From LtoJ: the effects of an assessment approach on student achievement in mathematics at the middle school level

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From LtoJ: the effects of an assessment approach on student achievement in mathematics at the middle school level

Abstract
This study investigated the effectiveness of the assessment approach From LtoJ as applied to the development of procedural skills and conceptual understandings in mathematics at the eighth grade level. The focal question of this study was: Does the literature support the assessment process used in the From LtoJ program? The information was gathered from approximately one hundred students taking pre-algebra in a three-year span. The curriculum database focused on the essential information a student must acquire in the areas of curriculum vocabulary and concepts, as well as their computational ability with fractions. Each week, random items were selected from the curriculum and given to students in the form of a question. Three separate quizzes were given in the areas of vocabulary, concepts, and computation of fractions.

Using the assessment approach From LtoJ, student achievement and success was increased and student failure was reduced in mathematics when compared to previous test results. Students were assessed through weekly quizzes. Analyzing the results enabled the teacher to make immediate adjustments in instruction to insure continuous improvement, both for individual students and for the class sections as a whole. The data collection indicated when the curriculum was presented in a continuous manner through the weekly assessments, students learned to internalize and retain knowledge of essential information. Thus student achievement was impacted in a positive manner using the assessment approach of From LtoJ.

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From LioJ: THE EFFECTS OF AN ASSESSMENT APPROACH ON STUDENT ACHIEVEMENT IN MATHEMATICS AT THE MIDDLE SCHOOL LEVEL

A Graduate Literature Review
Submitted to the
Division of Middle Level Education
Department of Curriculum and Instruction
In Partial Fulfillment
Of the Requirements for the Degree
Masters of Arts in Education
UNIVERSITY OF NORTHERN IOWA

By
Toni Andersen
January, 2004
ABSTRACT

This study investigated the effectiveness of the assessment approach From LtoJ as applied to the development of procedural skills and conceptual understandings in mathematics at the eighth grade level. The focal question of this study was: Does the literature support the assessment process used in the From LtoJ program? The information was gathered from approximately one hundred students taking pre-algebra at the eighth grade level in a three-year span. The curriculum database focused on the essential information a student must acquire in the areas of curriculum vocabulary and concepts as well as the computational ability of fractions. The curriculum databases were developed by the teacher using the standards and benchmarks of the coursework. Each week, random items were selected from the curriculum and given to students in the form of a verbal and/or written question. Three separate quizzes were given in the areas of vocabulary, concepts and computation of fractions.

Using the assessment approach, From LtoJ, student achievement and success was increased and student failure was reduced in mathematics when compared to previous test results. A collection of essential curricular information was distributed to students at the beginning of the school year. Students were assessed through weekly quizzes consisting of randomly selected information from the three separate databases of assessment questions. Analyzing the results of the individual quizzes and class total correct of questions enabled the teacher to make immediate adjustments in instruction to insure continuous improvement in student learning, both for individual students and for
the class sections as a whole. The data results were informative in nature for both students and educators to determine the progression of student learning. The data collection indicated when the curriculum was presented in a continuous manner through the weekly assessments, students learned to internalize and retain knowledge of essential information. Thus student achievement was impacted in a positive manner using the assessment approach of From LtoJ.
This Graduate Literature Review by: Toni Andersen

Titled: *From L to J: The Effects of a Assessment Approach on Student Achievement in Mathematics at the Middle School Level*

Has been approved as meeting the research requirement for the
Degree of Masters of Arts in Education

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Date Approved: 1/12/04
Graduate Faculty Reader

John E. Henning
Date Approved: 1/13/04
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Head, Department of Curriculum and Instruction
DEDICATION

This project is dedicated to those who helped me realize my dreams with support, inspiration and the magic of love.

All teaching involves the transmission of knowledge. To my students who have taught me to be curious. You have shared your thoughts and questions. You have shown me that I could learn more about teaching by listening and thinking. It is my ambition that you will be more knowledgeable, more open to life, and more understanding of the world than when you first entered my classroom. It is my hope that you remember our motto: Each person builds his own destiny.

To my husband, Bob, I thank you again and again. You gave me reassurance and understanding when I most needed it. When there just weren't enough hours in the day and you were “Mr. Mom”—Thank you! You are the motivation to do all the positive things I do in life. Thanks for believing in me.

To our children, Jacob and Caitlin, your patience while I worked on my “homework” taught me more about life than any education could have ever taught me. Thanks for being great kids and for making me laugh. To our son, Ryan, thank you for the late-night MSN pep talks. Your quest for higher learning is inspiring. Once again, each of you have taught me that being a parent is the highest calling an individual can obtain in this life.

I'll love you forever,
I'll like you for always,
As long as I'm living
my baby you'll be.
- Robert N. Munsch
ACKNOWLEDGEMENTS

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Mathematics instruction has been particularly challenging in recent years. The National Council of Teachers of Mathematics (NCTM) states the following:

Evidence from a variety of sources makes it clear that many students are not learning the mathematics they need or are expected to learn. The reasons for the deficiency are many: in some instances, students have not had the opportunity to learn important mathematics. In other instances, the curriculum offered to students does not engage them. Sometimes students lack a commitment to learning. (NCTM, 2000, pg. 4)

In current educational practices, teachers use assessment methods to obtain results data when analyzing student learning and skill level. When using results data, the information does not clearly illustrate where the students are in regards to the learning of essential knowledge. It is often collected too late to adjust instructional strategies to meet the needs of the students. Deming (1993) outlined the changes necessary in education for teachers to have “up-to-the-minute” data to clearly show where students are in comparison to the curricula being taught in the classroom. Though Deming’s (1993) Total Quality Management (TQM) is a business model, it is often applied in educational settings because it is student-centered as well as data-driven. The collection of process data gives the teacher more responsibility for student learning as well as the flexibility to
alter instruction to meet the learning needs of students. The collected data can provide a wealth of information regarding student achievement and teacher instruction. Without theory and data, the teacher and students move through the school year with no improvement in the classroom (Jenkins, 1997).

The management theory, Total Quality Management, (Deming, 1993) offered the following aim for education: increase the positives and decrease the negatives so that all students keep their yearning for learning. From this basic premise, the framework for DataNotGuesswork (Jenkins, 1997) was developed and applied to the educational setting and Leddick and Jenkins (2001) further refined the concept of quality in the classroom. DataNotGuesswork (DNG) emphasizes the attainment of curriculum benchmarks by analyzing student data. (Jenkins, personal communication, September, 2001) Jenkins (2003) continued to focus on the improvement of student learning through the assessment approach, From LtoJ. "From LtoJ is used to measure learning of information, student performance, student enthusiasm, and classroom performance." (Jenkins, 2003, p.14) From LtoJ utilizes graphs to display information regarding student achievement. In gathering and analyzing data, the histograms consider the “L” and the “J” curves of the graphs. At the beginning of the school year, when students are provided the essential information to be learned and the performance standards to be demonstrated, the curve of the students’ assessments should be in the shape of an “L” where students have much to learn about the curriculum. Many students do not know the information thus there are many who receive zeros on the assessments. The “J” curve represents the end of the year progress. Many students have met the year’s expectations of learning the curriculum thus there are many who receive high marks on the assessments.
Using the *From LtoJ* assessment approach, the goal was to increase student achievement and reduce student failure in middle school mathematics. Databases of essential concepts, vocabulary and fractional operations were written by the teacher for grade level eight based on the curricular standards and benchmarks following the conceptual guidelines provided by Jenkins who developed the assessment theory of *From LtoJ*. Database questions were deemed appropriate if they matched a particular benchmark of required knowledge for the students by the end of the eighth grade year. Student learning was assessed weekly through separate quizzes consisting of ten vocabulary items, five concept problems, and five fraction problems randomly selected from the each of the three databases. The teacher entered student results into a software program and generated graphs that displayed class progress. Analyzing the results data enables the teacher to make immediate adjustments in instruction to insure continuous improvement in learning.

In 2000, the learning process, *From LtoJ* was implemented in the eighth grade mathematics classroom for Essential Vocabulary. The scatter matrix shows the class period together as a single unit. With the use of a transparent overlay of the student run charts for each class period, comparisons can be made from class to class. In 2001 - 2002, the implementation of the *From LtoJ* was expanded to include the Computation of Fractions and Essential Concepts as well as Essential Vocabulary. Students can take more responsibility when given the opportunity to improve their own learning. When it is tangible, the students know what they are to be learning, and they know at any point how they are doing. In the eighth grade mathematics classroom, large graphs posted in the
classroom display class progress in mastering the essential information. In addition, each student keeps an individual graph to record personal progress towards mastery.

It should be noted that the students in all three years employed various strategies to increase their retention of the essential information as the school year progressed. Intentional memorization begins with not just having students memorize words or processes, but with the instructional process itself. Vygotsky (1978) calls this type of memory deliberate memory, which is a higher mental process. It refers to the use of memory strategies and processes that are employed to retain and internalize knowledge. Many students employed the use of flash cards as a study aid to review words or skills already taught and to preview information yet to come, while other students worked on practice problems.

**Purpose of Study**

This review of literature and of an established database was designed to provide information on the use of the assessment approach, *From LtoJ*, in the middle level mathematics classroom. The purpose of the study was to examine the effects at the student level of participating in the *From LtoJ* program. This study explored how the data gathering and analysis process of *From LtoJ* can positively effect student achievement in the pre-algebra classroom.

**Research Questions**

The focal question of this study is: Does the literature support the assessment process used in the *From LtoJ* program? Other questions flowed from this primary question:

- How does the *From LtoJ* process prepare students to construct their own mathematics knowledge?
What are the students’ perceptions of learning using From LtoJ in the mathematics classroom?

How does From LtoJ meet the unique developmental needs of middle school students?

Importance of Review of Literature and of an Existing Database

The quality of the educational system in the United States has been closely scrutinized by the public during the past decade. (NCTM, 2000, pg.20) With this scrutiny comes the need for school systems to implement assessments and accurately measure student achievement that will provide timely feedback to the students and to the general public. Unless a school employs assessments that are specific to the curriculum actually taught, it cannot accurately determine how well its students are learning (Marzano, 2003).

