive relationships between technology use for DDDM and student achievement.

Are the results of this study generalizable to other subjects and or grade levels? The Minnesota study across subjects and grade levels may reveal additional information about generalizing statements pertaining to the results. This study was limited to mathematics educators and common student mathematics assessments in Montana "AA" high schools. There is a question of certainty, but the results of this study may be generalizable to other disciplines, grade levels, or for that matter smaller sized Montana high school settings. To be certain, further examination of educators' habits pertaining to technology use for DDDM in smaller sized Montana high schools will provide for a more comprehensive response to the questions posed in this research. The inclusion of educators in all high school disciplines, as well as K-8 educators, would establish norms

for Montana educators' technology use that could be analyzed in comparison to Minnesota educators in the McLeod study. This close scrutiny and examination of Montana educators would raise the collective conscience of all Montana educators regarding the current practice of using technology for DDDM.

Summary

This research indicates that "AA" Montana high school mathematics educators and building administrators have formulated a belief system that advocates using technology for DDDM in school improvement efforts. These educators also indicate that the culture fosters an environment that relies on data for decision-making and that leadership supports and models the use of technology for DDDM concepts. Educators in Montana are ready for a systemic change that becomes more reliant on results driven reform. Leadership will influence or inhibit the reform. Montana "AA" educators believe that leadership is capable of fostering the use of technology for reform efforts.

Historically, Montana educators have been less than data-driven and have not necessarily utilized technology to assist in collection, storage, and analysis of information. Overwhelmingly, the educators examined in this research reported that inadequate time is provided for collaborative planning and the examination of results with colleagues. Increased systemic use of data systems technology will provide more availability of results. Increased time for collaboration will follow, as educators increasingly rely on information for their decision-making. School leadership must allow time for collaboration and the formation of teacher teams. A supportive belief system and

a nurturing culture that is ready for increased DDDM are encouraging signs for Montana education.

Considering the confidence that leadership is given by the studied population in this research, the difference in perceptions of teachers and building administrators must not be dismissed. Cognizant, thoughtful leadership must be prepared to address and adjust to this perceptual difference in attitudes toward using technology for DDDM. The awareness that teachers and building administrators differ slightly in their views for the use of technology and capacity for DDDM will assist both educators and administrators in not allowing this difference to hinder progress and improvement efforts. Increasing capacity for DDDM is essential for the improvement efforts of educators. Adequate time, as well as ready access to data through the use of data systems technology, is necessary to increase DDDM capacity of Montana "AA" mathematics educators and building administrators. Providing time and data accessibility through the use of technology will most likely narrow the perceived differences between teachers and administrators producing cohesive reform that is devoted to improving each and every student's education.

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APPENDICES

APPENDIX A

DATA-DRIVEN DECISION-MAKING DIAGNOSTIC

TEACHER SURVEY

Data-driven Decision Making Demographics Section

High school you are representing in completing this survey_____.

Your position in your building is
_____Building principal, associate or assistant
_____High school math instructor

1. How long have you held your position in your school or district?
   _____Less than one year
   _____One to three years
   _____Four to 15 years
   _____More than 15 years

2. If you have held a similar position in another district, for how many years did you hold this role in another district?
   _____Years

3. What software is used in your school as your student information system? Please indicate your system, e.g. (Schoolware, PowerSchool, eSchool, SASSI, Zangle,) _____.

4. Please rate your own technology fluency.
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced

5. Please rate your personal capacity for Data-Driven Decision Making (DDDM).
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced

The remaining survey questions use the following scale.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Please circle the response that best fits you and your school for the remainder of the survey questions.

Teacher Survey

Section 1 Yearly State Assessment

I receive state assessment results in my subject area each year. IF NO, SKIP TO NEXT SECTION.

