WPS MCAS Experience (Class of 2003): Implications for the High School Principals

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Introduction

This project was developed as an extension of a prior IQP project aimed at collecting and organizing Myers-Briggs Type Indicator (MBTI) data and performance data for the Class of 2003 in the Worcester Public School system. The performance data included coursework including transcript data, 8th grade MCAS and 10th grade MCAS scores. Although past groups, with the cooperation of area high schools, had created a reasonably complete data set, it was brought to our attention that the data set for the Class of 2003 contained a major hole due to the absence of MBTI data for South High School.

These data had been routinely collected at the end of the 2001-2002 school year, but after an employee at the Central Administration Building took sick, the collected data was misplaced and never recovered due to turnover in that office. This left a less than ideal situation for analyzing the system-wide MCAS data. A prior effort to re-administer the MBTI at South High resulted in collection of this information from about 100 of the 221 students in the Class of 2003 at South High. We decided that was not enough to be representative of the class and looked into the possibility of a follow-up data collection effort. At this point, our group decided to complete the data collection, better organize it, and produce an analysis of MCAS data in terms of the MBTI that would be useful to teachers, principals and guidance counselors for all five high schools, but especially South High. Interaction with Guidance Staff at South High led to a focus on those students who had taken the MCAS, which we thought would be virtually everyone. Actually, a number of students were off site in special programs or exempted for one reason or another. A list of about 75 additional students that should be added to the data set was compiled. In the end we collected data from about 50 of these. One homeroom

never did cooperate, and it was a cluster of especially strong (Honor and AP) students. This was our most serious lapse, but it produces a conservative bias in the sample. At least we know the average scores are not inflated by systematically missing the weaker students who are absent more, and less cooperative.

The main goal for analysis was to give useful feedback to local administrators that would identify correlations within the data based on personality type, 8th grade MCAS scores, and level of coursework which would serve as predictors of how a student will perform on the MCAS later in their high school career. The MCAS now plays a vital role in the career of a high school student, determining whether or not a student will ultimately be allowed to graduate from high school.

Specific study questions were proposed to direct our analysis with local administrators in mind. We figured that they would want ways of identifying those students at highest risk of failing the MCAS. In addition, they might want to know why they are predisposed to fail compared to their classmates that are generally more likely to pass. We wanted to indirectly urge them to develop plans to help these "at-risk" students early on. We also hoped to prove that there is a need for and value to continuing the collection of MBTI data, despite budget constraints. If a case could be made that it would improve the overall success rate of Worcester's students on the MCAS, this expense would be considered a bargain at the price of $5.00 per student, and we think it can be done for even less if certain economies of scale can be realized.

The proposed study questions are the following:

1. Based on 9th grade GPA and individual course grades, which students by MBTI type (learning style), course background, or average grade are most likely to struggle with the MCAS at the end of grade 10?

2. Are 8th grade MCAS scores a trustworthy predictor of how a student will perform on the MCAS in high school two years later – at least in terms of which students will fail the 10th grade MCAS?

3. What is the failure rate of each learning type based on the difficulty level of their course work in that subject?

4. Will students with the same learning type consistently do significantly better or worse than other types, or do they have different averages, but a lot of overlap in the score distributions?

5. Is the difficulty of academic courses in 9th and 10th grade a better indicator of MCAS scores in 10th grade than the 8th grade MCAS?

6. If there is a relationship between learning type and difficulty of courses, and outcome of 10th grade MCAS scores are both significant, can a substantially better prediction be made by combining these two variables into a composite index?

7. Is there a relationship between MBTI type and the correlation between student academic performance and standardized test scores? (Are some types more "predictable" performers based on their grades than others?)

8. Can a recommendation for coaching programs to improve MCAS scores be made for students who will need help based on the type of learner they are?

Acknowledgments

An undertaking of this magnitude could not have been possible without the help of numerous individuals. We would like to take this opportunity to thank some of them now.

First, we would like to acknowledge the prior IQP groups who worked to build and improve the dataset which we had to work with. Without that amazing foundation of cases, an in depth analysis could not have been possible.

Next, our advisor, Professor John M. Wilkes, who has spent incredible amounts of time and effort, not only assisting project groups interested in researching topics such as this, but also conducting his own research to improve knowledge in this field. His support and guidance improved the quality of this project as well as pushed us to look beyond conventional research and analysis methods.

Also, we would like to thank Worcester Polytechnic Institute for providing financial assistance which made the final stages of MBTI testing and data gathering possible. Without their support, we would not have been able to complete the data set for the Worcester Public Schools Class of 2003.

Finally, our project would not have been possible without the help of the surrounding Worcester Public High Schools, namely: South High School, North High School, Doherty High School, Burncoat Senior High School, and Worcester Vocational High School. Without them allowing our project group, as well as past groups to work closely with students and administrators to arrange the collection of MBTI, transcript, and MCAS data for the Class of 2003, the data set from which we made our analyses would not have been as strong and accurate as they are.

Literature Review

When the Massachusetts Education Reform Act of 1993 called for dramatic changes in public education, the Commonwealth not only started an effort to provide schools with greater and more equitable funding, but it started to take steps to implement statewide standards for students, educators, schools, and districts. Prior to 1993, the only statewide educational requirements written in law dealt with history and physical education. The Education Reform Act called for curriculum frameworks and learning standards for all students across the state in all core academic subjects. (http://www.doe.mass.edu/edreform/) In accordance with this Law, the Massachusetts Comprehensive Assessment System (MCAS) was enacted. The MCAS was intended to determine how well the public school systems, from individual students to entire districts, were achieving the academic learning standards defined in the Massachusetts Curriculum Frameworks. It was required by the state that the MCAS be designed to:

1. test all public schools students across the Commonwealth, including those with disabilities and students with limited English proficiency.
2. be administered annually in at least grades 4, 8, and 10*
3. measure performance based on the Massachusetts Curriculum Framework learning standards
4. report on the performance of individual students, schools, and districts (for example, beginning with the class of 2003, grade 10 students must pass the MCAS tests as one condition of eligibility for earning a high school diploma. Students will be given multiple opportunities, if necessary, to pass the tests between grades 10 and the end of their senior year. In addition to passing the MCAS tests, students must also meet local requirements for high school graduation.)

*Beginning in 2001, students in grades 3, 4, 5, 6, 7, 8, and 10 were tested. (http://www.doe.mass.edu/edreform/)

In order to obtain a proper assessment of school districts and the state schools as a whole, all public school students are labeled with a defined student status. One particular student is either termed: Regular, Student with Disabilities, or Student with Limited English Proficiency. *Students with Disabilities* are defined as "students who have an Individualized Education Plan (IEP) or a plan of instructional accommodations provided under Section 504 of the Rehabilitation Act of 1973." *Limited English Proficient (LEP)* students are "those students whose first language is a language other than English who are unable to perform ordinary classroom work in English." The remaining students with neither LEP nor disabilities are termed *Regular.*

In order to provide an opportunity for all students to take the MCAS and for the testing results to express, students with disabilities are given the MCAS Alternate Assessment. The results of this evaluation are not included in the determination of scaled score results, but are included in the determination of performance level results. Also, LEP students in school in the United States for three or fewer years, and for whom the Spanish language version of the test is not appropriate, are *not* counted in the determination of scaled scores or performance level results. (http://www.doe.mass.edu/mcas) LEP students may receive instruction in a range of programs and settings that include: Transitional Bilingual Education (TBE) programs, Two-way bilingual programs, English as a Second Language (ESL) programs, Sheltered English-language programs, and other language support or tutoring. To obtain an accurate overall measure of student assessment, the number of students absent on testing days must be controlled. "Students from any status group who are absent during the testing period, and who do not receive a medically documented absence, will receive a

minimum score of 200, and by default, a performance level of *Failing*." These three cases affect summary statistics although efforts have been made to minimize the number of students absent in testing days. Under no circumstances can a parent, by law, refuse their child's participation in MCAS. "Massachusetts General Laws chapter 76, Sections 2 and 4, establish penalties for truancy as well as for inducing unlawful absence of a minor from school." School discipline codes generally dictate local rules for school attendance and penalties for unauthorized absence from school or from a required part of a school day. (http://www.doe.mass.edu)

The Massachusetts Curriculum Frameworks define the subject matter that is designated for testing in each grade. The 2001 MCAS were distributed as follows:

English Language Arts:	grades 3, 4, 7, 8, and 10
Mathematics:	grades 4, 6, 8, and 10
Science and Technology:	grades 5, 8, and 10
History and Social Science:	grades 5, 8, and 10

Multiple choice questions are used in all content area tests where a student will select an answer from four options. Short-answer questions are used in Mathematics tests only. Here, students generate a brief response or short statement which leads to a numeric solution. Like multiple choice questions, open-response questions are used in all content area tests. Students create a one- or two-paragraph response in writing or in the form of a narrative or a chart, table, illustration, diagram, or graph as appropriate. Finally, writing prompts are used in English Language Arts tests only. Writing prompts, which may relate to a reading passage, are provided to the student. The student will then write a composition elaborating on the given prompt (http://www.doe.mass.edu).