If one of the main purposes of assessment is to inform teachers about their teaching, it can then be stated that teachers view assessment data mainly as an indication of the effectiveness of their teaching. Teaching mathematics in the world of high-stakes assessments requires results data to clearly inform all stakeholders that students are receiving a quality education. Teachers need to be clear about the reasons for using assessment techniques and be able to convey that message to students and parents alike (Wilkins, 2002).

This study can serve as a model for mathematics teachers and other educators interested in using the assessment approach From LtoJ to enhance student learning and achievement.
**Descriptions of Terms**

In order for readers to have a common understanding of the terms used in this paper, the following terms are defined:

**Assessment**: A set of strategies for discovering what students know or can do.

**Evaluation**: A value assigned to student performances and a judgment about the quality of a student’s performance or product of learning (Educators in Connecticut’s Pomperaug Regional School District 15, 1996). The typical end products of evaluation are grades.

**Process Data**: Data collected continuously over time. (Jenkins, 1993)

**Quality in Learning**: Integration of philosophy, theories, processes and tools of quality and learning to identify, analyze and remove barriers to learning (Bergman, 2002)

**Quality**: Meeting and exceeding existing and future student wants and needs. (Bergman, 2002)

**Results Data**: Data collected at the end of a learning cycle. (Jenkins, 1993)

**Test**: The presentation of a standard set of questions to be answered. Used to determine what a person knows in various formats such as multiple-choice, true/false, or essay examinations.

**Total Quality Management (TQM)**: A management philosophy, supported by a set of processes and tools, aimed at achieving a culture of continuous improvement, driven by all the people within an organization. (Garfield, 1992)
CHAPTER 2
METHODOLOGY AND PROCEDURES

Education reform calls for improvement in student achievement through varied assessment (Jackson, 2000; NCTM, 2000; United States Department of Education, 2001). The success of a mathematics program depends on the extent to which it accomplishes its goals and objectives (NCTM, 2000). A classroom assessment program must give the teacher information about each student's status and progress toward goals to determine if learning has taken place (NCTM, 2000; Stiggins, 1988). All assessment should have as its primary purpose the improvement of student learning (Jenkins, 1993). A variety of procedures are used to assess student progress in today's classrooms. One such assessment approach is From LtoJ.

Method of Identifying and Locating Literary Sources

According to Gall, Borg, and Gall (1996), there are four types of knowledge that research contributes to: description, prediction, improvement, and explanation. This study placed emphasis in the area of description due to the fact that there is little known about the educational outcomes when From LtoJ is implemented.

Multiple sources of information were used in order to ensure validity as well as increase the reliability of the data. The process of the literature review included searching and reviewing a wide range of information resources. After an initial online search of the resources located in the Educational Resources Information Center (ERIC) databases,
visits to the University of Nebraska at Omaha's University Library were utilized to collect copies of original articles.

The literature search yielded sources of varying relevance and quality. The following criteria to include research sources was considered:

1. relevance and/or historical value to topic,
2. reputation of author(s),
3. reputation of publishing house, and
4. date of publication.


In order to retrieve accurate information of the topic at hand, keywords were utilized to provide a focus for the search. Keywords and terms used included middle level, achievement, assessment, W. Edwards Deming, Total Quality Management, Data Not Guesswork, From LtoJ, and other less successful terms. Different levels of examination were employed to determine relevancy. A superficial scan of abstracts and recordings of different searches provided a basis for the collection of original works. Critical reading of the collected literature provided an overview of the research, identified gaps or limitations in the research and fostered future research ideas. Information was also gathered through workshop attendance on the topic of the assessment approach, From LtoJ as well as personal conversations regarding the implementation of From LtoJ and student achievement in the mathematics classroom.

Sources of Student Achievement Information

The study examined the proficiency rates of the Heartland Middle School (HMS) District Math Assessment, the Iowa Test of Basic Skills (ITBS), the Iowa Test of
Educational Development (ITEDs) and the Iowa Comprehensive Assessment of Mathematics (ICAMs). Proficiency is defined as the combined percentage of students in the intermediate and high achievement levels on the ITBS, ITEDs, and ICAMs. This data will be used to explain and clarify student achievement as related to the assessment approach of From LtoJ.

Student achievement information was analyzed using an established database of essential information. This essential information was gathered from the curriculum of the eighth grade mathematics classroom. There were specific content items required to be retained in the students' knowledge base by the completion of the eighth grade year. Utilization of the HMS eighth grade mathematics standards and benchmarks as well as the text provided the basis for the questions asked of students in the assessment process.

These content items were formulated into test questions and used in weekly quizzes to assess student comprehension. The assessments were given once a week to the mathematics students. The essential vocabulary (Top Vocab) quiz is given first. Students are asked a random selection of ten vocabulary terms. The teacher provided the students with the definition and the students wrote down the correct term. The computation of fractions quiz was given next with students calculating answers to five problems seen individually on the overhead. Students were then asked to solve five questions relating to the essential concepts of the mathematics course. All quizzes utilized the random selection of assessment items. This provided a comprehensive approach to the questions asked of students. These assessment results were tabulated using the individual and class scores from the weekly quizzes. Student achievement was assessed using individual and class graphs to track progress. Individual scores are based on a numeric score; the
number correct out of the possible correct. The class graphs are based on a percentile score to allow for absences or students transferring out of the school district.

The assessment results for this study were gathered at Heartland Middle School which, in 2003, was comprised of approximately four hundred twenty middle school students in grade levels six through eight. The student population was 51% male and 48% female. In eighth grade, the student population was 58% male and 42% female. The percentage of students receiving free-or-reduced lunches was 38% of the student population. The students of Heartland Middle School were predominately Caucasian with minority students making up less than 2% of the population. Minority students at Heartland Middle School were representative of the Asian and Hispanic ethnic groups. This population make up was also representative of the community at large.

This was a rural school district with total enrollment of approximately 1,550 students with approximately 82.9% of the graduating class of 2002 pursuing higher education. The number of dropout students was less than 0.5% for grades 11-12. The rural community was dependent on agriculture for its economic stability with light industry also contributing to the economy.
CHAPTER 3
REVIEW OF LITERATURE AND OF EXISTING DATABASE

Education cannot be limited to the confines of a textbook used in a particular grade level. The learning from one year must be carried over and applied in subsequent years. (Jenkins, personal communication, 2001). With this premise, a review of literature pertaining to the issues of middle school philosophy, assessment and achievement in mathematics, and the assessment approach From LtoJ will follow. First a review of middle school will be presented. This will be followed by a discussion of assessment and achievement in mathematics. Finally, based on the mathematics assessment data gathered at HMS, the development of the process of the assessment approach of From LtoJ will be explored.

Middle School Philosophy

The middle school concept has been part of American education since the early 1960s. It is unique in that it responds to the academic needs of young adolescents, but in a developmental framework. It is the blending of academics, pedagogy, and developmental needs of young adolescents.

A 1989 task force established by the Carnegie Council on Adolescent Development (CCAD) presented a report on its findings regarding middle grades research and effective educational practices (see Appendix B). The task force’s report, entitled Turning Points: Preparing American Youth for the 21st Century, established eight essential principles for improving middle level education:
Large middle schools should be divided into smaller learning communities.

Middle schools should teach a core of common knowledge to all students.

Middle schools should be organized to ensure success for all students.

Educators and principal are to have the major responsibility and power to make decisions about adolescent schooling.

Middle schools are to be staffed by teachers who are experts at teaching young adolescents.

Schools should promote good health; education and health are linked.

Families should be allied with school staff through mutual respect, trust, and communication.

Schools and communities need to be partners in educating young adolescents.

Exemplary middle schools develop programs and practices around the needs of young adolescents (CCAD, 1989; NCTM, 1997; National Middle School Association [NMSA], 1995). The primary agenda of middle school education is to promote young adolescents' intellectual development (Jackson, 2000; NCTM, 2000). The middle grades are a powerful place where adolescents can develop a mature sense of self-esteem, a constructive method for expressing themselves regarding their interests, and an avenue to direct their endless energy (CCAD, 1989). An academically rigorous learning environment addresses these critical developmental stages. Middle school education is organized around teams of teachers from diversified subject areas providing instruction on a common set of subject-matter. The inter-disciplinary approach is emphasized, encouraging students to draw broader connections, think analytically rather than merely memorize, and engage their personal creativity as a resource in the educational process.
Research indicates a positive correlation between student achievement and the degree to which the middle school model is implemented: the more complete the implementation, the better the result. (CCAD, 1989; Jackson & Davis, 2000).

Assessment at the Middle Level

The National Council of Teachers of Mathematics (1987) states that public expectations for middle school mathematics are as follows:

- Set up problems with the appropriate operations
- Approach and work on problems using a variety of techniques
- Understand the underlying mathematical features of a problem
- Work with others to solve problems
- See the applicability of mathematical ideas to common and complex problems
- Solve open problem situations typical of most real problems formulated
- See and value the beauty and utility of mathematics.

Middle schools across the United States have implemented aggressive initiatives to increase expectations for students. Many different kinds of assessments should be used to determine a student's understanding and progress (NCTM, 2000). The purpose of assessment should be to improve learning and teaching. It is gathering information about student learning that can be used to provide feedback to students about their learning as well as feedback to the instructor about students' achievement of course goals (Angelo & Cross, 1993).

Assessment involves the processes of gathering data to make educational decisions about students, giving feedback to students about their progress, and judging

As high-stakes, state-mandated performance assessments become a matter of public record, educators are more accountable for student achievement and the use of “best practices” in the mathematics classroom is mandatory (Vogler, 2002). Assessment has been discussed by Warren and Nisbet (2001) stating:

In the area of informing the teacher, assessment was most often used to help plan the next phase of instruction and to evaluate one’s own effectiveness in teaching.

In the area of informing the learner, assessment was often used to provide a positive experience for students regarding their strengths not weaknesses (pg. 350).