1. I have adequate time to review and interpret yearly state assessment results.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

2. State assessment results are <u>detailed</u> enough to adequately inform my instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

3. Yearly state assessment results provide me with the information I need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

4. I make changes in my instruction based on yearly state assessment results.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

5. I have received adequate training to effectively interpret and act upon yearly state assessment results.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 2 Other Yearly Assessments

I receive other yearly assessment results (e.g., Terranova, ITBS, ITED) in my subject area each year. IF NO, SKIP TO NEXT SECTION.

6. I have adequate time to review and interpret results from these other yearly assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

7. Results from these other yearly assessments are <u>detailed</u> enough to adequately inform my instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

8. Results from these other yearly assessments provide me with the information I need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

9. I make changes in my instruction based on results from these other yearly assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

10. I have received adequate training to effectively interpret and act upon results from these other yearly assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 3 Common Periodic Assessment

I collaborate with other teachers to create and use common periodic assessments for ongoing progress monitoring of student learning. IF NO, SKIP TO NEXT SECTION.

11. I have adequate time to review and interpret results from these common assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

12. Results from these common assessments are <u>detailed</u> enough to adequately inform my instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

13. Results from these common assessments provide me with the information I need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

14. I make changes in my instruction based on results from these common assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

15. I have received adequate training to effectively interpret and act upon results from these common assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 4 Other Periodic Assessments

I use other (i.e., not teacher-created) periodic assessments (e.g., Scantron, STAR, DIBELS, CBM) for ongoing progress monitoring of student learning. IF NO, SKIP TO NEXT SECTION.

16. Results from these other periodic assessments are detailed enough to adequately inform my instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

17. Results from these other periodic assessments provide me with the information I need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

18. I make changes in my instruction based on results from these other periodic assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

19. I have received adequate training to effectively interpret and act upon results from these other periodic assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 5 Data Visibility & Transparency

20. Teachers and parents communicate frequently about student performance data.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

21. When distributed, data and reports are tailored to meet the needs of the particular audience.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

22. Parents and community members understand how our school's adequate yearly progress (AYP) status is tied to assessment scores.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

23. My school uses data to celebrate organizational and instructional progress and successes.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

24. A climate of data visibility and transparency is present in my school.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 6 Acting Upon Data

25. I use assessment data to identify subgroups of students who are not experiencing academic success.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

26. I use assessment data to identify individual students who are not experiencing academic success.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

27. In this school I am encouraged to try out new teaching strategies.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

28. Student achievement in my school is improving significantly as a result of data-driven practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 7 Goal Setting

29. Our school improvement goals are clear, specific, measurable, and based on student data.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

30. I use data from yearly student assessments to set instructional targets and goals.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

31. I use data from periodic student assessments to set instructional targets and goals.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 8 Teacher Teams

32. I meet at least 4 to 6 times a year with a small team of other teachers to look at student data and devise instructional strategies and interventions.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

33. When I have professional meetings with other teachers, our discussions focus on student learning outcomes and results rather than on procedural, political, or social matters.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

34. Teachers are given adequate time for collaborative planning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

35. Teachers in our school have sustained conversations about teaching practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 9 Data Systems and Technology

36. Which of these types of technology systems do you use to collect and/or analyze student performance data? (check all that apply)

_____1. Data warehouse solution purchased from a vendor
_____2. Data warehouse solution developed by the district
_____3. Student information system
_____4. Relational database software (e.g., Access, FileMaker Pro)
_____5. Spreadsheet software (e.g., Excel)
_____6. Software to facilitate classroom assessment
_____7. Other
_____8. I don't use any of these systems

37. Teachers have input into school and district data management and analysis strategies.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

38. Teachers have input into the data elements that are captured in school and district data systems.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

39. Teachers have input into the reports that are created by school and district data systems.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

40. I can access the information I need from school and district data systems to examine relationships that impact student learning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

41. I understand how using data management technologies can improve student learning outcomes.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

42. I know how to use spreadsheets and/or other technology tools to collect and analyze student data for progress monitoring during the year.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

43. Our school has the technology systems it needs to utilize data for school improvement.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 10 Alignment

44. Student achievement data are used to inform school and district improvement initiatives.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

45. Staff development usually focuses on student learning and teaching techniques.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