The MCAS are divided into categories which are then reported in the following manner:

English Language Arts
- Strand 1: Composition

Mathematics
- Strand 1: Number Sense and Operation
- Strand 2: Patterns, Relations, and Algebra
- Strand 3: Geometry
- Strand 4: Measurement
- Strand 5: Data Analysis, Statistics, and Probability

Science and Technology/Engineering
- Strand 1: Earth and Space Science
- Strand 2: Life Science (Biology)
- Strand 3: Physical Sciences (Physics and Chemistry)
- Strand 4: Technology/Engineering

History and Social Science
- Strand 1: U.S. History
- Strand 2: World History
- Strand 3: Geography
- Strand 4: Economics
- Strand 5: Civics and Government

Each test is comprised of subunits that are reported individually, as a strand, for ease of reviewing the strong and weak areas of a student in any given subject.

MCAS are scored by professional scorers as well as Massachusetts teachers, all of whom have been trained. In order to keep continuity throughout the scoring process, all open response answers are scored by professional scorers only. These scorers use a scoring guide, or rubric, to score the open responses. These scoring guides indicate the knowledge and skills students must demonstrate to earn a maximum score of four points. To the same effect, compositions are scored by Massachusetts teachers at the Summer Scoring Institutes held since 1998. Compositions are evaluated on two criteria: (1) topic

development, based on a 1-6 score point scale, and (2) standard English conventions, based on a 1-4 point scale. As of the 2001, the overall MCAS scores range from 200 to 280 points and are associated with performance levels as follows:

Advanced scores range from:	260 to 280
Proficient scores range from:	240 to 259
Needs Improvement scores range from:	220 to 239
Warning/Failing scores range from:	200 to 219

In all cases, the students scores are rounded to the nearest even integer. The following are the definitions that are associated with each performance level:

Advanced: Students at this level demonstrate a comprehensive and in-depth understanding of rigorous subject matter, and provide sophisticated solutions to complex problems.

Proficient: Students at this level demonstrate a solid understanding of challenging subject matter, and solve a wide variety of problems.

Needs Improvement: Students at this level demonstrate partial understanding of subject matter, and solve some simple problems.

Warning/Failing: Students at this level demonstrate minimal understanding of subject matter, and do not solve simple problems.

> In May 2001, the Board of Education voted to change the name of the lowest performance level from *Failing* to *Warning* for MCAS tests at grades 3 and 8. The new label better reflects both the purpose of the tests and the informative nature if students' performance at the elementary and middle school levels. The name change does not indicate a change in level of knowledge and skills that students must demonstrate to reach the *Needs Improvement* level (http://www.doe.mass.edu).

Test results for students in grade 10 are a source of student accountability. Beginning with the class of 2003, all students are required to pass the MCAS tests in English Language Arts and Mathematics, as well as complete all required coursework, in order to receive a high school diploma. At the elementary and intermediate levels, the MCAS scores are used to make improvements in teaching and learning. Parents and

students use the results to monitor students' progress. Also, local educators form and tailor curriculum and instruction based upon common strengths and weaknesses of a total population of students. Also, in order to maintain accountability on a school and district level, "the Board of Education has established standards for performance for districts that improve or fail to improve student academic performance, as required by the Education Reform Law (http://www.doe.mass.edu)."

All public school students are required to take the MCAS tests. Students in charter schools, in institutional school programs, in educational collaboratives, receiving publicly funded special education in private schools, with disabilities (who either have an Instructional Education Program (IEP) or receive Section 504 instructional accommodations), and who are limited English proficient (unless they have been enrolled in the United States schools for three or fewer years AND who are not eligible for the Spanish version of the MCAS) are also grouped into this category. On the other hand, home-schooled students are *not* a part of the public school system and therefore are not required by law to take the MCAS (http://www.doe.mass.edu).

MBTI

There are other ways to predict a student's success on achievement tests such as the MCAS. First, trends can be established when analyzing and comparing annual scores in a school or district. One method is the administration of personality type indicators that are known to be related to learning style. With these, one can demonstrate that a certain type of student may be predisposed to doing better on the MCAS compared to students of a different cognitive style or type of learner.

In 1942, initial development of the Myers-Briggs Type Indicator (MBTI) began when a mother-daughter team, Katherine Briggs and Isabel Briggs Myers started on their quest to operationalize Carl Jung's Theory of 1923. Jung's theory stated that individual differences in personality are based upon two human attitudes:

Extraverts: draw their energy primarily from the outer world if other people and events.

Introverts: draw their energy from their inner thoughts and experiences.

Other dichotomous variables (which Jung called functions in his theory) also shaped one's personality. Isabel described all three of these variables as measures of "preference" rather than ability. However, she also likened these preferences to that for the left or right hand, indicating that difference in ability might develop over time.

Sensation: refers to perceptions that are observable by the five senses.

Intuition: refers to the perception of possibilities and meaning by way of the unconscious.

Thinking: refers to making decisions by using logic

Feeling: refers to making decisions by considering one's personal values

The judging/perceiving orientation was not part of Jung's original theory, but was added by Myers and Briggs to identify one's orientation to the outer world.

Judging: concerned with planning, organizing, making decisions, and coming to closure

Perceiving: concerned with being flexible and spontaneous, and with collecting additional information before making decisions

(Murphy, Ed., 817)

The most recent version of the MBTI was published in 1998. This is a brief and simple test that can be administered individually or in a group, and is an ideal way for

students to understand their personality/learning types. Our Class of 2003 data set was created using the Form G of the MBTI that contains 126 items of which 100 items are used in scoring. It is written at the ninth-grade level. The respondents answer forced-choice items that are written to reflect the poles of the dichotomies." The goal of the MBTI test is to provide individual feedback on four dichotomous scales: (http://www.capt.org)

Extraversion-Introversion	(EI)
Sensing-Intuition	(SN)
Thinking-Feeling	(TF)
Judging-Perceiving	(JP)

The various combinations of these four scales result in sixteen possible personality types, each represented by a four-letter code indicating the preference of each of the dichotomies. (www.myersbriggs.org) The four-letter code is based on the general ideas of where the individual prefers to focus his or her attention (EI Scale), how he or she acquires information, or finds out about things (SN Scale), how he or she makes decisions (TF Scale), and how he or she orients toward the outer world (JP Scale). (Murphy, 816) The four-letter combination will then be matched by the individual to a supplied table and will be able to read about and better understand their personality type. This method provides an approximate accuracy of 85% for 3 or 4 of the scales as judged by verification and feedback session results. It is our goal to find correlations between MCAS scores and learning style based on the MBTI typology, and our specific procedure will focus particularly on its S-N and J-P scales. This will prove that the success of students taking the MCAS depends not only on what information they know about and understand, but what type of learner that they are. By doing so, we will examine the

equity and cognitive bias issues that have been raised about the MCAS and standardized testing in general. We tend to support the goals of the MCAS as they involve educational reform and the public accountability of schools. However, in the area of high stakes testing for the individual student, such questions have to be examined. We hope to demonstrate that the administration of learning styles indicators like the MBTI in high school is crucial when high stakes testing is going on, both to guide teachers on how to reach the student and protect the individual from arbitrary standards that do not take into account the relative difficulty of multiple choice test items for people of various cognitive styles.