In discussing assessment, Jenkins (2003) states:

Ideally a measurement system has two components: One begins at the state level, moves to the district and then to the school level. The other system begins with the classroom, combines classrooms to create school data, and then schools are combined for district data. The first is results data; the second is data on the learning process. Both are necessary to adequately monitor learning for all students (pg. 31).

Kohn (1999) describes the assessment of learning in much the same manner:

Learning doesn’t take place at a district or state level; it takes place in a classroom. Therefore, the assessment should be focused on students’ learning over time by the person in the best position to judge the quality of that learning.
There's an inherent problem with any one-shot test that's designed and then scored by somebody far away.

The current reporting practices of standardized testing limit the use of alternative classroom assessment practices (Jenkins, personal communication, 2003). Methods of reporting students' achievement in mathematics need to change so that various types of assessments can be incorporated in the reporting methods used to communicate with students and parents (Schmidt & Brosnan, 1996, pg.17). The uses of traditional methods of assessments such as tests, quizzes, homework, are easy to quantify and calculate. However, "educators and school districts need to review grading and reporting policies to best convey what is valued in mathematics (attainment of concepts, knowledge and skill, problem solving, and a positive attitude toward mathematics) to the parents and students" (Schmidt & Brosnan, 1996, pg.19). If knowledge is viewed as more than a collection of facts and ideas implemented in rote procedures, active individual internalization of knowledge can be thought of as a goal of education (Albert, 2000, pg. 25).

**Mathematics and Achievement at the Middle Level**

The research literature on student achievement reveals that students learn in different ways (Tomlinson, 1995). Mathematics achievement among eighth graders was influenced by motivation, attitude, and academic engagement. Singh and Granville (2002) found "school-related motivation and attitude can be affected by more positive school experiences and better instructional approaches. Educators must work to strengthen positive attitudes and modify negative attitudes by promoting better classroom practices and providing positive experiences in mathematics" (pg. 330).
The Professional Standards for Teaching Mathematics (1991) stated a need for the development of instructional practices that would support mathematics teachers to become more proficient in:

- Selecting mathematical tasks to engage students interest and intellect
- Providing opportunities to deepen their understanding of the mathematics being studied and its applications
- Orchestrating classroom discourse in ways that promote the investigations and growth of mathematical ideas
- Using and helping student use, technology and other tools to pursue mathematical investigation
- Seeking and helping students seek, connections to previous and developing knowledge
- Guiding individual, small-group and whole class work (NCTM, 1991).

These practices represented a considerable change from the customary mathematics classroom where the teacher typically answered homework questions, provided a brief explanation of new materials, and then assigned the homework with students spending the remaining time doing their homework. (NCTM, 1991). The NCTM Standards (1995) call for the use of many new teaching practices (such as orchestrating group work, facilitating classroom discussions, nurturing reasoning and conjecturing, and employing multiple forms of assessment) most of which are not currently used by many math teachers. Educators “need to reject the notion that knowledge is a collection of facts and ideas implemented in rote procedures with students functioning as passive learners” (Albert, 2002, pg. 147).
The language of mathematics can sometimes be confusing for students to comprehend and apply appropriately. Many mathematical vocabulary words are unique to the subject area, some terms have different meanings in everyday usage than in technical mathematics, and some are used in mathematics in more than one way. However, terms, phrases, and symbols are essential when communicating mathematical ideas; and becoming fluent with them is vital for children's mathematical learning (Rubenstein & Thompson, 2002). The goal is for mathematical language to become fluid, natural, and "a powerful tool...to foster the learning of mathematics" (NCTM, 2000).

It is widely assumed that an improvement in self-concept leads to an improvement in academic achievement. Research has examined the relationship between academic achievement and self-concept. According to Skaalvik and Valas (1992):

The perspective holds that the achievement--self-concept relation changes in early adolescence (at the end of elementary and the beginning of middle school). As self-concept becomes better established and more stable, it may increasingly affect motivation and study behavior, which in turn may affect academic achievement. Performance is affected through student motivation and study behavior. Motivation is affected directly by achievements (pg. 29).

Educators should have an awareness of the perception: If elementary students think they are able to do the mathematics task, the belief of the students at the middle level will be positive and, as a result, increase student achievement.

From Total Quality Management to Data Not Guesswork to From LtoJ

The assessment approach From LtoJ has its basis in the work of Dr. W. Edwards Deming, Dr. Susan Leddick, and Dr. Lee Jenkins. An American statistician, W. Edwards...
Deming, developed a management theory for business that is being implemented in the educational practices of public schools. The theory, Total Quality Management (TQM), focuses on customer satisfaction, employee empowerment, and product quality. TQM provides a method of managing and structuring learning that promotes challenge and internalization (Deming, 1993). Weaver (1992) suggests:

Students become involved in their own education by questioning the learning process. Teachers view education through students’ eyes. Instead of using standardized tests and grades to measure students’ progress, assessment of student progress is done regularly throughout the school year. By doing so, schools avoid bringing problems to students’ attention at the end of the year, when it is too late to do anything about them (pg. 1).

The Total Quality Management concepts relevant to this study included:

- Focus on the learning process, not the rating process.
- Objectives are posted or handed out to help students keep a sense of direction.
- Students are taught strategies for learning, remembering, and applying what they have learned in the classroom.
- Teachers communicate interest to students.
- The teacher expresses expectations for improvement.
- No one is complacent about student achievement; there is an expectation that educational programs will be changed so that they work better (Cotton, 1994, p 35).

The ideas of TQM appear to be relevant to improving teaching and learning. The fundamental idea is that feedback from students can help provide direction for
improvement. A number of studies have examined the value of providing the results from frequent assessment to students. One approach that has been studied provided teachers with weekly performance graphs on individual students. Children in classrooms in which teachers received this feedback performed at significantly higher levels than students in classrooms in which the performance graphs were not available (Whitehurst, 2003). Assessment feedback should be returned to the student quickly so that adjustments and improvements can be made in a timely way. The combination of TQM and assessment can be viewed as one way to build a partnership in learning between teachers and students (Angelo, 1993).

The Quality Teacher by William Glasser (1993) provides information on six conditions for quality schoolwork:

- There must be a warm, supportive learning environment.
- Students should be asked to do only useful work.
- Students should be asked to do the best they can do.
- Students should be asked to evaluate their own work and improve it.
- Quality work always feels good.
- Quality work should never be destructive (p. 42).

From the Total Quality Management System, the DataNotGuesswork method was suggested by Deming and developed by Jenkins while a superintendent of schools in the Enterprise School District (Redding, CA) and the Antioch School District (Antioch, CA). The method was then refined and systematized by Leddick, a consultant in organization design and continuous improvement. Leddick assisted with Deming's public seminars and served as his personal aide during the last ten years of his life.
The benefits of DataNotGuesswork according to Jenkins and Leddick, were:

- **Focus:** It makes the learning explicit. It defines for the teacher and student what is supposed to be learned in a given amount of time.

- **Feedback:** The teacher can observe the data and respond with appropriate changes in instruction.

- **Engagement:** Students can take more responsibility for their own learning.

- **Steadfast performance:** The preview/review component of DNG ensures that students retain what they’ve learned. They are not given permission to forget. (Jenkins, 2001, p.15).

From DataNotGuesswork, the assessment approach, *From L to J*, was developed by Jenkins, a former classroom teacher and math/science coordinator. Most recently a California school superintendent, Jenkins assists teachers and administrators with the improvement of student learning through the implementation of the assessment approach, *From L to J*. The theory fosters student independence by developing self-discipline that will serve the student throughout his or her educational career. The implementation of frequent assessments reinforces skills, while students practice the concepts of the required curriculum.

The basic conceptual framework of *From L to J* according to Jenkins (2003) is outlined below:

- **Students are told at the beginning of the year exactly what information is to be learned that year. Many other interesting topics might be discussed, but this is the essential information.**

- **The work from prior grades is connected to current grade-level expectations.**
➢ From the beginning, students are quizzed on a sample of end-of-the-year expectations. These items are randomly selected at the time of the quiz to eliminate cramming and “psyching-out” the teacher to ascertain what will be quizzed.

➢ Students graph their progress toward meeting the end-of-the-year standards. This is called a student run chart. [Note: Class periods as a whole may be graphed together using the student run chart.]

➢ The teacher graphs the progress of the class as a whole. The teacher not only needs to know the contribution of each student, also where the class as a whole is going. This is called the class run chart.

➢ In order to “leave no child behind”, teachers not only need to be able to look at the progress of each child on their individual student run chart, but the progress of the class as a whole. The teacher must be able to see the progress of each student on one sheet of paper. The statistical tool that accomplishes this is the scatter diagram (Jenkins, 2003).

Review of Database

Data collection took place for the school years 1999 - 2000, 2000 - 2001, and 2001 - 2002. A variety of assessment tools were utilized to determine student knowledge. Assessment instruments included the Harlan Community School District Math Assessment, the Iowa Test of Basic Skills (ITBS), the Iowa Test of Educational Development (ITED) and the Iowa Comprehensive Assessment of Mathematics (ICAMs). Three purposes for assessment at the Harlan Community School District were (1) to determine each student’s developmental level within a content area, (2) to identify a
student's strengths and weaknesses in subject areas, and (3) to monitor year-to-year
growth in the basic skills. For the purposes of this study, student achievement data
focused on proficiency level of students. Proficiency level is defined as the combined
percentage of students in the intermediate and high achievement levels on the Iowa Test
of Basic Skills, Iowa Test of Educational Development, and the Iowa Comprehensive
Assessment of Mathematics. The Iowa Test of Basic Skills was utilized at the eighth
grade level and the Iowa Test of Educational Development was utilized at the 9th grade
level.