46. Staff development initiatives are designed to build educators' collective (rather than individual) capacity to achieve their goals through job-embedded learning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

47. My professional development has helped me use data more effectively.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

48. School and classroom improvement efforts are aligned with <u>content-specific instructional best practices.</u>

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 11 Support

49. My school adequately supports teachers' use of data to improve classroom instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

50. Our school receives adequate support for implementing district improvement initiatives.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

51. State standards result in better schools and increased learning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 12 Beliefs

52. I have a solid conceptual understanding of data-driven decision-making principles and practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

53. I am a valued member of my school's data-driven reform efforts.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

54. If we constantly analyze what we do and adjust to get better, we will improve.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

55. Data-driven educational practices can improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

56. Using data has improved the quality of decision-making in my school.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

57. Most teachers in my school are working as hard as they can to meet high educational standards.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

58. Persistently low-performing schools need outside intervention to improve,

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 13 Data Safety

59. As a school we have open and honest discussions about data.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

60. There is a strong sense of trust among teachers and administrators in our school.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

61. Classroom data is used for teacher feedback and information, not for teacher evaluation and/or job-related sanctions.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 14 Leadership

62. Our school has a shared vision for success that is based on student achievement and growth.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

63. Our school uses data to determine if we are achieving our vision.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

64. Our district provides a clear and consistent message that ongoing formative assessment of student performance is a primary expectation of teachers.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

65. Leaders in our schools use data to convince people of the need for change.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

66. Administrators effectively model data-driven educational practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 15 Culture

67. Our school culture emphasizes continuous improvement.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

68. Most teachers in the school routinely use data to inform their instructional practices and understand student needs.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

69. Our school uses data to uncover problems that might otherwise remain hidden.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

70. In our school, problems are viewed as issues to be solved, not as barriers to action.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

71. There is a systematic reliance on hard data as a basis for decision-making at both the classroom and school levels.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Thank you for your contribution to new knowledge.

DDDM Mean results for Teachers

Demographics Information

Data-driven Decision Making Demographics Section

High school you are representing in completing this survey___One of 10 High schools participating in the research___.

Your position in your building is
_____Building principal, associate or assistant
__90___High school math instructor

1. How long have you held your position in your school or district?
   __9___Less than one year
   __7___One to three years
   __38___Four to 15 years
   __36___More than 15 years

2. If you have held a similar position in another district, for how many years did you hold this role in another district?
   _____Years

3. What software is used in your school as your student information system? Please indicate your system, e.g. (Schoolware, PowerSchool, eSchool, SASSI, Zangle,) __ 4 responses were given_Zangle, SASI, PowerSchool, and School Master_.

4. Please rate your own technology fluency.
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced
   Mean = 2.73

5. Please rate your personal capacity for Data-Driven Decision Making (DDDM).
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced
   Mean = 2.09

Teacher Survey Mean Results

Section 1 Yearly State Assessment
I receive state assessment results in my subject area each year. IF NO, SKIP TO NEXT SECTION

1) 3.22	2) 3.42	3) 3.27	4) 3.54	5) 3.03
			Section	3.29

Section 2 Other Yearly Assessments
I receive other yearly assessment results (e.g., Terranova, ITBS, ITED) in my subject area each year. IF NO, SKIP TO NEXT SECTION.

6) 2.71	7) 2.90	8) 2.75	9) 3.17	10) 2.90
			Section	2.89

Section 3 Common Periodic Assessment
I collaborate with other teachers to create and use common periodic assessments for ongoing progress monitoring of student learning. IF NO, SKIP TO NEXT SECTION.

11) 3.39	12) 4.02	13) 4.06	14) 4.30	15) 3.67
			Section	3.89

Section 4 Other Periodic Assessments
I use other (i.e., not teacher-created) periodic assessments (e.g., Scantron, STAR, DIBELS, CBM) for ongoing progress monitoring of student learning. IF NO, SKIP TO NEXT SECTION.