The Worcester Public Schools stopped administering the MBTI as of the Class of 2003, due to financial constraints. The lack of in house advocates (they retired) and analysis capability to put the results to timely and effective use were also factors. This study will allow the administrators to review that choice and decide whether to seek external grant funding to resume this program of cognitive profiling while various tutoring programs and approaches to intervention are given trials and assessed. Hence, we have stressed trying to keep our analysis focused on the questions a high school Principal, Counselor or other administrators who work closely with teachers would want to have answered as the case for resuming such a program is assessed.

Methodology

Data Collection

The MBTI – replacement data collection process required our coordination with the South High School administration, namely the Principal and Guidance Councilors. After determining that the original set of data was not going to be located and scored, we compared class lists provided to us to the Class of 2003 data set and were able to determine the names of students for whom we were still missing MBTI data after the last recovery attempt. By organizing these students according to homeroom, we were able to re-administer the MBTI to fifty more students out of the seventy-five who had taken the normal MCAS, but not the MBTI. Their score sheets were then scored electronically by CAPT, and the results were mailed back to us. We then worked to incorporate this new data into the original data set. This effort filled a large part of the data gap and made South High's data set as representative as those obtained at the other four high schools in the city.

Before the analysis proceeded, we took the liberty of further consolidating the dataset by creating variables which summarized some of the existing variables. It was more efficient to work with these summary variables. Upon completion, we were ready to move forward with the analysis portion of the project which we hoped would produce the expected correlations. However, since we had already decided that the proposed study questions would have policy implications, theory testing was subordinate to policy issues. Throughout the analysis phase of the project we tried to consistently focus on providing "useful" information about potential "lead" indicators.

Tools For Analysis

The Class of 2003 data set contained just over 700 usable cases out of over 900 MBTI questionnaires completed. The other cases of MBTI data could not be linked to MCAS data, transcript data, or both. A substantial data cleaning effort awaits future researchers who want to do better than this using insider information to locate coding errors and ID problems. In order to make the comparisons and complex analyses that we needed, with so many cases, it was recommended that we use a database software program designed for social science now called: Statistical Product and Service Solutions, (SPSS) (It used to be Statistical Package for the Social Sciences). Not only could this program handle a large number of cases, up to 2.15 billion, and a large number of variables, a maximum of 32, 768, but it was designed to enable users to make visual summaries of an analysis, including tables, charts, and graphs (http://www.spss.com).

Gamma and Spearman Numbers

Certain values within the variables of the data set can be classified as being ordinal. For example, 10^{th} grade MCAS math scores or 8^{th} grade MCAS math scores can be classified as having ordinality because the user can set values for each letter (A, P, NI, F) and ultimately set a position of order to each score (i.e. A will be in the highest position, P in the second position, etc.). In these situations, nonparametric correlation coefficients such as 'Gamma' or 'Spearman's Correlation' coefficients can be very useful in the analysis of the data set by assessing the degree of relationship between two ordinal variables. The SPSS Gamma correlation varies between + or – 1. A Gamma value between (+ or -) 0.4 to 1 is of analytical interest. The Spearman coefficient similarly

produces strength of relationship assessments. Once the Spearman coefficient is calculated, it can be squared to determine what percentage of the variance in the dependent variable is explained by variance in the independent variable. It is standard that a 0.5 (25%) or higher Spearman value reflects a strong correlation between the chosen variables.

Gamma or Spearman Coefficient	Percentage of Variance	
.9	81%	A virtual identity
.7	49%	A very strong relationship
.6	36%	A robust relationship
.5	25%	A strong relationship
.4	16%	A moderate relationship
.3	9%	A modest relationship
.2	4%	A weak relationship

Analysis

One of the main goals of this project is to identify those students who may be at risk of failing the MCAS. Therefore, a number of comparisons must be made within the dataset to identify which factors will be the most revealing lead indicator of MCAS performance. When looking over the data available for analysis, one of the first ideas that comes to mind is to compare the 8th grade MCAS scores to those of the 10th grade test. Because the tests are quite similar, it is reasonable to assume that the first test is a good predictor for scores on the second. For the sake of continuity, the English scores were compared in a separate table than the Math scores. Because the scores are ordinal values, it is possible to compute a Gamma or Spearman value for the data. That means that not only will it be possible to analyze percentages of students changing scores in the years between tests, but also how strong a correlation exists between the two test scores. In short, it tells you how much better than guessing at random you would do by rank ordering the students based on 8th grade score to predict their 10th grade relative ranking.

Although there was some drift of MCAS scores into the higher and lower categories for some of the students, these numbers remain strikingly stable. The Gamma values of .852 for English and .882 for Math and Spearman values of .683 and .729 respectively, indicate that for over 70% of the cases, 8th grade MCAS scores are a very good predictor of what 10th grade relative performance will be. The following two tables each compare the 8th grade practice MCAS scores (horizontal rows) with the actual MCAS, which the students took in 10th grade (vertical columns). Following the actual

data comparisons are tables containing the correlation values which were computed by SPSS.

Grade 8 English MCAS vs. Grade. 10 English MCAS Crosstabulation

			Gr. 10 EN MCAS			
			A	P	NI	F
Gr. 8 EN MCAS	A	Count	7	3	0	0
		Expected Count *	.6	2.9	3.8	2.7
		% within Gr. 8 EN MCAS	70.0%	30.0%	.0%	.0%
	P	Count	50	206	124	14
		Expected Count *	24.4	113.2	148.6	107.8
		% within Gr. 8 EN MCAS	12.7%	52.3%	31.5%	3.6%
	NI	Count	1	57	199	102
		Expected Count *	22.2	103.2	135.4	98.2
		% within Gr. 8 EN MCAS	.3%	15.9%	55.4%	28.4%
	F	Count	0	3	30	140
		Expected Count *	10.7	49.7	65.2	47.3
		% within Gr. 8 EN MCAS	.0%	1.7%	17.3%	80.9%

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Gamma	.852	.017	31.885	.000
	Spearman Correlation	.683	.019	28.569	.000(c)
Interval by Interval	Pearson's R	.677	.017	28.124	.000(c)
Number of Valid Cases		936			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 1

Grade 8 Math MCAS vs. Grade 10 Math MCAS Crosstabulation

			Gr. 10 MA MCAS			
			A	P	NI	F
Gr. 8 MA MCAS	A	Count	15	4	0	0
		Expected Count *	1.9	3.8	6.9	6.4
		% within Gr. 8 MA MCAS	78.9%	21.1%	.0%	.0%
	P	Count	67	80	27	1
		Expected Count *	17.4	35.3	63.3	59.1
		% within Gr. 8 MA MCAS	38.3%	45.7%	15.4%	.6%
	NI	Count	11	87	153	28
		Expected Count *	27.7	56.2	100.9	94.2
		% within Gr. 8 MA MCAS	3.9%	31.2%	54.8%	10.0%
	F	Count	1	20	163	291
		Expected Count *	47.1	95.7	171.9	160.3
		% within Gr. 8 MA MCAS	.2%	4.2%	34.3%	61.3%

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Gamma	.882	.014	34.972	.000
	Spearman Correlation	.729	.017	32.779	.000(c)
Interval by Interval	Pearson's R	.745	.015	34.383	.000(c)
Number of Valid Cases		946			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 2

The next piece of analysis carried out concerns the Myers-Briggs Type Indicator assessment, specifically the **E**xtravert/**I**ntrovert and **S**ensing/I**N**tuitive markers. The students were broken down into 4 groups according to their Types: Extravert Sensing, Extravert Intuitive, Introvert Sensing, and Introvert Intuitive. These were denoted by the letters ES, EN, IS, and IN. These students were then compared by their 10^{th} grade MCAS scores. This project is geared toward finding ways to identify students at risk, so the failing scores were the most telling.

When looking only at those students receiving a failing score on the MCAS, an obvious pattern arises. It appears that Sensing students are earning much lower marks than their Intuitive counterparts. This holds true for both the English and Math scores. A less noticeable secondary pattern emerges when observing the Extravert/Introvert split, with Extraverts scoring higher than Introverts in English, and the opposite being true for Math. The following graphs show average MCAS scores for each type group. The longer bars represent a higher average number of failures, as an A is equal to 1, and an F is equal to 4.