Table 1. ITBS Math Total – Grade 8

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>79.6</td>
<td>75.8</td>
<td>81.5</td>
</tr>
<tr>
<td>Male</td>
<td>81.5</td>
<td>81.7</td>
<td>77.7</td>
</tr>
<tr>
<td>Female</td>
<td>78.2</td>
<td>69.8</td>
<td>85.2</td>
</tr>
<tr>
<td>Race/Ethnicity Data is not disaggregated because group size is less than 10.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Free/Reduced</td>
<td>60.0</td>
<td>55.6</td>
<td>69.2</td>
</tr>
<tr>
<td>Non-Free/Reduced</td>
<td>NA*</td>
<td>NA*</td>
<td>84.7</td>
</tr>
</tbody>
</table>

*Not Available

Table 2. ITED Math Total – Grade 9

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All Students</td>
<td>87.5</td>
<td>85.7</td>
<td>82.7</td>
</tr>
<tr>
<td>Male</td>
<td>89.7</td>
<td>82.9</td>
<td>78.8</td>
</tr>
<tr>
<td>Female</td>
<td>85.1</td>
<td>88.0</td>
<td>86.0</td>
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<tr>
<td>Race/Ethnicity Data is not disaggregated because group size is less than 10.</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Free/Reduced</td>
<td>79.2</td>
<td>87.0</td>
<td>82.7</td>
</tr>
<tr>
<td>Non-Free/Reduced</td>
<td>NA*</td>
<td>76.2</td>
<td>82.7</td>
</tr>
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</table>

*Not Available
Table 3. Local Achievement Data 02-03

<table>
<thead>
<tr>
<th>Percentage of Students Proficient</th>
<th>ITBS and ITED</th>
<th>2002-2003</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Total</td>
<td>HCS*</td>
<td>Iowa</td>
</tr>
<tr>
<td>Grade 8 (ITBS)</td>
<td>83.2</td>
<td>73.1</td>
</tr>
<tr>
<td>Grade 9 (ITED)</td>
<td>82.7</td>
<td>81.3</td>
</tr>
</tbody>
</table>

*A pseudonym is used.

Table 4. ICAM Mathematics 2002-2003

ICAM Math Module: Patterns, Functions & Algebra
Eighth Grade Students – 2002-2003
141 Students Tested*

<table>
<thead>
<tr>
<th>All Students</th>
<th>Total Students</th>
<th>Level 1 (Below 25%)</th>
<th>Level 2</th>
<th>Level 3 (Above 85%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Students Included</td>
<td>140</td>
<td>8</td>
<td>5.7%</td>
<td>99</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
</tr>
</tbody>
</table>
| *Includes students identified as excluded from testing and students with invalid answer documents.

<table>
<thead>
<tr>
<th>Subgroups</th>
<th>Total Students</th>
<th>Level 1 (Below 25%)</th>
<th>Level 2</th>
<th>Level 3 (Above 85%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>75</td>
<td>3</td>
<td>4.0%</td>
<td>51</td>
</tr>
<tr>
<td>Female</td>
<td>65</td>
<td>5</td>
<td>7.7%</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>21</td>
<td>28.0%</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>18.5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5. ICAM Mathematics 2001-2002

ICAM Math Module: Patterns, Functions & Algebra
2001-2002
125 Students Tested

<table>
<thead>
<tr>
<th>Test Group</th>
<th>Level 1 Low</th>
<th>Level 2</th>
<th>Level 3 High</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Eighth Grade</td>
<td>9.6%</td>
<td>60.8%</td>
<td>29.6%</td>
</tr>
<tr>
<td>Male</td>
<td>12.5%</td>
<td>59.4%</td>
<td>28.1%</td>
</tr>
<tr>
<td>Female</td>
<td>6.6%</td>
<td>62.3%</td>
<td>28.1%</td>
</tr>
</tbody>
</table>
Table 6. Math Achievement

<table>
<thead>
<tr>
<th>1992 Norms</th>
<th>2000 Norms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math Grade 8 ITBS</td>
<td>Math Grade 8 ITBS</td>
</tr>
<tr>
<td>High Performance 99-00</td>
<td>High Performance 00-01</td>
</tr>
<tr>
<td>High Performance 00-01</td>
<td>High Performance 01-02</td>
</tr>
<tr>
<td>All Students</td>
<td>16.9</td>
</tr>
<tr>
<td>All Students</td>
<td>18.6</td>
</tr>
<tr>
<td>All Students</td>
<td>13.0</td>
</tr>
<tr>
<td>Male</td>
<td>Intermediate Performance 99-00</td>
</tr>
<tr>
<td>Male</td>
<td>Intermediate Performance 00-01</td>
</tr>
<tr>
<td>Male</td>
<td>62.7</td>
</tr>
<tr>
<td>Male</td>
<td>62.9</td>
</tr>
<tr>
<td>Male</td>
<td>65.2</td>
</tr>
<tr>
<td>Female</td>
<td>Low Performance 99-00</td>
</tr>
<tr>
<td>Female</td>
<td>Low Performance 00-01</td>
</tr>
<tr>
<td>Female</td>
<td>20.3</td>
</tr>
<tr>
<td>Female</td>
<td>18.6</td>
</tr>
<tr>
<td>Female</td>
<td>21.7</td>
</tr>
</tbody>
</table>

2000 Essential Information

Chart 3.1 is the scatter diagram for 2000 Essential Vocabulary. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of words correct is 200 points. The number of the words correct range from 20 to 40 in Week 1. In Week 30, the number of words correct range from 120 to 140.

Chart 3.2 is the class run chart for 2000 Essential Vocabulary. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2000 for Essential Vocabulary attained 15% correct in Week 1 and 74% correct in Week 30. The graph showed an upward trend of the data points with 10 data points showing all-time high points to that point in the school year. For example, in
Week 21, the class attained a percentage of 54% which was the highest percentage they achieved.

Charts 3.3 – 3.7 (See Appendix G) are student run charts for 2000 Essential Vocabulary for class periods one through five. With class sizes of 20 students in each class period, the total possible number of items correct is 200 words. It should be noted that for the purposes of data collection at the district level, each class size was set at twenty to maintain consistency. First period scores range from 36 to 121 words in Weeks 1 through 30 respectively. Second period scores ranged from 30 in Week 1 to 158 in Week 30. Third period scores ranged from 28 in Week 1 to 152 in Week 30. Fourth period scores ranged from 25 in Week 1 to 155 in Week 30. Finally, fifth period scores ranged from 35 to 153 in Week 1 through Week 30 respectively.
Chart 3.8 is the scatter diagram for 2001 Essential Vocabulary. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of words correct is 200 points. The number of the words correct range from 40 to 60 in Week 1. In Week 30, the number of words correct range from 120 to 160.

Chart 3.9 is the class run chart for 2001 Essential Vocabulary. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2001 for Essential Vocabulary attained 30% correct in Week 1 and 76% correct in Week 30. The graph showed an upward trend of the data points with 10 data points showing all-time high points to that point in the school year.

Charts 3.10 – 3.14 (See Appendix H) are student run charts for 2001 Essential Vocabulary for class periods one through five. First period scores range from 58 to 121 words in Weeks 1 through 30 respectively. Second period scores ranged from 70 in Week 1 to 145 in Week 30. Third period scores ranged from 50 in Week 1 to 152 in Week 30. Fourth period scores ranged from 52 in Week 1 to 157 in Week 30. Finally, fifth period scores ranged from 65 to 178 in Week 1 through Week 30 respectively.

Chart 3.15 is the scatter diagram for 2001 Fractions. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of fractions problems correct is 100 points. The number of the problems correct range from 20 to 35 in Week 1. In Week 30, the number of problems correct range from 70 to 80.
Chart 3.16 is the class run chart for 2001 Fractions. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2001 for Fractions attained 32% correct in Week 1 and 77% correct in Week 30. The graph showed an upward trend of the data points with 15 data points showing all-time high points to that point in the school year.

Charts 3.17–3.21 (See Appendix I) are student run charts for 2001 Fractions for class periods one through five. First period scores range from 36 to 84 words in Weeks 1 through 30 respectively. Second period scores ranged from 33 in Week 1 to 76 in Week 30. Third period scores ranged from 24 in Week 1 to 74 in Week 30. Fourth period scores ranged from 25 in Week 1 to 78 in Week 30. Finally, fifth period scores ranged from 34 to 75 in Week 1 through Week 30 respectively.

Chart 3.22 is the scatter diagram for 2001 Essential Concepts. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of concept questions correct is 100 points. The number of the questions correct range from 5 to 20 in Week 1. In Week 30, the number of questions correct range from 60 to 70.

Chart 3.23 is the class run chart for 2001 Essential Concepts. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2001 for Essential Concepts attained 22% correct in Week 1 and 66% correct in Week 30. The graph showed an upward trend of the data points with 14 data points showing all-time high points to that point in the school year.
Charts 3.24–3.28 (See Appendix J) are student run charts for 2001 Essential Concepts for class periods one through five. First period scores range from 34 to 67 words in Weeks 1 through 30 respectively. Second period scores ranged from 24 in Week 1 to 74 in Week 30. Third period scores ranged from 18 in Week 1 to 62 in Week 30. Fourth period scores ranged from 7 in Week 1 to 66 in Week 30. Finally, fifth period scores ranged from 21 to 64 in Week 1 through Week 30 respectively.
Chart 3.23

2001 Essential Concepts Class Run Chart

Normalized Scores (%) vs. Assessments

Student scores
Chart 3.8

2001 Essential Vocabulary Class Scatter Matrix
Chart 3.9

2001 Essential Vocabulary Class Run Chart

Normalized Scores (%)
Chart 3.16

2001 Fractions Chart Run Chart

Normalized Scores (%)
2002 Essential Information

Chart 3.29 is the scatter diagram for 2002 Essential Vocabulary. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of words correct is 200 points. The number of the words correct range from 40 to 80 in Week 1. In Week 30, the number of words correct range from 140 to 180.

Chart 3.30 is the class run chart for 2002 Essential Vocabulary. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2002 for Essential Vocabulary attained 37% correct in Week 1 and 86% correct in Week 30. The graph showed an upward trend of the data points with 13 data points showing all-time high points to that point in the school year.