	16) 3.91	17) 4.00	18) 4.18	19) 3.45
			Section	3.87

Section 5 Data Visibility & Transparency

20) 2.68	21) 2.87	22) 2.14	23) 3.12	24) 3.22
			Section	2.81

Section 6 Acting Upon Data

25) 3.60	26) 4.20	27) 4.86	28) 3.29
		Section	3.99

Section 7 Goal Setting

29) 4.26	30) 3.70	31) 4.07
	Section	4.01

Section 8 Teacher Teams

32) 2.70	33) 3.81	34) 1.96	35) 3.38
		Section	2.96

Section 9 Data Systems and Technology

36. Which of these types of technology systems do you use to collect and/or analyze student performance data? (check all that apply)

	1.	2.	3.	4.	5.	6.	7.	8.
No	70	72	66	84	64	73	78	65
Yes	20	18	24	6	26	17	12	25

37) 2.51	38) 2.52	39) 2.50	40) 3.17	41) 3.92	42) 4.27	43) 3.99
	Design	2.51			Access	3.83
					Section	3.27

Section 10 Alignment

44) 3.80	45) 3.93	46) 3.66	47) 3.39	48) 3.48
			Section	3.65

Section 11 Support

49) 3.86	50) 3.24	51) 3.72
	Section	3.61

Section 12 Beliefs

52) 3.70	53) 2.83	54) 4.85	55) 4.40	56) 3.61	57) 4.97	58) 3.70
					Section	4.01

Section 13 Data Safety

59) 4.04	60) 3.83	61) 4.15
	Section	4.01

Section 14 Leadership

62) 4.52	63) 4.43	64) 4.04	65) 4.04	66) 3.55
			Section	4.12

Section 15 Culture

67) 4.54	68) 3.85	69) 3.90	70) 4.47	71) 3.73
			Section	4.10

APPENDIX B

DATA-DRIVEN DECISION-MAKING DIAGNOSTIC

ADMINISTRATOR SURVEY

Data-driven Decision Making Demographics Section

High school you are representing in completing this survey_____.

Your position in your building is
_____Building principal, associate or assistant
_____High school math instructor

1. How long have you held your position in your school or district?
   _____Less than one year
   _____One to three years
   _____Four to 15 years
   _____More than 15 years

2. If you have held a similar position in another district, for how many years did you hold this role in another district?
   _____Years

3. What software is used in your school as your student information system? Please indicate your system, e.g. (Schoolware, PowerSchool, eSchool, SASSI, Zangle,) _____.

4. Please rate your own technology fluency.
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced

5. Please rate your personal capacity for Data-Driven Decision Making (DDDM).
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced

The remaining survey questions use the following scale.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Please circle the response that best fits you and your school for the remainder of the survey questions.

Administrator Survey

Section 1 Yearly State Assessment

1. State assessment results are detailed enough to adequately inform teachers' instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

2. Yearly state assessment results provide schools with the information they need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

3. Teachers make changes in their instruction based on yearly state assessment results.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

4. I have received adequate training to effectively interpret and act upon yearly state assessment results.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 2 Other Yearly Assessments

My school uses other yearly assessments (e.g., Terranova, ITBS, ITED) besides those from the state. IF NO, SKIP TO NEXT SECTION.

5. Results from these other yearly assessments are detailed enough to adequately inform teachers' instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

6. Results from these other yearly assessments provide schools with the information they need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

7. Teachers make changes in their instruction based on results from these other yearly assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

8. I have received adequate training to effectively interpret and act upon results from these other yearly assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 3 Common Periodic Assessment

Teachers in my school create and use common periodic assessments for ongoing progress and monitoring of student learning. IF NO, SKIP TO NEXT SECTION

9. Results from these common assessments are detailed enough to adequately inform teachers' instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

10. Results from these common assessments provide schools with the information they need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

11. Teachers make changes in their instruction based on results from these common assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

12. I have received adequate training to effectively <u>interpret and act upon results</u> from these common assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 4 Other Periodic Assessments

Our teachers use other (i.e., not teacher-created) periodic assessments (e.g., Scantron, STAR, DIBELS, CBM) for ongoing progress monitoring of student learning. IF NO, SKIP TO NEXT SECTION.