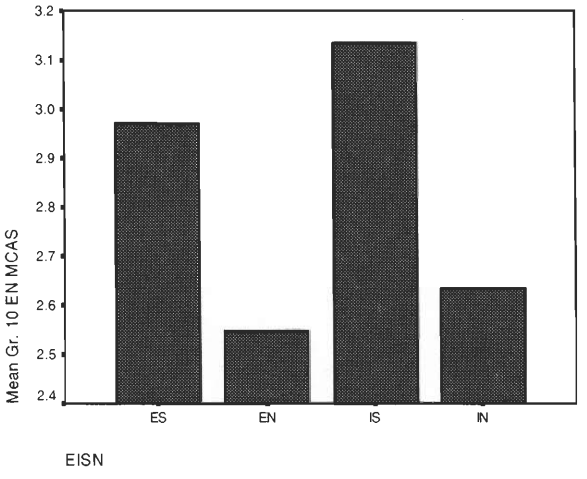

Table 3

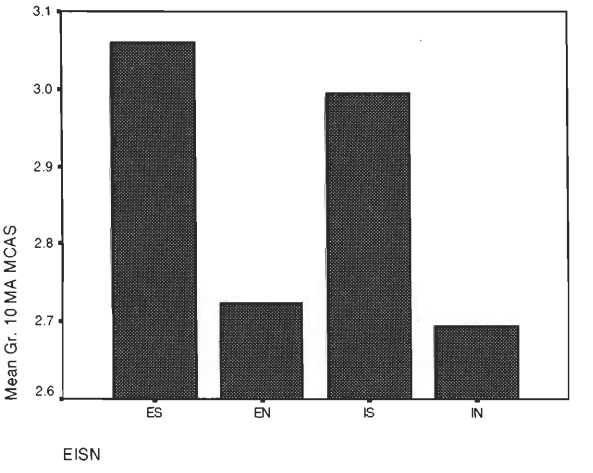

Table 4

Extravert/Introvert Sensing/Intuitive Learning Types vs. Grade 10 English MCAS Crosstabulation

			Gr. 10 EN MCAS			
			A	P	NI	F
EISN	ES	Count	8	60	110	69
		Expected Count *	14.9	74.7	96.9	60.5
		% within EISN	3.2%	24.3%	44.5%	27.9%
	EN	Count	21	105	99	31
		Expected Count *	15.4	77.5	100.4	62.7
		% within EISN	8.2%	41.0%	38.7%	12.1%
	IS	Count	7	30	66	67
		Expected Count *	10.2	51.4	66.7	41.6
		% within EISN	4.1%	17.6%	38.8%	39.4%
	IN	Count	11	41	31	24
		Expected Count *	6.4	32.4	42.0	26.2
		% within EISN	10.3%	38.3%	29.0%	22.4%

Table 5

Extravert/Introvert Sensing/Intuitive Learning Types vs. Grade 10 Math MCAS Crosstabulation

			Gr. 10 MA MCAS			
			A	P	NI	F
EISN	ES	Count	11	49	102	86
		Expected Count *	25.0	52.8	95.8	74.3
		% within EISN	4.4%	19.8%	41.1%	34.7%
	EN	Count	26	76	97	57
		Expected Count *	25.8	54.5	98.9	76.7
		% within EISN	10.2%	29.7%	37.9%	22.3%
	IS	Count	19	28	60	65
		Expected Count *	17.3	36.6	66.5	51.6
		% within EISN	11.0%	16.3%	34.9%	37.8%
	IN	Count	23	14	44	27
		Expected Count *	10.9	23.0	41.7	32.4
		% within EISN	21.3%	13.0%	40.7%	25.0%

Table 6

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

The final factors which hypothetically should have a large impact on MCAS scores are the difficulty level of courses in which a student has enrolled, and their final grades in those classes. Viewed separately, neither of these figures give spectacular results. Using English MCAS scores as an example, average English class grades will explain about 23% of the variance in English MCAS scores, while average difficulty of courses taken does better, explaining about 57% of the MCAS score variance. However, when used together, these two figures become very powerful tools in predicting the outcome of the 10^{th} grade MCAS. Again using the example of English scores, by separating students according to average class scores an amazing 69% of cases can be predicted in the "B" average grade range by using average course difficulty as an indicator. Correlations are also very strong for the "A" and C" ranges. It is not until the "D" and "F" ranges that correlations drop off steeply. Our theory for explaining this phenomenon is the fact that lower grades do not match a student's ability as well as higher grades in the same classes. At that level, it becomes impossible to tell what a student's ability level is simply based on course difficulty, because they are not performing day to day at their ability level compared to the other students in that same course. We have also included a breakdown of Course Level vs. MCAS score, this time separated by Type Value. (Tables 13 and 14) This gives good indication of how the course difficulty affects MCAS scores within the different learning types.

English Course Level vs. Grade 10 English MCAS Crosstabulation

			Gr. 10 EN MCAS			
			A	P	NI	F
English Course Level Scale	Mostly Honors	Count	41	169	92	7
		Expected Count *	18.7	93.9	120.9	75.6
		% within English Course Level Scale	13.3%	54.7%	29.8%	2.3%
	Mostly College Prep	Count	3	56	173	96
		Expected Count *	19.8	99.6	128.3	80.2
		% within English Course Level Scale	.9%	17.1%	52.7%	29.3%
	Mostly General Courses	Count	3	11	39	87
		Expected Count *	8.5	42.5	54.8	34.2
		% within English Course Level Scale	2.1%	7.9%	27.9%	62.1%

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Gamma	.758	.028	22.037	.000
	Spearman Correlation	.594	.025	20.551	.000(c)
Interval by Interval	Pearson's R	.576	.026	19.593	.000(c)
Number of Valid Cases		727			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 7

Math Course Level vs. Grade 10 Math MCAS Crosstabulation

			Gr. 10 MA MCAS			
			A	P	NI	F
Math Course Level Scale	Mostly Honors	Count	63	126	83	7
		Expected Count *	26.7	59.3	108.4	84.6
		% within Math Course Level Scale	22.6%	45.2%	29.7%	2.5%
	Mostly College Prep	Count	11	36	177	130
		Expected Count *	33.9	75.2	137.6	107.3
		% within Math Course Level Scale	3.1%	10.2%	50.0%	36.7%
	Mostly General Courses	Count	0	2	40	97
		Expected Count *	13.3	29.5	54.0	42.1
		% within Math Course Level Scale	.0%	1.4%	28.8%	69.8%

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Gamma	.615	.021	27.642	.000
	Spearman Correlation	.649	.020	23.696	.000(c)
Interval by Interval	Pearson's R	.628	.019	22.383	.000(c)
Number of Valid Cases		772			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 8

English Average Grade vs. Grade 10 English MCAS Crosstabulation

			Gr. 10 EN MCAS			
			A	P	NI	F
English Ave Grade scale	A	Count	29	55	23	9
		Expected Count *	7.0	35.1	45.5	28.4
		% within English Ave Grade scale	25.0%	47.4%	19.8%	7.8%
	B	Count	14	104	83	45
		Expected Count *	14.8	74.4	96.5	60.2
		% within English Ave Grade scale	5.7%	42.3%	33.7%	18.3%
	C	Count	2	58	139	82
		Expected Count *	16.9	85.0	110.2	68.8
		% within English Ave Grade scale	.7%	20.6%	49.5%	29.2%
	D	Count	1	12	44	40
		Expected Count *	5.8	29.3	38.1	23.8
		% within English Ave Grade scale	1.0%	12.4%	45.4%	41.2%
	F	Count	1	7	17	15
		Expected Count *	2.4	12.1	15.7	9.8
		% within English Ave Grade scale	2.5%	17.5%	42.5%	37.5%

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Gamma	.481	.037	12.191	.000
	Spearman Correlation	.403	.032	12.297	.000(c)
Interval by Interval	Pearson's R	.394	.032	11.964	.000(c)
Number of Valid Cases		780			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 9