Charts 3.31 – 3.35 (See Appendix K) are student run charts for 2002 Essential Vocabulary for class periods one through five. First period scores range from 82 to 183 words in Weeks 1 through 30 respectively. Second period scores ranged from 50 in Week 1 to 158 in Week 30. Third period scores ranged from 98 in Week 1 to 152 in Week 30. Fourth period scores ranged from 48 in Week 1 to 157 in Week 30. Finally, fifth period scores ranged from 86 to 184 in Week 1 through Week 30 respectively.

Chart 3.36 is the scatter diagram for 2002 Fractions. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of fractions problems correct is 100 points. The number of the problems correct range from 10 to 40 in Week 1. In Week 30, the number of problems correct range from 80 to 95.
Chart 3.37 is the class run chart for 2002 Fractions. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2002 for Fractions attained 24% correct in Week 1 and 89% correct in Week 30. The graph showed an upward trend of the data points with 11 data points showing all-time high points to that point in the school year.

Charts 3.38 – 3.42 (see Appendix L) are student run charts for 2002 Fractions for class periods one through five. First period scores range from 40 to 96 words in Weeks 1 through 30 respectively. Second period scores ranged from 27 in Week 1 to 92 in Week 30. Third period scores ranged from 16 in Week 1 to 90 in Week 30. Fourth period scores ranged from 23 in Week 1 to 82 in Week 30. Finally, fifth period scores ranged from 12 to 75 in Week 1 through Week 30 respectively.

Chart 3.43 is the scatter diagram for 2002 Essential Concepts. This is an eighth grade scatter matrix with each dot representing a class period. Continuous improvement is noted by the upward trend of the data points. With a class of 20 students, the possible number of concept questions correct is 100 points. The number of the questions correct range from 20 to 40 in Week 1. In Week 30, the number of questions correct range from 70 to 90.

Chart 3.44 is the class run chart for 2002 Essential Concepts. Each point represents the total number of corrected answers as a normalized score or percentage. The eighth grade class of 2002 for Essential Concepts attained 32% correct in Week 1 and 83% correct in Week 30. The graph showed an upward trend of the data points with 12 data points showing all-time high points to that point in the school year.
Charts 3.45 – 3.49 (See Appendix M) are student run charts for 2002 Essential Concepts for class periods one through five. First period scores range from 44 to 90 words in Weeks 1 through 30 respectively. Second period scores ranged from 29 in Week 1 to 80 in Week 30. Third period scores ranged from 24 in Week 1 to 86 in Week 30. Fourth period scores ranged from 26 in Week 1 to 81 in Week 30. Finally, fifth period scores ranged from 37 to 74 in Week 1 through Week 30 respectively.
2002 Essential Vocabulary
Class Run Chart
Chart 3.36

2002 Fractions Class Scatter Matrix

Scores

Assessments
2002 Essential Concepts
Class Run Chart

Normalized Scores (%)
Improved test scores are a by-product of improved learning (Jenkins, 2003). The use of standardized tests to determine student achievement is commonplace in many schools. In the eighth grade mathematics classroom, students are assessed using multiple assessment tools. Using three years of data collected after the implementation of the assessment approach *From LtoJ* in the area of Essential Vocabulary, comparisons show an improvement in percentage of students proficient on the Iowa Test of Basic Skills. In comparing the students as eighth graders in 1999 – 2000 and the same students as freshman in 2000 – 2001, the number of students proficient increased 7.9%. Similarly, the eighth graders of 2000 – 2001 as freshman in 2001 – 2002 increased the proficiency rate by 9.9%. The eighth graders of 2001-2002 increased the proficiency rate by 1.2% as freshman in 2002 – 2003.

The use of the Iowa Comprehensive Assessment of Mathematics at the eighth grade level is given to the students in the spring of each school year. Of most interest in analyzing the data for the ICAM is the low number of students who are considered at the low level. Eight students out of 140 students, or 5.7%, in 2002 – 2003 were considered to be a Level 1. In comparison, 11 students out of 125, or 9.6% in 2001 – 2002 were considered to be Level 1.

Through the use of the class period student run graphs, students saw the progression of learning. Students no longer had permission to forget essential information previously taught and had the essential information databases from which to preview upcoming essential information. In all the data collected and reviewed, learning was constant throughout the year. Perhaps the best indicator of success, however, cannot be
graphed. In speaking to educators at the high school levels, it was remarked that the retention of essential information from the eighth grade year to the freshman and sophomore years was evident in the high school classrooms (T. Peterson & B. Custer, personal communication, 2003). Less review was needed and less time was wasted providing time for more in-depth instruction of the curriculum (T. Peterson, personal communication, 2003).

Students were interviewed informally regarding their achievement and continuous improvement in the mathematics classroom and meticulous field notes were recorded as the assessment theory of From LtoJ was implemented and utilized during the process of data collection. Students were also asked to summarize their individual learning processes in their math journals. Middle school students seem to have valuable insights into their own thought processes. When presented with the question: Why does From LtoJ work in our classroom?” students’ replies carried the same general thoughts. Comments made included: “I think this works because it identifies what we need to learn, so I can focus on those things and track how I’m doing.” and “I have to know this stuff to do well.”
CHAPTER 4
SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary of Study
The importance of being mathematically literate in order to function in today's society has been well documented by educators and employers alike. Student learning is related to many factors and the most important may be different depending on the educational level of the student. Factors that influence learning may change as the goals and interests of students change. It is important for educators as well as parents to know that middle level students who have the opportunity to study concepts associated with algebra, geometry and statistics are more likely to develop their knowledge of these subjects and will then exhibit continued growth in those content areas (NCTM, 2000). Likewise a lack of emphasis on concepts in mathematics curriculum will impede student learning.

All middle school students should be engaged in learning curriculum that provides a balance of knowledge and skill acquisition (NCTM, 2000). From LtoJ provides a varied approach to instructional practices as well as a means for adolescents to develop a lasting understanding of mathematical concepts and skills. With From LtoJ, students are actively engaged in their own learning as they demonstrate knowledge of mathematics.

Mathematics assessment must reflect what is important for student to learn, rather than what is easy to assess. Rather than serving as tool to measure learning, the From
LtoJ assessments served as a tool to organize the learning of essential information. The primary academic and conceptual needs identified were:

- Basic skill (essential concepts, vocabulary, and fractions) development and retention,
- Building student understanding of the curriculum; and
- Building confidence in the knowledge of the curriculum (Jenkins, 2003).

In using the From LtoJ process, the focus of assessment became improvement rather than grades and performance relative to peers, progress rather than fixed achievement and a student’s next steps to learning rather than past accomplishments.

Students can succeed in this program even if their basic skills are deficient.

Even though From LtoJ is more difficult than the traditional drill or rote method students formerly used to demonstrate their learning, it caused less stress for the students. In documented field notes, students agreed that From LtoJ helped them in some way with basic understanding of important mathematical concepts. Students responses echo this process:

- The program was fun, way better than just doing assignments.
- From LtoJ taught us new ways to understand mathematics.
- From LtoJ helped us learn to solve problems and made us think.
- It was a challenge every week, but I became confident in my abilities. I always wanted to do better each week.

The assessment approach, From LtoJ, provided:

- continual feedback for both the students and teacher,
- a team approach to learning and instruction,
a means to improve the working and learning processes, and
increased cooperation and communication as students and teacher work
toward continuous improvement.

The nature and purpose of this study was to gather descriptive information
concerning the assessment approach From LtoJ and student achievement. By becoming
actively engaged in this process, the benefits included: the immediate monitoring of
student progress on the acquisition of the essential information; increased student
motivation to learn and retain essential information; and increased student perception as a
community of learners (Jenkins, personal communication, 2003).

Through the implementation of this long-term improvement strategy, students
displayed greater achievement on the passing rates. The curriculum was presented in a
continuous manner. Students learn to internalize and retain knowledge. Weekly quizzes
are given to emphasize understanding. The quizzes which are based on the standards and
benchmarks of the curriculum develop both basic and new skills as well as retention of
prior learning. One of Deming’s principles for management is to “drive out fear.” This
process of continuous improvement built confidence and the instant feedback helped
boost that confidence while quickly identifying where weaknesses in individual and class
learning lie.

Rather than a teaching system, From LtoJ can be considered a learning system by
providing a focus that makes the learning of the essential information explicit. As the
authors of Principles and Standards for School Mathematics suggest, “Classrooms in
which students are encouraged to present their thinking and in which everyone
contributes by evaluating one another’s thinking provide rich environments for learning mathematical reasoning” (NCTM, 2000, pg. 57).

The primary aim of the From LtoJ implementation focused on increased student success and the reduction of failure. Students had time to create their own knowledge, to learn concepts and skills and were given opportunities to see material over and over until learning and retention took place. Students’ problem-solving and higher level thinking skills improved but mathematics communication improved as well through the From LtoJ implementation.

Implications of Data Results

The ultimate goals of education are performance and achievement. The goal in the eighth grade mathematics classroom was to implement an assessment approach where continuous improvement could take place. The essential element of continuous improvement is to score higher than the individual student, class period or grade level, ever have before.

Students understand from the data collected and posted in the classroom that essential information assessments are providing feedback about their learning as well as continuous improvement in the area of mathematics. While students in the classroom kept individual student run charts, the class scatter matrices, the class run charts, and the class period run charts were the focus for the instructor. When students saw that they were moving together toward improvement as a team, they expressed more confidence about themselves and their abilities. (Various students, personal communication, 2001-2003).
Continuous improvement was not about group totals versus individual effort; it was about both combined. Class run charts were valuable in that they gave a view of learning over time. The use of the scatter matrix provided an overview of how all class periods were performing as a grade level.

At the beginning of the school year, scores are low, in part, to the learning process required to introduce the procedures to the students. Lack of retention of prior instruction was also a factor in the low scores. However, the students’ ability to do the vocabulary, fractions, and concepts quizzes increased over time and an upward scoring trend was established in the graphs.