13. Results from these other periodic assessments are detailed enough to adequately inform teachers' instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

14. Results from these other periodic assessments provide schools with the information they need to improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

15. Teachers make changes in their instruction based on results from these other periodic assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

16. I have received adequate training to effectively interpret and act upon results from these other periodic assessments.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 5 Data Visibility & Transparency

17. Teachers and parents communicate frequently about student performance data.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

18. When distributed, data and reports are tailored to meet the needs of the particular audience.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

19. Parents and community members understand how our school's adequate yearly progress (AYP) status is tied to assessment scores.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

20. My school uses data to celebrate organizational and instructional progress and successes.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

21. A climate of data visibility and transparency is present in my school.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 6 Acting Upon Data

22. My school uses assessment data to identify subgroups of students who are not experiencing academic success.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

23. My school uses assessment data to identify individual students who are not experiencing academic success.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

24. In my school teachers are encouraged to try out new teaching strategies.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

25. Student achievement in my school is improving significantly as a result of data-driven practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 7 Goal Setting

26. Our school improvement goals are clear, specific, measurable, and based on student data.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

27. Teachers use data from yearly student assessments to set instructional targets and goals

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

28. Teachers use data from periodic student assessments to set instructional targets and goals.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 8 Teacher Teams

29. Teachers meet at least 4 to 6 times a year with a small team of other teachers to look at student data and devise instructional strategies and interventions.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

30. When teachers have professional meetings with each other, their discussions focus on student learning outcomes and results rather than on procedural, political, or social matters.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

31. Teachers are given adequate time for collaborative planning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

32. Teachers in our school have sustained conversations about teaching practices. When I have professional meetings with other administrators, our discussions focus on student learning outcomes and results rather than on procedural, political, or social matters

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 9 Data Systems and Technology

33. Which of these types of technology systems do you use to collect and/or analyze student performance data? (check all that apply)

_____1. Data warehouse solution purchased from a vendor
_____2. Data warehouse solution developed by the district
_____3. Student information system
_____4. Relational database software (e.g., Access, FileMaker Pro)
_____5. Spreadsheet software (e.g., Excel)
_____6. Software to facilitate classroom assessment
_____7. Other
_____8. I don't use any of these systems

34. Principals have input into school and district data management and analysis strategies.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

35. Principals have input into the data elements that are captured in school and district data systems.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

36. Principals have input into the reports that are created by school and district data systems.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

37. I can access the information I need from school and district data systems to examine relationships that impact student learning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

38. I understand how using data management technologies can improve student learning outcomes.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

39. I know how to use spreadsheets and/or other technology tools to collect and analyze student data for progress monitoring during the year.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

40. Our school has the technology systems it needs to utilize data for school improvement.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 10 Alignment

41. Student achievement data are used to inform school and district improvement initiatives.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

42. Staff development usually focuses on student learning and teaching techniques.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

43. Staff development initiatives are designed to build educators' collective (rather than individual) capacity to achieve their goals through job-embedded learning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

44. My professional development has helped me use data more effectively.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

45. School and classroom improvement efforts are aligned with content-specific instructional best practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 11 Support

46. The district adequately supports teachers' use of data to improve classroom instruction.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

47. Our school receives adequate support for implementing district improvement initiatives.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

48. State standards result in better schools and increased learning.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 12 Beliefs

49. I have a solid conceptual understanding of data-driven decision-making principles and practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

50. I am a valued member of my district’s data-driven reform efforts.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

51. If we constantly analyze what we do and adjust to get better, we will improve.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

52. Data-driven educational practices can improve student learning outcomes and close achievement gaps.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

53. Using data has improved the quality of decision-making in my school.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

54. Most teachers in my school are working as hard as they can to meet high educational standards.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