Math Average Grade vs. Grade 10 Math MCAS Crosstabulation

			Gr. 10 MA MCAS			
			A	P	NI	F
Math Ave Grade scale	A	Count	30	23	7	9
		Expected Count *	7.0	14.7	26.7	20.7
		% within Math Ave Grade scale	43.5%	33.3%	10.1%	13.0%
	B	Count	37	82	92	29
		Expected Count *	24.2	51.1	92.8	71.9
		% within Math Ave Grade scale	15.4%	34.2%	38.3%	12.1%
	C	Count	12	58	138	104
		Expected Count *	31.4	66.5	120.6	93.5
		% within Math Ave Grade scale	3.8%	18.6%	44.2%	33.3%
	D	Count	0	4	54	69
		Expected Count *	12.8	27.1	49.1	38.1
		% within Math Ave Grade scale	.0%	3.1%	42.5%	54.3%
	F	Count	0	0	12	24
		Expected Count *	3.6	7.7	13.9	10.8
		% within Math Ave Grade scale	.0%	.0%	33.3%	66.7%

Symmetric Measures

		Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
Ordinal by Ordinal	Gamma	.604	.031	16.817	.000
	Spearman Correlation	.502	.028	16.235	.000(c)
Interval by Interval	Pearson's R	.506	.026	16.391	.000(c)
Number of Valid Cases		784			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 10

English Course Level vs Grade 10 English MCAS vs. English Average Grade Crosstabulation

English Course Level: Mostly Honors

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	27	42	8	0
	Expected Count *	19.3	36.5	15.3	6.0
	% within English Course Level Scale	35.1%	54.5%	10.4%	.0%
B	Count	12	88	33	1
	Expected Count *	7.7	56.9	44.8	24.6
	% within English Course Level Scale	9.0%	65.7%	24.6%	.7%
C	Count	1	35	41	2
	Expected Count *	.6	16.4	39.1	22.9
	% within English Course Level Scale	1.3%	44.3%	51.9%	2.5%
D	Count	0	3	9	2
	Expected Count *	.1	1.7	6.4	5.8
	% within English Course Level Scale	.0%	21.4%	64.3%	14.3%
F	Count	1	1	1	2
	Expected Count *	.1	.9	2.1	1.9
	% within English Course Level Scale	20.0%	20.0%	20.0%	40.0%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

English Course Level vs Grade 10 English MCAS vs. English Average Grade Crosstabulation (continued)

English Course Level: Mostly College Prep

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	1	9	13	7
	Expected Count *	7.5	14.2	5.9	2.3
	% within English Course Level Scale	3.3%	30.0%	43.3%	23.3%
B	Count	1	14	39	16
	Expected Count *	4.0	29.7	23.4	12.9
	% within English Course Level Scale	1.4%	20.0%	55.7%	22.9%
C	Count	1	20	78	37
	Expected Count *	1.0	28.3	67.3	39.5
	% within English Course Level Scale	.7%	14.7%	57.4%	27.2%
D	Count	0	7	29	26
	Expected Count *	.6	7.7	28.1	25.6
	% within English Course Level Scale	.0%	11.3%	46.8%	41.9%
F	Count	0	6	14	10
	Expected Count *	.8	5.3	12.8	11.3
	% within English Course Level Scale	.0%	20.0%	46.7%	33.3%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

English Course Level vs Grade 10 English MCAS vs. English Average Grade Crosstabulation (continued)

English Course Level: Mostly General Courses

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	1	4	2	2
	Expected Count *	2.3	4.3	1.8	.7
	% within English Course Level Scale	11.1%	44.4%	22.2%	22.2%
B	Count	1	2	10	28
	Expected Count *	2.3	17.4	13.7	7.5
	% within English Course Level Scale	2.4%	4.9%	24.4%	68.3%
C	Count	0	3	19	42
	Expected Count *	.5	13.3	31.7	18.6
	% within English Course Level Scale	.0%	4.7%	29.7%	65.6%
D	Count	1	2	6	12
	Expected Count *	.2	2.6	9.5	8.7
	% within English Course Level Scale	4.8%	9.5%	28.6%	57.1%
F	Count	0	0	2	3
	Expected Count *	.1	.9	2.1	1.9
	% within English Course Level Scale	.0%	.0%	40.0%	60.0%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

English Course Level vs Grade 10 English MCAS vs. English Average Grade Crosstabulation (continued)

Symmetric Measures

English Ave Grade scale			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
A	Ordinal by Ordinal	Gamma	.738	.085	6.576	.000
		Spearman Correlation	.524	.072	6.561	.000(c)
	Interval by Interval	Pearson's R	.491	.077	6.010	.000(c)
	N of Valid Cases		116			
B	Ordinal by Ordinal	Gamma	.829	.043	13.403	.000
		Spearman Correlation	.656	.043	13.567	.000(c)
	Interval by Interval	Pearson's R	.654	.043	13.472	.000(c)
	N of Valid Cases		245			
C	Ordinal by Ordinal	Gamma	.720	.049	10.968	.000
		Spearman Correlation	.529	.043	10.376	.000(c)
	Interval by Interval	Pearson's R	.521	.043	10.164	.000(c)
	N of Valid Cases		279			
D	Ordinal by Ordinal	Gamma	.389	.158	2.091	.037
		Spearman Correlation	.212	.101	2.119	.037(c)
	Interval by Interval	Pearson's R	.173	.111	1.714	.090(c)
	N of Valid Cases		97			
F	Ordinal by Ordinal	Gamma	.361	.272	1.209	.227
		Spearman Correlation	.205	.166	1.290	.205(c)
	Interval by Interval	Pearson's R	.252	.168	1.608	.116(c)
	N of Valid Cases		40			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 11

Math Course Level vs. Grade 10 Math MCAS vs. Math Average Grade Crosstabulation

Math Course Level: Mostly Honors

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	26	17	1	1
	Expected Count *	19.2	15.2	4.6	6.0
	% within Math Course Level Scale	57.8%	37.8%	2.2%	2.2%
B	Count	28	64	21	1
	Expected Count *	16.4	39.4	44.3	13.9
	% within Math Course Level Scale	24.6%	56.1%	18.4%	.9%
C	Count	9	44	48	2
	Expected Count *	3.7	18.6	45.6	35.1
	% within Math Course Level Scale	8.7%	42.7%	46.6%	1.9%
D	Count		1	12	0
	Expected Count *		.4	5.6	7.0
	% within Math Course Level Scale		7.7%	92.3%	.0%
F	Count			1	3
	Expected Count *			1.3	2.7
	% within Math Course Level Scale			25.0%	75.0%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Math Course Level vs. Grade 10 Math MCAS vs. Math Average Grade Crosstabulation (continued)

Math Course Level: Mostly College Prep

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	3	5	2	5
	Expected Count *	6.4	5.1	1.5	2.0
	% within Math Course Level Scale	20.0%	33.3%	13.3%	33.3%
B	Count	6	18	54	11
	Expected Count *	12.8	30.8	34.5	10.9
	% within Math Course Level Scale	6.7%	20.2%	60.7%	12.4%
C	Count	2	10	74	53
	Expected Count *	5.0	25.1	61.5	47.4
	% within Math Course Level Scale	1.4%	7.2%	53.2%	38.1%
D	Count		3	37	48
	Expected Count *		2.8	37.7	47.5
	% within Math Course Level Scale		3.4%	42.0%	54.5%
F	Count			10	13
	Expected Count *			7.7	15.3
	% within Math Course Level Scale			43.5%	56.5%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Math Course Level vs. Grade 10 Math MCAS vs. Math Average Grade Crosstabulation (continued)

Math Course Level: Mostly General Courses

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	0	1	4	3
	Expected Count *	3.4	2.7	.8	1.1
	% within Math Course Level Scale	.0%	12.5%	50.0%	37.5%
B	Count	0	0	17	17
	Expected Count *	4.9	11.8	13.2	4.2
	% within Math Course Level Scale	.0%	.0%	50.0%	50.0%
C	Count	0	1	13	49
	Expected Count *	2.3	11.4	27.9	21.5
	% within Math Course Level Scale	.0%	1.6%	20.6%	77.8%
D	Count		0	5	20
	Expected Count *		.8	10.7	13.5
	% within Math Course Level Scale		.0%	20.0%	80.0%
F	Count			1	8
	Expected Count *			3.0	6.0
	% within Math Course Level Scale			11.1%	88.9%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Math Course Level vs. Grade 10 Math MCAS vs. Math Average Grade Crosstabulation (continued)