As the process continued in 2002 – 2003, the class run chart and the individual class student run charts, students made gains in all areas of essential information. Through the continued use of the *From LtoJ* learning process, learning was improved and students experienced a growth in knowledge.

Educators have an opportunity to alter the negative attitudes and strengthen more positive attitudes toward mathematics by promoting better classroom practices and by providing positive experiences in mathematics. In regards to mathematics instruction in the middle level classroom, the NCTM (1987) recommended:

- basic skills in mathematics be defined to encompass more than computational facility,
- the success of mathematics programs and student learning should be evaluated by a wider range of measures than conventional testing, and
more mathematics study should be required for all students and a flexible curriculum with a greater range of options be designed to accommodate the diverse needs of the student population.

The *From LtoJ* process addresses each of these points by providing a deeper understanding of mathematics through the use of frequent assessments. These frequent assessments, whether done weekly or otherwise, evaluate student learning. The presentation of the essential information throughout the curriculum provides flexibility to meet diverse learner needs and gives direction for instructional improvement. The teacher can constantly monitor the students as individuals and as a whole. The collection of assessment data in an on-going manner provides the teacher with feedback during instruction as to the areas or concepts that need continued focus for increased improvement.

The use of *From LtoJ* meets all three mathematics recommendations through the implementation of vocabulary, conceptual and computational assessments. This assessment approach implementation provides a flexible curriculum and evaluation method to meet the needs of all learners, not just the high achievers. Because one of the few places students must “talk mathematics” is in the classroom, teachers must give attention to mathematical language learning. Identification must be made of the difficulties in learning mathematical language and some strategies to deal with these difficulties. Teachers must increase their sensitivity to issues in language learning and create strategies to help students become fluent in mathematical communication.
At a time when middle school students' enthusiasm toward learning decreases incrementally, granting autonomy to a student appears to be less of a motivating factor than increasing feedback from their graphed assessment data. This feedback enhances a student's sense of competence through involvement.

**Recommendations**

The following recommendations should be considered in the middle school mathematics classroom:

1. Educators must take advantage of every opportunity to use strategies that reinforce intrinsic motivation to sustain effort throughout a student’s education.
2. Students should see their assessment data frequently graphed and displayed.
3. Interaction with assessment data by students should be frequent, in order for them to see and value progress being made.

Of all the reform recommendations made by the NCTM, making mathematical connections is among the more difficult to achieve. At the middle school level, students are beginning to appreciate the real power of mathematics. Mathematical connections can relate mathematical topics to students’ daily lives and to other mathematical topics but are probably most helpful in relating mathematics to other curriculum areas. These connections help students understand mathematics better and see it as a useful and interesting subject to study.

Based on data collected, the following actions were deemed necessary:

- Revision of the middle school math essential information to narrow the focus and limit the amount of mastery information items per grade level.
Revision of problem and test item databases to make them more concise.

Establishment of essential information should include "real-world" problem assessment, such as time, money, and measurement to provide an appreciation of mathematics is used outside the school setting.

Establishment of essential information databases at sixth and seventh grade levels to provide continuous improvement at all middle levels. Student learning can be improved with "current grade (to learn), prior grade (to review), and future grades (for information)" (Jenkins, 2003).

The development of a specific assessment instrument to be administered at beginning and end of the year assessing the retention of essential information.

Disaggregation of collected data for specific assessment instrument into various sub-groups to gain insight regarding instruction for those sub-groups.

Further data needs to be collected regarding the frequency of assessment data displayed and how viewing the results in graphic form influences the students' motivation to learn.

Continuous improvement is needed to improve student learning. The implementation of the stated recommendations may further improve student learning and increase student achievement.

Conclusion

"What we assess we must value" (Jenkins, 2003, personal communication). Many studies have been done in regards to both student achievement and math assessment as separate issues. From LtoJ provides a means for ongoing data collection to adjust teaching strategies throughout the year to improve the quality of learning by end of the
Middle level teachers “must do everything possible to enhance the probability of every student being successful” (Stevenson, 1992, p. 215). The assessment approach From LtoJ offers students the means to construct their own knowledge while retaining essential information. Higher order thinking skills emerge from basic skills to improve student achievement. Continuous improvement is the focus of the teaching and the learning when From LtoJ is implemented in the middle school mathematics classroom.
REFERENCES


Appendix A – Letter of Permission

April 21, 2003

TO WHOM IT MAY CONCERN:

Toni Andersen, 8th grade math teacher at HCMS, has access and permission to use any data collected by the school district for the purpose of completing her master's degree in middle level education.

Sincerely,

Teresa Coenen
Principal
Appendix B: Turning Points: Preparing American Youth for the 21st Century

Recommendations for Transforming Middle Grade Schools

The Task Force calls for middle grade schools that:

➢ Create small communities for learning where stable, close, mutually respectful relationships with adults and peers are considered fundamental for intellectual development and personal growth. The key elements of these communities are schools-within-schools or houses, students and teachers grouped together as teams, and small group advisories that ensure that every student is known well by at least one adult.

➢ Teach a core academic program that results in students who are literate, including in the sciences, and who know how to think critically, lead a healthy life, behave ethically, and assume the responsibilities of citizenship in a pluralistic society. Youth service to promote values for citizenship is an essential part of the core academic program.

➢ Ensure success for all students thought elimination of tracking by achievement level and promotion of cooperative learning, flexibility in arranging instructional time, and adequate resources (time, space, equipment and materials) for teachers.

➢ Empower teachers and administrators to make decisions about the experiences of middle grade students through creative control by teachers over the instructional program linked to greater responsibilities for students’ performance, governance committees that assist the principal in designing and coordinating school-wide programs, and autonomy and leadership within sub-
schools or houses to create environments tailored to enhance the intellectual and emotional development of all youth.

- Staff middle grade schools with teachers who are expert at teaching young adolescents and who have been specially prepared for assignment to the middle grades.

- Improve academic performance through fostering the health and fitness of young adolescents, by providing a health coordinator in every middle grade school, access to health care and counseling services, and a health-promoting school environment.

- Reengage families in the education of young adolescents by giving families meaningful roles in school governance, communicating with families about the school program and student’s progress, and offering families opportunities to support the learning process at home and at the school.

- Connect schools with communities, which together share responsibility for each middle grade student’s success, through identifying service opportunities in the community, establishing partnerships and collaborations to ensure students’ access to health and social service, and using community resources to enrich the instructional program and opportunities for constructive after-school activities.

Appendix C: *From LtoJ* Concepts

Variation and Classroom Graphing

1. *From LtoJ* is used to measure learning of information, student performance, student enthusiasm, classroom management (i.e. attendance, behavior), and to meet special education requirements.

2. Process measurement provides feedback during the course. Results measurements are the final data at year's end or data from standardized assessments.

3. The three basic graphs are the class run chart, student run chart, and the scatter diagram.

4. The student overlay combines the student run chart and scatter diagram to precisely answer the question, "How is my child doing compared to other students?"

5. Effective use of data requires the study of patterns and trends, not merely two data points.

6. Random sampling of end-of-the-year items provides students a constant review of what has been taught and a constant preview of what is yet to come.

7. The square root of "n" is an ample sample size for accurate data, if collected weekly or bi-weekly.

8. The classroom (or department/school) histogram's shape should progress from an "L" to a bell and finally to a "J".

9. There are two kinds of variation: special and common.

10. Seven points in a row are needed to rule out good and bad luck.

11. The four generations of management are (1) I'll do it myself, (2) do it the way I tell you, (3) management by objective, and (4) agree on an aim and work together to accomplish it.

12. Data can be disaggregated to see how sub-sets of students are performing and aggregated to study whole grade levels and departments.

13. Ranks data should be replaced with control charts.
System
14. The seven elements of a system are: aim, input, supply, process, feedback, customers, and output.
15. The primary aim of schools is to increase student success and reduce failure.
16. Dr. Deming estimated that problems are the fault of the system of 96% of the time and of the people 4% of the time.
17. There's no shortage of good people -- unless we choose to create one.
18. The improve system results, work on system processes.
19. A clear aim unifies people and practices.

Epistemology
20. The learning sequence is data, graph the data, gain insight, test hypotheses, and gain knowledge.
21. Experience is not the best teacher; continually testing theories is.
22. It takes one example contrary to a theory to require that you revisit the theory.
23. Ask why at least five times to search out root causes.
24. Information is about the past; performance is learned to create a better future.
25. The #1 requirement of leaders is to create more leaders.
26. Dr. Deming's learning cycle has four parts: plan, do, study, and act.

Psychology
27. Dr. Deming called the Western Society practices of destroying people's self-worth, "The Forces of Destruction." These forces include stars, grades, incentives, management by numbers alone, and management by objectives.
28. It is not the responsibility of educators to motivate students but to determine what is causing them to lose their motivation and stop such practices.
29. A major responsibility of all leaders is to drive out fear from their organizations.
30. Leaders help people remove system barriers.
Appendix D – Essential Information – Essential Vocabulary Database

The Top Vocab! – Mathematical Vocabulary

There are words in the real world that are math related. We should know these words so that we can read, write, and, most importantly, think mathematically. This list contains math vocabulary used in 8th grade math. You are familiar with some of the words, while others will be new. Each week, there will be a quiz consisting of ten vocabulary words chosen randomly from this list. They may be repeated from one week to the next week or they may not. That’s random!

Your responsibility is to learn these words and retain the definitions as we progress through the school year.