55. Persistently low-performing schools need outside intervention to improve,

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 13 Data Safety

56. As a school we have open and honest discussions about data.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

57. There is a strong sense of trust among teachers and administrators in our school.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

58. Classroom data is used for teacher feedback and information, not for teacher evaluation and/or job-related sanctions.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 14 Leadership

59. Our school has a shared vision for success that is based on student achievement and growth.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

60. Our school uses data to determine if we are achieving our vision.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

61. Our district provides a clear and consistent message that ongoing formative assessment of student performance is a primary expectation of teachers.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

62. Leaders in our district use data to convince people of the need for change.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

63. Administrators effectively model data-driven educational practices.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Section 15 Culture

64. Our school culture emphasizes continuous improvement.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

65. Most teachers in the school routinely use data to inform their instructional practices and understand student needs.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

66. Our school uses data to uncover problems that might otherwise remain hidden.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

67. In our school, problems are viewed as issues to be solved, not as barriers to action.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

68. There is a systematic reliance on hard data as a basis for decision-making at both the classroom and school levels.

1	2	3	4	5	6
Strongly Disagree	Moderately Disagree	Slightly Disagree	Slightly Agree	Moderately Agree	Strongly Agree

Thank you for your contribution to new knowledge.

DDDM Mean results for Administrators

Demographics Information

Data-driven Decision Making Demographics Section

High school you are representing in completing this survey___One of 10 high schools studied in this research____.

1. Your position in your building is
   __35___Building principal, associate or assistant
   _____High school math instructor

2. How long have you held your position in your school or district?
   __3___Less than one year
   __5___One to three years
   __22___Four to 15 years
   __5___More than 15 years

3. If you have held a similar position in another district, for how many years did you hold this role in another district?
   _____Years
4. What software is used in your school as your student information system? Please indicate your system, e.g. (Schoolware, PowerSchool, eSchool, SASSI, Zangle,) __ 4 responses were given_Zangle, SASI, PowerSchool, and School Master_.

5. Please rate your own technology fluency.
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced
   Mean = 2.97

6. Please rate your personal capacity for Data-Driven Decision Making (DDDM).
   _____Novice
   _____Nearing Proficient
   _____Proficient
   _____Advanced
   Mean = 2.46

Administrator Survey Mean Results

Section 1 Yearly State Assessment

1) 3.74	2) 3.57	3) 3.20	4) 3.44
		Section	3.49

Section 2 Other Yearly Assessments

My school uses other yearly assessments (e.g., Terranova, ITBS, ITED) besides those from the state. IF NO, SKIP TO NEXT SECTION.

5) 3.88	6) 3.94	7) 3.12	8) 3.59
		Section	3.63

Section 3 Common Periodic Assessment

Teachers in my school create and use common periodic assessments for ongoing progress and monitoring of student learning. IF NO, SKIP TO NEXT SECTION

9) 4.72	10) 4.44	11) 4.48	12) 4.46
		Section	4.53

Section 4 Other Periodic Assessments

Our teachers use other (i.e., not teacher-created) periodic assessments (e.g., Scantron, STAR, DIBELS, CBM) for ongoing progress monitoring of student learning. IF NO, SKIP TO NEXT SECTION.

13) 4.15	14) 4.12	15) 3.88	16) 3.64
		Section	3.95

Section 5 Data Visibility & Transparency

17) 3.54	18) 3.89	19) 3.14	20) 4.00	21) 4.03
			Section	3.72

Section 6 Acting Upon Data

22) 5.00	23) 4.63	24) 5.31	25) 4.14
		Section	4.77

Section 7 Goal Setting

26) 5.03	27) 3.97	28) 4.17
	Section	4.39

Section 8 Teacher Teams

29) 3.63	30) 4.03	31) 3.17	32) 3.71
		Section	3.63

Section 9 Data Systems and Technology

33. Which of these types of technology systems do you use to collect and/or analyze student performance data? (check all that apply)

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**
No	19	24	7	21	9	28	32	34
Yes	16	11	28	14	26	7	3	1