Symmetric Measures

Math Ave Grade scale			Value	Asymp. Std. Error(a)	Approx. T(b)	Approx. Sig.
A	Ordinal by Ordinal	Gamma	.781	.078	5.891	.000
		Spearman Correlation	.606	.084	6.190	.000(c)
	Interval by Interval	Pearson's R	.635	.074	6.672	.000(c)
	N of Valid Cases		68			
B	Ordinal by Ordinal	Gamma	.821	.039	14.245	.000
		Spearman Correlation	.649	.040	13.088	.000(c)
	Interval by Interval	Pearson's R	.636	.037	12.622	.000(c)
	N of Valid Cases		237			
C	Ordinal by Ordinal	Gamma	.836	.033	16.945	.000
		Spearman Correlation	.644	.032	14.655	.000(c)
	Interval by Interval	Pearson's R	.621	.032	13.796	.000(c)
	N of Valid Cases		305			
D	Ordinal by Ordinal	Gamma	.726	.104	5.166	.000
		Spearman Correlation	.393	.067	4.762	.000(c)
	Interval by Interval	Pearson's R	.391	.063	4.726	.000(c)
	N of Valid Cases		126			
F	Ordinal by Ordinal	Gamma	.374	.283	1.248	.212
		Spearman Correlation	.183	.145	1.088	.284(c)
	Interval by Interval	Pearson's R	.168	.143	.994	.327(c)
	N of Valid Cases		36			

a Not assuming the null hypothesis.
b Using the asymptotic standard error assuming the null hypothesis.
c Based on normal approximation.
*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Table 12

Extravert/Introvert Sensing/Intuitive Learning Types vs. Grade 10 English MCAS vs. English Average Grade Crosstabulation

Extravert-Sensing

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	5	9	12	4
	Expected Count *	7.5	14.2	5.9	2.3
	% within EISN	16.7%	30.0%	40.0%	13.3%
B	Count	3	30	23	14
	Expected Count *	4.0	29.6	23.6	12.8
	% within EISN	4.3%	42.9%	32.9%	20.0%
C	Count	0	16	53	27
	Expected Count *	.7	19.8	47.5	28.0
	% within EISN	.0%	16.7%	55.2%	28.1%
D	Count	0	3	16	20
	Expected Count *	.4	4.8	17.7	16.1
	% within EISN	.0%	7.7%	41.0%	51.3%
F	Count	0	2	6	4
	Expected Count *	.3	2.1	5.1	4.5
	% within EISN	.0%	16.7%	50.0%	33.3%

Extravert-Intuitive

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	11	23	4	1
	Expected Count *	9.8	18.5	7.7	3.0
	% within EISN	28.2%	59.0%	10.3%	2.6%
B	Count	7	52	33	6
	Expected Count *	5.6	41.4	33.1	17.9
	% within EISN	7.1%	53.1%	33.7%	6.1%
C	Count	1	22	40	15
	Expected Count *	.6	16.1	38.6	22.8
	% within EISN	1.3%	28.2%	51.3%	19.2%
D	Count	1	6	16	4
	Expected Count *	.3	3.3	12.2	11.1
	% within EISN	3.7%	22.2%	59.3%	14.8%
F	Count	1	2	6	5
	Expected Count *	.4	2.4	5.9	5.3
	% within EISN	7.1%	14.3%	42.9%	35.7%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Extravert/Introvert Sensing/Intuitive Learning Types vs. Grade 10 English MCAS vs. English Average Grade Crosstabulation (continued)

Introvert-Sensing

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	5	12	5	2
	Expected Count *	6.0	11.4	4.8	1.9
	% within EISN	20.8%	50.0%	20.8%	8.3%
B	Count	2	8	18	17
	Expected Count *	2.6	19.0	15.2	8.2
	% within EISN	4.4%	17.8%	40.0%	37.8%
C	Count	0	9	34	32
	Expected Count *	.5	15.5	37.1	21.9
	% within EISN	.0%	12.0%	45.3%	42.7%
D	Count	0	1	7	11
	Expected Count *	.2	2.4	8.6	7.8
	% within EISN	.0%	5.3%	36.8%	57.9%
F	Count	0	0	2	5
	Expected Count *	.2	1.2	3.0	2.6
	% within EISN	.0%	.0%	28.6%	71.4%

Introvert-Intuitive

English Ave Grade scale		Gr. 10 EN MCAS			
		A	P	NI	F
A	Count	8	11	2	2
	Expected Count *	5.8	10.9	4.6	1.8
	% within EISN	34.8%	47.8%	8.7%	8.7%
B	Count	2	14	9	8
	Expected Count *	1.9	14.0	11.1	6.0
	% within EISN	6.1%	42.4%	27.3%	24.2%
C	Count	1	11	12	8
	Expected Count *	.2	6.6	15.8	9.3
	% within EISN	3.1%	34.4%	37.5%	25.0%
D	Count	0	2	5	5
	Expected Count *	.1	1.5	5.4	4.9
	% within EISN	.0%	16.7%	41.7%	41.7%
F	Count	0	3	3	1
	Expected Count *	.2	1.2	3.0	2.6
	% within EISN	.0%	42.9%	42.9%	14.3%

Table 13

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Extravert/Introvert Sensing/Intuitive Learning Types vs. Grade 10 Math MCAS vs. Math Average Grade Crosstabulation

Extravert-Sensing

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	5	6	2	1
	Expected Count *	6.1	4.7	1.4	1.8
	% within EISN	35.7%	42.9%	14.3%	7.1%
B	Count	3	20	25	11
	Expected Count *	9.1	20.2	22.6	7.1
	% within EISN	5.1%	33.9%	42.4%	18.6%
C	Count	3	22	48	39
	Expected Count *	4.3	20.8	49.5	37.3
	% within EISN	2.7%	19.6%	42.9%	34.8%
D	Count		1	24	27
	Expected Count *		1.6	22.1	28.3
	% within EISN		1.9%	46.2%	51.9%
F	Count			3	8
	Expected Count *			3.7	7.3
	% within EISN			27.3%	72.7%

Extravert-Intuitive

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	4	6	1	1
	Expected Count *	5.2	4.0	1.2	1.6
	% within EISN	33.3%	50.0%	8.3%	8.3%
B	Count	18	43	29	4
	Expected Count *	14.5	32.1	36.0	11.4
	% within EISN	19.1%	45.7%	30.9%	4.3%
C	Count	4	24	48	22
	Expected Count *	3.8	18.2	43.3	32.7
	% within EISN	4.1%	24.5%	49.0%	22.4%
D	Count		3	14	22
	Expected Count *		1.2	16.6	21.2
	% within EISN		7.7%	35.9%	56.4%
F	Count			5	8
	Expected Count *			4.3	8.7
	% within EISN			38.5%	61.5%

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Extravert/Introvert Sensing/Intuitive Learning Types vs. Grade 10 Math MCAS vs. Math Average Grade Crosstabulation (continued)

Introvert-Sensing

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	8	8	0	3
	Expected Count *	8.3	6.3	1.9	2.5
	% within EISN	42.1%	42.1%	.0%	15.8%
B	Count	10	10	27	13
	Expected Count *	9.3	20.5	23.0	7.3
	% within EISN	16.7%	16.7%	45.0%	21.7%
C	Count	1	10	24	34
	Expected Count *	2.7	12.8	30.5	23.0
	% within EISN	1.4%	14.5%	34.8%	49.3%
D	Count		0	7	8
	Expected Count *		.5	6.4	8.1
	% within EISN		.0%	46.7%	53.3%
F	Count			2	7
	Expected Count *			3.0	6.0
	% within EISN			22.2%	77.8%

Introvert-Intuitive

Math Ave Grade scale		Gr. 10 MA MCAS			
		A	P	NI	F
A	Count	13	3	4	4
	Expected Count *	10.4	8.0	2.4	3.1
	% within EISN	54.2%	12.5%	16.7%	16.7%
B	Count	6	9	11	1
	Expected Count *	4.2	9.2	10.4	3.3
	% within EISN	22.2%	33.3%	40.7%	3.7%
C	Count	4	2	18	9
	Expected Count *	1.3	6.1	14.6	11.0
	% within EISN	12.1%	6.1%	54.5%	27.3%
D	Count		0	9	12
	Expected Count *		.7	8.9	11.4
	% within EISN		.0%	42.9%	57.1%
F	Count			2	1
	Expected Count *			1.0	2.0
	% within EISN			66.7%	33.3%

Table 14

*. Expected if the cases were distributed randomly – i.e., there was no relationship.