1. Algebra – a study of arithmetic in which symbols, usually letters, represent numbers
2. Order of operations – the rules to follow when more than one operation is used
3. Variable – a symbol, usually a letter, used to represent a number in mathematical expressions or sentences
4. Exponent – in a power, the number of times the base is used as a factor.
5. Factor – when two or more numbers are multiplies, each number is a factor of the product.
6. Power – a number that can be written using an exponent.
7. Base – in a power, the number used as a factor, or the base of a parallelogram or a triangle is any side of the figure, or in a percent proportion, the number to which the percentage is compared, or the bases of a prism are the two parallel congruent faces.
8. Associative property of equality – \((a + b) + c = a + (b + c)\) or \((ab)c = a(bc)\)
9. Commutative property of equality – \(a + b = b + a\) or \(ab = ba\)
10. Evaluate – to find the value of an expression by replacing the variables with numerals.
11. Addition property of equality – If you add the same number to each side of an equation, the two sides remain equal. If \(a = b\), then \(a + c = b + c\).
12. Subtraction property of equality – If you subtract the same number to each side of an equation, the two sides remain equal. If \(a = b\), then \(a - c = b - c\).
13. Inverse operation – pairs of operations that undo each other. Addition and subtraction are inverse operations. Multiplication and division are inverse operations.
14. Division property of equality – if the same nonzero number divides each side of an equation, then the two sides remain equal. If \(a = b\), then \(a ÷ c = b ÷ c\).
15. Multiplication property of equality – If each side of an equation is multiplied by the same number, then the two sides remain equal. If \(a = b\), then \(ac = bc\).
16. Distributive property – the sum of two addends multiplied by a number is the sum of the product of each addend and the number. \(a(bc) = \)
17. Rectangle – a quadrilateral with four congruent angles but not four congruent sides
18. Perimeter – the distance around a geometric figure
19. Square – a parallelogram with all sides and all angles congruent
20. Parallelogram – a quadrilateral with two pairs of parallel sides and congruent angles
21. Area – the number of square units needed to cover a surface enclosed by a geometric figure
22. Altitude – a segment in a quadrilateral that is perpendicular to both bases, with endpoints on the base lines or the segment that goes from the vertex of a cone to its base and is perpendicular to the base
23. Height – the length of the altitude of a triangle or a quadrilateral
24. Inequality – a mathematical sentence that contains one of the following signs: <, >, =, ≤, ≥, or ≠.
25. Integer – positive and negative whole numbers
26. Graph – to draw or plot the points named by those numbers on a number line or coordinate plane
27. Coordinate – the number associated with a point on the number line or coordinate plane
28. Absolute value – the number of units a number is from zero on the number line
29. Opposite – two integers are opposites if they are represented on the number line by points that are the same distance from zero, but on opposite sides of zero. The sum of opposites is zero.
30. Additive inverse – two integers that are opposites of each other
31. Matrix – a rectangular arrangement of elements in rows and columns
32. Row – numbers side-by-side horizontally
33. Column – numbers stack on top of each other in a vertical arrangement
34. Element – each number in a matrix is called an element
35. Coordinate system – a plane in which a horizontal number line and a vertical number line intersect at their zero points
36. Origin – the point of intersection of the x-axis and y-axis in a coordinate system
37. X-axis – the horizontal number line which helps to form the coordinate system
38. Y-axis – the vertical number line of the two perpendicular number lines in the coordinate system
39. Quadrant – one of the four regions into which two perpendicular number lines separate the coordinate plane
40. Ordered pair – a pair of numbers used to locate a point in the coordinate system (x, y)
41. Ratio – a comparison of two numbers by division
42. Rate – in a percent proportion, the ratio of a number to 100 or a ratio of two measurements having different units
43. Unit rate – a rate with a denominator of one
44. Proportion – a statement of equality of two or more ratios
45. Percent – a ratio that compares a number to 100
46. Frequency table – a table for organizing a set of data that shows the number of times each item or number appears
47. Statistics – the branch of mathematics that deals with collecting, organizing, and analyzing data
48. Bar graph – a graphic form using bars to make comparisons of statistics
49. Histogram – a special type of bar graph that displays the frequency of data that has been organized into equal intervals. The intervals cover all possible values of data; therefore there are no spaces between the bars of the graph.
50. Circle graph – a type of statistical graph used to compare parts of a whole
51. Line plot – a graph that uses an X above number on a number line each time that number occurs in a set of data.
52. Data analysis – to study data and draw conclusions from the numbers observed
53. Cell – the basic unit of a spreadsheet; can contain data, labels, or formulas
54. Mean – the sum of the numbers in a set of data divided by the number of pieces of data
55. Median – the middle number in a set of data when the data are arranged in numerical order
56. Mode – the number or item that appears most often in a set of data
57. Range – the set of output values in a function or the difference between the greatest number and the least number in a set of data
58. Scatter plot – a type of graph that shows the general relationship between two sets of data
59. Parallel lines – lines in the same plane that do not intersect. The symbol \( \parallel \) means parallel.
60. Vertical angles – congruent angles formed by the intersection of two lines
61. Supplementary angles – if the sum of the measures of two angles is 180 degrees
62. Polygon – a simple closed figure in a plane formed by three or more line segments
63. Triangle – a polygon having three sides and three angles
64. Acute angle – an angle with a measure greater than 0 degrees and less than 90 degrees
65. Right angle – an angle that measures 90 degrees
66. Obtuse angle – an angle that measures greater than 90 degrees but less than 180 degrees
67. Scalene – a triangle with no congruent angles
68. Isosceles – a triangle that has two congruent sides
69. Equilateral – all sides of a figure are congruent
70. Perpendicular – two lines or line segments that intersect to form right angles
71. Complementary angles – if the sum of the measures of two angles is 90 degrees
72. Quadrilateral – a polygon having four sides
73. Rhombus – a parallelogram with four congruent sides and two pairs of congruent angles
74. Trapezoid – a quadrilateral with exactly one pair of parallel sides.
75. Line symmetry – figures that match exactly when folded that divides a figure into two halves that are reflections of each other.
76. Reflection – a type of transformation where a figure is flipped over a line of symmetry.
77. Rotation – when a figure is turned around a central point.
78. Rotational symmetry – a figure has rotational symmetry if it can be turned less than 360 degrees about its center and still looks like the original
79. Congruent triangles – triangles that have the same size and shape.
80. Similar triangles – triangles that have the same shape but may not have the same size.
81. Tessellation – a repetitive pattern that fit together with no holes or gaps.
82. Transformation – movements of geometric figures to modify tessellations.
83. Translation – a method used to make changes in the polygons of tessellations by sliding a figure horizontally, vertically, or both.
84. Prime number – a whole number greater than 1 that has exactly two factors, 1 and itself
85. Composite number – any whole number greater than 1 that has more than two factors.
86. Prime factorization – expressing a composite number as the product of prime numbers.
87. Factor tree – a diagram showing the prime factorization of a number.
88. Fundamental theorem of arithmetic – a property of numbers that states every number has a unique set of prime factors.
89. Greatest common factor – the greatest of the common factors of two or more numbers.
90. Rational number – numbers of the form \( \frac{a}{b} \), when \( a \) and \( b \) are integers and \( b \neq 0 \).
91. Terminating decimal – a decimal whose digits end. Every terminating decimal can be written as a fraction with a denominator of \( 10, 100, 1,000, \text{ and so on} \).
92. Repeating decimal – a decimal whose digits repeat in groups of one or more.
93. Bar notation – in repeating decimals the line or bar placed over the digits that repeat.
94. Probability – the chance that some event will happen. It is the ratio of the number of ways a certain event can occur to the number of possible outcomes.
95. Multiple – the product of a number, a variable and any whole number. 28 is a multiple of 4 and.
96. Least common multiple – the least of nonzero common multiples of two or more numbers.
97. Least common denominator – the least common multiple of the denominators of two or more fractions.
98. Scientific notation – a way of expressing numbers as the product of a number that is at least 1 but less than 10 and a power of ten.
99. Mixed number – the sum of a whole number and a fraction (for example: 6 2/3)
100. Multiplicative inverse – a number times its multiplicative inverse is equal to 1.
101. Reciprocal – the multiplicative inverse of a number
102. Sequence – a list of numbers in a certain order, such as 2, 4, 6, 8, 10 and so on.
103. Term – a number, variable, or a product of number and variables or a number in a sequence
104. Arithmetic sequence – a sequence of numbers in which you can find the next term by adding the same number to the previous term.
105. Geometric sequence – when multiplying by a constant factor, the sequence, forms consecutive terms of a sequence
106. Circle – the set of all points in a plane that are the same distance from a given point called a center
107. Center – the given point from which all points on a circle or sphere are the same distance
108. Radius – the distance from the center of a circle to any point on the circle
109. Diameter – the distance across a circle through its center
110. Circumference – the distance around a circle
111. Percentage – in a percent proportion, a number (P) compared to another number called the base (B)
112. Discount – the amount by which the regular price is reduced
113. Markup – the difference between the price paid by the merchant and the increased selling price
114. Selling price – the amount the customer pays for an item
115. Interest – the amount charged or paid for the use of money
116. Principal – the amount of an investment or debt

117. Similar polygons – polygons are similar if the corresponding angles are congruent and their corresponding sides are in proportion

118. Pentagon – a polygon having five sides

119. Scale drawing – a drawing that is similar but either larger or smaller than the actual object

120. Scale model – a replica of an original object that is either too large or too small to be built at actual size

121. Scale – the ratio of a given length on a drawing or model to its corresponding length in reality

122. Dilation – the process of reducing or enlarging an image in mathematics

123. Scale factor – the ratio of a dilated image to the original image

124. Perfect square – a rational number whose square root is a whole number

125. Square root – one of the two equal factors of a number

126. Radical sign – the symbol used to indicate a nonnegative square root

127. Irrational number – a number that cannot be expressed as a fraction

128. Real number – the set of rational numbers together with the set of irrational numbers

129. Hypotenuse – the side opposite the right angle in a right triangle

130. Legs – the two sides of a right triangle that form the right angle

131. Pythagorean Theorem – in a right triangle, the square of the length of the hypotenuse is equal to the sum of the squares of the lengths of the legs $c^2 = a^2 + b^2$

132. Function – a relation in which each element of the input is paired with exactly one element of the output according to specified rule