34) 4.34	35) 4.18	36) 4.03	37) 4.51	38) 4.86	39) 4.69	40) 4.32
	Design	4.18			Access	4.42
					Section	4.60

Section 10 Alignment

41) 4.89	42) 4.91	43) 4.44	44) 4.34	45) 4.60
			Section	4.64

Section 11 Support

46) 4.54	47) 3.94	48) 3.89
	Section	4.12

Section 12 Beliefs

49) 4.71	50) 4.20	51) 5.31	52) 5.23	53) 4.80	54) 5.00	55) 3.43
					Section	4.67

Section 13 Data Safety

56) 4.83	57) 4.40	58) 4.89
	Section	4.70

Section 14 Leadership

59) 5.11	60) 4.77	61) 4.69	62) 4.77	63) 4.71
			Section	4.81

Section 15 Culture

64) 5.03	65) 4.31	66) 4.63	67) 4.83	68) 4.31
			Section	4.62

APPENDIX C

CONSENT FOR PARTICIPATION

Dear Mathematics Education Leader:

As educators, we are interested in the advancement of learning in the subject of mathematics. You are currently employed in a Montana "AA" high school district and have leadership responsibilities in the instruction of mathematics. You have been selected for participation in a research project because of your interest in improving mathematics instruction and finding out what affects student achievement.

I am a doctoral student in the educational leadership program at Montana State University. As a part of my doctoral studies, I am conducting research regarding the use of technology tools for curriculum and instructional decision making in high school mathematics.

You will soon be contacted by the high school principal in your district inviting you to respond to a data-driven decision making diagnostic. Your participation is crucial to the success and findings of the research. The survey will take approximately 20 minutes to complete. Some of you are working in a district leadership position and will be asked to respond to surveys regarding two or more high schools. Please complete the survey for each district high school. Your answers may vary from one high school to the next within your district.

The survey is a self-assessment of your high school's use of technology tools for data-driven decision making. This instrument will assess your school's or district's progress in data-driven decision making to help improve student learning.

The survey will be completely confidential, and no information about you personally will appear anywhere in the report of the study, nor will it be reported verbally to any other person. Your school will not be identified by name in the results of the study.

The benefits to you as a participant are to gain knowledge regarding the potential effects of using technology for decision making purposes on student achievement. Your participation is voluntary, and you are under no obligation other than to answer the survey questions to the best of your knowledge. Your participation will strengthen the reliability and validity of the research results.

I hereby give my consent to participate voluntarily in a research study to be conducted by Dennis Sulser, regarding using technology tools for decision making in mathematics.

_____ _____

Name Date

Sincerely,

Dennis Sulser, Doctoral Candidate, Montana State University

APPENDIX D

INVITATION TO SCHOOL PRINCIPAL FOR PARTICIPATION

Dear “AA” High School Principal:

In my effort to research the relationship between “using technology tools for decision making” and “student mathematics achievement,” I am asking for your partnership in a research endeavor. The results of this project will have implications for improved mathematics achievement, mathematics curriculum decision making, and for additional data management technology funding for your school and others across the state.

Each “AA” school will have up to 25 participants for the research. If you agree to this study, I am asking you to be my contact for dissemination and collection of the diagnostic survey instruments. Each diagnostic will be labeled with the specific position of the participant. The following are asked to participate in a data-driven diagnostic of your school and district:

1. Every math teacher in your school, 10 to14
2. Every building administrator (please include all assistant principals), 4 to 5
3. Superintendents, 1
4. High school curriculum directors, 1 to 3
5. Directors of secondary ed, 1 to 2
6. Technology integration specialists, 1 to 2
7. Technology coordinators, 1 to 2

I will send to you copies of the diagnostic for each of your school and district participants. The diagnostic instrument will be sent to you on **October 15, 2005**. I am asking you to distribute and collect the diagnostic instrument and return to me in the self-addressed envelope that will be provided for you. It is critical that the completed diagnostics are returned to me no later than **November 15, 2005**. Full participation in the diagnostic is critical to the success, validity, and reliability of this research project.