Discussion of Results

As stated in the methodology section, we have compiled a list of proposed study questions which were to be addressed using the analysis data. For reasons of organization, the questions will be outlined again and answered one by one.

As a general rule, we have decided that a group of students is "in danger" of failing on the MCAS if 70% or greater of their number scores less than Proficient on the 10^{th} grade MCAS for a given subject.

1. Based on 9^{th} grade GPA and individual course grades, which students by MBTI type (learning style), course background, or average grade are most likely to struggle with (be "at risk") the MCAS at the end of grade 10?

Our analysis has shown that students with a Sensing preference in their learning style score dramatically lower than their Intuitive counterparts. As seen in Tables 5 and 6, the ES and IS learning types both score below the 70% cutoffs, while the EN and IN learners all score within an acceptable range of risk. As far as establishing how well a student must perform grade-wise in a particular course level, we have compiled the following chart to outline the required marks to achieve success on the MCAS:

English

Honors Level	Students must achieve C average or higher.
College Prep	Students must achieve A average.
General Courses	A average will not adequately guarantee success.*

* As there were a very small number of students in the General Courses category with A averages in English, the percentages did not properly represent the situation. Because of this, an estimation was based on a combination of the 92.7% failure rate in English for those with a B average, and 87.5% failure rate in Math for those with an A average.

Math

Honors Level	Students must achieve C average or higher.
College Level	Students must achieve A average.
General Courses	A average will not adequately guarantee success.

As shown in Table 11, College Prep courses are barely preparing students to pass the MCAS. Only an A average in these courses will assure a reasonable chance of success in both English and Math.

2. Are 8th grade MCAS scores a trustworthy predictor of how a student will perform on the MCAS in high school two years later – at least in terms of which students will fail the 10th grade MCAS?

Yes, in Table 1 and 2 of the analysis our Gamma values show a very high correlation between 8th grade MCAS practice scores and the 10th grade re-test. The numbers show that 72.6% of the variance in MCAS English scores in 10th grade and 77.8% of the variance in 10th grade Math MCAS scores is explained by the 8th grade scores. These 8th grade preliminary test scores are reasonably accurate and easy to use predictors for future MCAS performance. It is likely that efforts to improve the performance of whole classes rather than struggling individuals was the norm before the first test. After that, the people still in trouble got individualized attention. However, that is less helpful than it seems. That only means that the two tests rank order the students among themselves in about the same way. If you want to know who will "fail" – it is important to note that fewer students failed in 8th grade than in 10th. The exam in 10th grade appears to be more difficult, or at least was for this group, more in one subject (English) than the other (Math) but in general that was the pattern. So, the 8th grade MCAS lets

you identify your bottom 20% of students very accurately, and nothing done between 8th grade and 10th grade to help the students on the low end seems to have greatly altered things. That more people failed the 10th grade test probably just means that it was more challenging, and such variation will always limit the value of the practice tests as a predictor of who will pass. From year to year, one or the other will be harder for the students. Ideally, one wants the 8th grade test to more accurately model the 10th grade edition, thereby giving more telling results.

3. What is the failure rate of each learning type based on the difficulty level of their course work in that subject?

Mostly Honors	**Percentage of Failing Scores**
IS	7.1%
ES	2.5%
EN	0.8%
IN	0.0%
College Prep	
IS	46.4%
ES	31.7%
IN	26.3%
EN	15.8%
General Courses	
IS	70.5%
IN	70.0%
ES	59.6%
EN	48.3%

Even when differentiating by course level, the conclusions made concerning type bias hold true. However, in the general courses, failure rates are so high that the trend that would be evident in average scores is obscured. This analysis again points out the need for extra emphasis on the improvement of the

Sensing learners' scores when they are faced with the need to demonstrate mastery on this type of a paper and pencil test.

4. Will students with the same learning type consistently do significantly better or worse than other types, or do they have different averages, but a lot of overlap in the score distributions?

Separating the learning types into their sixteen different combinations has proven to be a futile effort in terms of pinpointing groups at risk. Because a single MBTI type is composed of so many different factors, fragment the sample so that when used together it is hard to get a significant finding. However, using our method of separating the data only by the Sensing and Intuition markers, the significant pattern involving the high failure rates in the Sensing group, as described above, emerged.

5. Is the difficulty of academic courses in 9^{th} and 10^{th} grade a better indicator of MCAS scores in 10^{th} grade than the 8^{th} grade MCAS?

Although, the correlations between 10^{th} grade MCAS scores and course level in both English and Math are good indicators of students' performances, it is the correlation between the 8^{th} grade and 10^{th} grade MCAS scores that shows the most promise overall. The 8^{th} grade correlations show that 72.6% of the variance in English cases and 77.8% of the variance Math scores will receive the same score on the 10^{th} grade MCAS. Average course level accurately predicted 57.1% of the variance in English scores and 66.4% of the variance in Math scores. While these are also substantial numbers, the 8^{th} grade MCAS scores remain a better predictor overall.

6. If the relationship between learning type and difficulty of courses, and outcome of 10th grade MCAS scores are both significant, can a better prediction be made by combining these two variables?

As shown in the analysis, while both course level and average grade are both adequate predictors individually, when combined, they create a much more powerful tool for score analysis. For this reason, we used this method of analysis as one of our primary indicators. Evidence for this can be viewed in Tables 7 – 11.

7. Is there a relationship between MBTI type and the correlation between student academic performance and standardized test scores? (Are some types more "predictable" performers based on their grades than others?)

Using the MBTI type classifications which we have already established (Extravert/Sensing, Extravert/Intuitive, Introvert/Sensing, Introvert/Intuitive), it can easily been seen that the E/N group has a noticeably higher correlation between academic performance (both course work and course level) and MCAS scores. While the other groups results remain significant, the E/N's show up to 21% more explained variance than the others. E/N, I/S and I/N all seem to fall into approximately the same range.

8. Can a recommendation for coaching programs to improve MCAS scores be made for students who will need help based on the type of learner they are?

It is very obvious from the results of our analysis that this type of testing is biased towards Intuitive learners. Using MBTI data, administrators can easily identify the at risk Sensing learners and begin coaching programs intended to prepare them for this type of test. The secondary pattern which emerged between

Extraverts and Introverts (Shown in Tables 3 and 4) also gives administrators the opportunity to begin early coaching programs. Giving extraverts additional Math instruction and Introverts additional English instruction, could help to even out the rift between scores, and of course Extraverts love group work and learn well in open discussion. Introverts benefit more from one on one coaching long on demonstration and short on talk.

Conclusions

From the very beginning of this project, our goal has been to find a reliable way for administrators to identify students at risk of failing the MCAS and thereby not graduating high school. Through a series of analyses on the Worcester Public Schools data set for the Class of 2003, we were able to ascertain that not only is it possible to identify those students at risk, but there are multiple reliable ways to do so.

All three factors: 8th grade MCAS scores, MBTI learning type, and collected transcript data each are able to serve as powerful predictors for 10th grade MCAS performance. However, when used together, it is possible to make an even more exact prediction.

It is our hope that local administrators will put these findings to use within their schools to identify at risk students early on, and to place them in coaching programs specifically targeted toward their deficiencies. Also, we desire to demonstrate the predictive power of the MBTI assessment for situations of this type, in hopes that it will be reinstated as one of the tools available to WPS guidance personnel for shaping the curriculums of individual students. Because our findings were based on questions developed by the project group itself, it is rather tough to determine the true worth of this research to the school system without any sort of feedback.

We have accomplished everything that was originally established for project goals. This piece of research should now give the Worcester area school system a starting point for the improvement of their MCAS preparatory program, and boost the performance levels of individual students, thereby improving citywide scores overall. As stated before, the Class of 2003 dataset contains coding errors which were beyond the

scope of this project to correct. If future researchers wish to correct these problems, even more precise results may be obtained from the then-expanded pool of data. Also, it may be meaningful to conduct a follow-up study centered on area school administrators, intended to gauge the true usefulness of this project.