133. Function table – a table organizing the input, rule, and output of a function

134. Domain – the set of input values in a function

135. Linear function – an equation in which the graphs of the solutions form a line

136. Solid – a three-dimension figure

137. Prism – a three-dimension figure that has two parallel and congruent bases in the shape of polygons

138. Edge – the intersection of faces of a three-dimensional figure

139. Vertex – the point of a prism where the faces intersect

140. Pyramid – a solid figure that has a polygon for a base and triangles for sides

141. Volume – the number of cubic units need to fill the space occupied by a solid

142. Circular cylinder – a cylinder with two bases that are parallel, congruent circular regions

143. Circular cone – a shape in space that has a circular base and one vertex

144. Surface area – the sum of the areas of all the faces of a three-dimensional figure

145. Tree diagram – a diagram used to show the total number of possible outcomes in a probability experiment

146. Monomial – a number, variable, or a product of a number and one or more variables

147. Polynomial – the sum or difference of two or more monomials

148. Binomial – a polynomial with exactly two terms

149. Factoring – finding the factors of a product

150. Trinomial – a polynomial with three terms
# FABULOUS FRACTIONS

<table>
<thead>
<tr>
<th>SKILL NUMBER</th>
<th>SKILL</th>
<th>EXAMPLES</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>ADDITION OF FRACTIONS</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/8 + 1/10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7/12 + 1/3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/7 + 9/28</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/8 - 3/5</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td><strong>SUBTRACTION OF FRACTIONS</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3/25 - 1/50</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/3 - 1/4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 ½ - 1 5/6</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 3/8 - 1/2</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td><strong>MULTIPLICATION OF FRACTIONS</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>5/16 x 1/5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4/5 x 3/4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 1/3 x 3/5</td>
<td></td>
</tr>
<tr>
<td></td>
<td>16/3 x 1/8</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td><strong>DIVISION OF FRACTIONS</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>¾ ÷ ½</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 ÷ 6/7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1/8 ÷ 1/3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1 ¼ ÷ 3 ½</td>
<td></td>
</tr>
</tbody>
</table>
# Appendix F - Essential Information – Essential Concepts Examples

<table>
<thead>
<tr>
<th>Skill Number</th>
<th>Skill</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Add the negative integers.</td>
<td>-4 + 7</td>
</tr>
<tr>
<td>2</td>
<td>Subtract the negative integers.</td>
<td>9 - -5</td>
</tr>
<tr>
<td>3</td>
<td>Multiply the negative integers.</td>
<td>4 x -3</td>
</tr>
<tr>
<td>4</td>
<td>Divide the negative integers.</td>
<td>-8 ÷ 4</td>
</tr>
<tr>
<td>5</td>
<td>Use order of operation.</td>
<td>7(6 - 4) + 3</td>
</tr>
<tr>
<td>6</td>
<td>Solving one step algebraic equations.</td>
<td>9 + n = 26</td>
</tr>
<tr>
<td>7</td>
<td>Solving two step algebraic equations.</td>
<td>3x - 4 = 7</td>
</tr>
<tr>
<td>8</td>
<td>Solve and graph one step inequalities.</td>
<td>n - 9 &lt; 26</td>
</tr>
<tr>
<td>9</td>
<td>Use a formula to solve a problem.</td>
<td>A = l + w</td>
</tr>
<tr>
<td>10</td>
<td>Apply the commutative property.</td>
<td>Rewrite 6 + 4</td>
</tr>
<tr>
<td>11</td>
<td>Apply the associative property.</td>
<td>Rewrite (9 + 3) + 7</td>
</tr>
<tr>
<td>12</td>
<td>Apply the distributive.</td>
<td>Rewrite 7(3 + 8)</td>
</tr>
<tr>
<td>13</td>
<td>Combine like terms.</td>
<td>3(x + 4x)</td>
</tr>
<tr>
<td>14</td>
<td>Solving open addition problems.</td>
<td>X + 7 = 29</td>
</tr>
<tr>
<td>15</td>
<td>Solving open subtraction problems.</td>
<td>M - 4 = 13</td>
</tr>
<tr>
<td>16</td>
<td>Solving open multiplication problems.</td>
<td>7w = 35</td>
</tr>
<tr>
<td>17</td>
<td>Solving open division problems.</td>
<td>Q + 14 = 6</td>
</tr>
<tr>
<td>18</td>
<td>Solving proportions.</td>
<td>X = 10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3 15</td>
</tr>
<tr>
<td>19</td>
<td>Solve linear equations.</td>
<td>2x + y = 10</td>
</tr>
<tr>
<td>20</td>
<td>Estimate to solve a problem.</td>
<td>203 x 19</td>
</tr>
<tr>
<td>21</td>
<td>Translate verbal phrases into algebraic</td>
<td>7 less than twice a</td>
</tr>
<tr>
<td></td>
<td>expressions.</td>
<td>number q.</td>
</tr>
</tbody>
</table>
Appendix G – Chart 3.3 – 2000 Essential Vocabulary
Chart 3.4 – 2000 Essential Vocabulary

2000 Essential Vocabulary Student Run Chart for 2nd Period

Scores for 2nd Period

Assessments

Week 1
Week 2
Week 3
Week 4
Week 5
Week 6
Week 7
Week 8
Week 9
Week 10
Week 11
Week 12
Week 13
Week 14
Week 15
Week 16
Week 17
Week 18
Week 19
Week 20
Week 21
Week 22
Week 23
Week 24
Week 25
Week 26
Week 27
Week 28
Week 29
Week 30

0 20 40 60 80 100 120 140 160 200

72
2000 Essential Vocabulary
Student Run Chart for 4th Period

Scores for 4th Period

Assessments

Week1
Week2
Week3
Week4
Week5
Week6
Week7
Week8
Week9
Week10
Week11
Week12
Week13
Week14
Week15
Week16
Week17
Week18
Week19
Week20
Week21
Week22
Week23
Week24
Week25
Week26
Week27
Week28
Week29
Week30
2000 Essential Vocabulary
Student Run Chart for 5th Period
Appendix H – Chart 3.10 – 2001 Essential Vocabulary

[Chart showing scores for 1st Period with assessments for each week from Week 1 to Week 20]
Chart 3.11 – 2001 Essential Vocabulary

Student Run Chart for 2nd Period

Scores for 2nd Period

Assessments
Chart 3.12 – 2001 Essential Vocabulary

2001 Essential Vocabulary Student Run Chart for 3rd Period

Scores for 3rd Period

Assessments
Chart 3.13 – 2001 Essential Vocabulary

2001 Essential Vocabulary Student Run Chart for 4th Period

Scores for 4th Period

Assessments

Week1
Week2
Week3
Week4
Week5
Week6
Week7
Week8
Week9
Week10
Week11
Week12
Week13
Week14
Week15
Week16
Week17
Week18
Week19
Week20
Week21
Week22
Week23
Week24
Week25
Week26
Week27
Chart 3.14 – 2001 Essential Vocabulary

2001 Essential Vocabulary
Student Run Chart for 5th Period

Scores for each period

Assessments
Chart 3.19 – 2001 Computation of Fractions

Scores for 3rd Period
Chart 3.20 – 2001 Computation of Fractions

2001 Fractions
Student Run Chart for 4th Period

Scores for 4th Period
Chart 3.21 – 2001 Computation of Fractions
2001 Essential Concepts
Student Run Chart for 1st Period

Scores for 1st Period

Assessments
Chart 3.25 – 2001 Essential Concepts

2001 Essential Concepts
Student Run Chart for 2nd Period

Assessments

Scores for 2nd Period

87
2001 Essential Concepts
Student Run Chart for 4th Period

Scores for 4th Period

Assessments
Scores for 5th Period

Chart 3.28 – 2001 Essential Concepts
Appendix K - Chart 3.31 - 2002 Essential Vocabulary

2002 Essential Vocabulary Student Run Chart for First Period

Scores for First Period

Assessments
Chart 3.32 – 2002 Essential Vocabulary

2002 Essential Vocabulary
Student Run Chart for Second Period

Scores for Second Period

Assessments

Week 1 - Week 30
Chart 3.35 – 2002 Essential Vocabulary
Appendix L – Chart 3.38 – 2002 Computation of Fractions
Chart 3.39 – 2002 Computation of Fractions
Chart 3.40 – 2002 Computation of Fractions
Chart 3.41 – 2002 Computation of Fractions
Chart 3.42 – 2002 Computation of Fractions

2002 Fractions
Student Run Chart for Fifth Period

Assessments

Scores for Fifth Period
Chart 3.46 – 2002 Essential Concepts
Scores for Third Period

Chart 3.47 – 2002 Essential Concepts
Chart 3.49 – 2002 Essential Concepts

2002 Essential Concepts
Student Run Chart for Fifth Period

Scores for Fifth Period

Assessments

0 10 20 30 40 50 60 70 80 90 100

105
<table>
<thead>
<tr>
<th>Number and Operation</th>
<th>Data Analysis and Probability</th>
<th>Measurement</th>
<th>Algebra</th>
<th>Geometry</th>
</tr>
</thead>
</table>
| Demonstrates ability to compute using addition and multiplication properties and order of operations with whole numbers, rational numbers, and integers. | Use various tools to organize and interpret data  
- Creates, reads, and interprets various kinds of graphs (i.e., histograms, line graphs, stem and leaf plots, box-and-whisker plots)  
- Identify and use measures of central tendencies (mean, median, mode). | Understand conversions and relationships within systems  
- Converts units of length, capacity and mass in customary and metric systems.  
Uses tools and techniques for determining area and volume  
- Find the area of various types of two-dimensional figures  
- Find the surface area and volume of prisms  
- Find the volume of cylinders. | Demonstrate the ability to solve linear equations.  
- Solve one-step equations using rational numbers.  
- Solve two-step equations with one variable term (i.e., 3x-2=34). | Understands and applies geometric properties in order to solve problems.  
- Use proportions to solve problems involving similar figures.  
- Use the Pythagorean Theorem to find the lengths of sides of right triangles. |
| Computes using the 4 basic operations with rational numbers. | Demonstrates an understanding of probability  
- Find the probability of one or more events. | | | |
| Simplifies powers, exponents, and square roots. | | | | |
| Uses order of operations to simplify expressions. | | | | |
| Find equivalent forms of decimals, fractions, and percents. | | | | |
| | | | | |