The diagnostic is a self-assessment of your high school’s use of technology tools for data-driven decision making. This instrument will assess your school’s or district’s progress in data-driven decision making to help improve student learning.

In addition to the completion of the data-driven diagnostic, I am asking you to collect specific **testing data** to be correlated with the results of the diagnostic survey. Attached is a checklist of **test data**, **enrollment information**, and examples of the testing information I am requesting. If you would kindly complete the information on the testing results, I would very much appreciate your individual effort. Please provide the requested information and return to me in the attached envelope by **October 15**. Attached to this packet of materials is a fresh $20 bill for your efforts.

The survey and testing information will be completely confidential, and no information about you personally will appear anywhere in the report of the study, nor will it be reported verbally to any other person. Your school will not be identified by name.

Each survey participant, including you, is asked to complete the consent for participation agreement. The consent for participation details the participant’s role, responsibility, and the researcher’s commitment to confidentiality of the individual and school.

Sincerely,

Dennis Sulser, your friend and colleague!!

November 10, 2005

Dear "AA" Principal Colleagues:

Attached is a $20.00 for your efforts in the Data-Driven Decision Making research. Thank you for your continued support in this endeavor.

1. Do not survey central office administrators or coordinators. The response from various districts was sketchy at best. To survey central office in one district and not others would invalidate the returned surveys. **(One less step for you to complete.)**

2. Administer the **salmon colored survey to each of your building administrators**. It is critical that every building administrator participate. **(Salmon Colored Survey) The administrator survey is on line and can be accessed at the following URL:**
https://websurveyor.net/wsb.dll/39416/administrators.htm
I recommend using the web-based survey as it will save you time as well as the participants from your school.

3. Administer the **white colored survey to each of your building math teachers**. It is critical that every building math teacher participate. **(White Colored Survey) The teacher survey is on line and can be accessed at the following URL:**
https://websurveyor.net/wsb.dll/39416/teachers.htm
Again I recommend using the web-based survey as it will save your teachers time in completing the survey.

4. **Return** the paper surveys by **Friday, December 9** in the stamped self-addressed envelope or ensure that participants have submitted the electronic survey by the same date, **Friday, December 9**.

Thank you for your continued support and assistance. Please call (406-655-1300) or e-mail sulserd@billings.k12.mt.us if you have questions.

Sincerely,

Dennis Sulser

APPENDIX E

CHECK LIST FOR PRINCIPAL DATA COLLECTION

Data check list of items to be returned by the building principal.

Please return all requested material by October 15, 2005 in the postage paid envelope to:
Dennis Sulser, Principal
Billings West High School
2201 St. John's Ave.
Billings, MT 59102

_____ 1. MontCAS, Phase 2 Measured Progress CRT MATHEMATICS school summary report for spring 2004 and spring 2005. (Sample provided)

_____ 2. ITED NRT for MATHEMATICS TOTAL school narrative summary report for spring 2004 and spring 2005. (Sample provided)

_____ 3. ACT school summary report for 2004 and 2005 school year. (Sample provided)

_____ 4. SAT school summary report for 2004 and 2005 school year. (Sample provided)

_____ 5. Percentage of grade 12 students enrolled in mathematics for the 2004 and 2005 school years. (Enrolled seniors in mathematics / Total of senior class) Your registrar may be able to assist you with this.
2004 Enrolled seniors in math_____ 2004 Senior class enrollment_____ = _____%

2005 Enrolled seniors in math_____ 2005 Senior class enrollment_____ = _____%

_____ 6. Math instructors at your school responding to the survey. Please list the total of potential respondents.

Math Instructors_____.

_____ 7. Building level administrators at your school responding to the survey. Please list the total of potential respondents.

Building Administrators_____.

_____ 8. Central office level responders to the survey. Please list the total of potential respondents.

Central Office personnel_____.

_____ 9. Technology specialist responders to the survey. Please list the total of potential respondents.

Tech specialists_____.

Thank you for your assistance and response to this research!!!!!