Appendix A: 2001 MCAS Results

Item 1: Worcester Public Schools

Item 2: State-wide Scores

Worcester(348)

MCAS Tests of Spring 2001
Percentage of Students at Each Performance Level

	Advanced	Proficient	Needs Improvement	Warning/ Failing (Tested)	Warning/ Failing (Absent)	Average Raw/Scaled Score	Number of Students Included*
ALL STUDENTS							
Grade 3							
Reading		43	42	14	0	27	2,017
Grade 4							
English Language Arts	4	33	44	19	0	234	1,990
Mathematics	5	17	49	28	0	230	2,044
Grade 6							
Mathematics	4	15	33	48	0	226	2,039
Grade 7							
English Language Arts	3	29	39	29	1	230	1,604
Grade 8							
English Language Arts	3	39	38	19	2	234	1,703
Mathematics	3	12	30	54	1	223	1,767
History and Social Science	0	5	31	63	1	219	1,753
Grade 10							
English Language Arts	5	24	37	30	4	229	1,341
Mathematics	8	17	34	39	2	228	1,376
REGULAR EDUCATION STUDENTS							
Grade 3							
Reading		47	43	10	0	28	1,604
Grade 4							
English Language Arts	5	37	44	14	0	236	1,569
Mathematics	7	19	52	22	0	232	1,582
Grade 6							
Mathematics	6	18	37	39	0	228	1,595
Grade 7							
English Language Arts	3	34	41	21	1	232	1,322
Grade 8							
English Language Arts	3	45	38	12	1	236	1,410
Mathematics	4	15	35	46	1	225	1,430
History and Social Science	0	6	36	58	1	220	1,420
Grade 10							
English Language Arts	6	27	39	23	5	231	1,140
Mathematics	9	19	36	34	2	229	1,152
STUDENTS WITH DISABILITIES							
Grade 3							
Reading		32	40	28	0	24	348
Grade 4							
English Language Arts	2	16	44	38	0	226	386
Mathematics	2	9	43	47	0	224	389
Grade 6							
Mathematics	1	3	21	75	0	217	389
Grade 7							
English Language Arts	1	6	28	63	2	219	272
Grade 8							
English Language Arts	0	8	36	54	2	221	281
Mathematics	0	1	10	88	1	213	284
History and Social Science	0	1	11	86	2	213	282
Grade 10							
English Language Arts	0	1	18	76	5	217	148
Mathematics	0	1	19	77	3	216	151
LIMITED ENGLISH PROFICIENT STUDENTS							
Grade 3							
Reading		8	38	54	0	15	65
Grade 4							
English Language Arts	0	9	43	49	0	222	35
Mathematics	0	1	36	62	1	218	73
Grade 6							
Mathematics	0	0	4	96	0	213	55
Grade 7							
English Language Arts	0	0	20	80	0	216	10
Grade 8							
English Language Arts	0	8	25	67	0	219	12
Mathematics	0	2	17	81	0	216	53
History and Social Science	2	0	2	96	0	212	51
Grade 10							
English Language Arts	2	11	40	47	0	224	53
Mathematics	14	22	21	44	0	231	73

State(000)

MCAS Tests of Spring 2001
Percentage of Students at Each Performance Level

	Advanced	Proficient	Needs Improvement	Warning/ Failing (Tested)	Warning/ Failing (Absent)	Average Raw/Scaled Score	Number of Students Included*
ALL STUDENTS							
Grade 3							
Reading		62	31	7	0	30	75,803
Grade 4							
English Language Arts	7	44	38	11	0	239	75,665
Mathematics	10	24	46	19	0	235	76,770
Grade 6							
Mathematics	13	23	30	33	0	233	77,682
Grade 7							
English Language Arts	6	49	32	12	0	239	73,358
Grade 8							
English Language Arts	8	59	25	8	1	242	71,457
Mathematics	11	23	34	31	0	233	73,128
History and Social Science	1	10	48	40	1	224	72,958
Grade 10							
English Language Arts	15	35	31	17	1	239	64,177
Mathematics	18	27	30	24	1	237	65,350
REGULAR EDUCATION STUDENTS							
Grade 3							
Reading		69	28	3	0	31	62,403
Grade 4							
English Language Arts	8	50	36	6	0	241	61,917
Mathematics	12	28	47	13	0	238	62,556
Grade 6							
Mathematics	15	27	32	26	0	236	64,807
Grade 7							
English Language Arts	7	56	30	6	0	241	61,405
Grade 8							
English Language Arts	9	66	21	3	0	245	59,508
Mathematics	13	27	37	23	0	235	60,515
History and Social Science	1	12	53	33	0	226	60,415
Grade 10							
English Language Arts	18	39	31	11	1	241	54,825
Mathematics	21	30	31	17	1	239	55,479
STUDENTS WITH DISABILITIES							
Grade 3							
Reading		31	47	22	0	25	10,895
Grade 4							
English Language Arts	1	16	49	33	0	227	11,798
Mathematics	2	10	45	42	0	226	11,861
Grade 6							
Mathematics	2	7	22	70	0	219	11,473
Grade 7							
English Language Arts	1	16	45	38	1	225	11,150
Grade 8							
English Language Arts	0	24	45	30	1	229	11,225
Mathematics	1	6	23	69	1	219	11,449
History and Social Science	0	2	24	73	1	217	11,395
Grade 10							
English Language Arts	2	12	32	51	2	223	8,835
Mathematics	3	9	27	60	2	222	8,970
LIMITED ENGLISH PROFICIENT STUDENTS							
Grade 3							
Reading		21	52	27	0	22	2,505
Grade 4							
English Language Arts	1	13	43	41	1	224	1,950
Mathematics	2	8	38	52	1	222	2,353
Grade 6							
Mathematics	2	3	14	79	1	216	1,402
Grade 7							
English Language Arts	0	15	36	48	1	224	803
Grade 8							
English Language Arts	0	19	46	33	2	226	724
Mathematics	2	5	22	70	1	218	1,164
History and Social Science	0	1	15	83	1	214	1,148
Grade 10							
English Language Arts	1	8	30	59	2	221	517
Mathematics	6	12	24	56	1	224	901

* This column indicates the number of students that received a

Appendix B: Reporting Changes for 2001 MCAS Tests

Changes in the Reporting of 2001 MCAS Test Results

Although the fundamental elements of MCAS reporting (i.e., performance levels, scaled scores, and item analysis results) remain in place, there are several changes to the reporting of 2001 MCAS test results. These reporting changes have occurred for a variety of reasons and their impact on the interpretation and use of MCAS test results range from minor to substantial. This section of the report will provide a brief overview and discuss impact of changes in the following areas:

- Grade Levels and Content Areas Tested
- Renaming the *Failing* performance level to *Warning*
- Grade 3 Reading Performance Levels
- New Standards for Grade 4 English Language Arts
- Reporting of Scaled Scores below 220 and above 260
- Implementation of the MCAS Alternate Assessment
- Inclusion of Results for Out-of-District Students
- Reporting of Results for Selected Subgroups of Students

GRADE LEVELS AND CONTENT AREAS TESTED

There are several changes to the grade levels and content areas included in the spring 2001 administration of the MCAS tests. Three tests were shifted to new grade levels, two tests were added, and one test was suspended.

The grade four Science and Engineering/Technology test and History and Social Science test were moved from grade 4 to grade 5. The primary purpose of this move was to lessen the testing time within a school year for students at the elementary level. Because of the recent significant changes to the Science and Engineering/Technology *Curriculum Framework*, scaled score and performance level results will not be reported on the Science and Engineering/Technology test in 2001. There will also be no reporting of scaled scores and performance levels on the History and Social Science test. Because of impending changes to the History and Social Science *Curriculum Framework*, it was not practical to set standards and create a reporting scale for the 2001 History and Social Science test.

Also to lessen testing time within a school year, the grade 8 English Language Arts test was moved from grade 8 to grade 7. However, in order to provide current grade 8 students with the opportunity to participate in the MCAS English Language Arts test prior to high-stakes testing at grade 10, the grade 8 English Language Arts test was also administered for a final time. Performance standards for the grade 7 ELA test were established in the summer of 2001, and performance level and scaled score results are reported. It should be noted that the grade 7 test and its performance standards are independent of the previous grade 8 test and standards.

Two new MCAS tests were administered for the first time in spring 2001. The grade 3 Reading test replaces the grade 3 Iowa Test of Basic Skills administered statewide from 1997 through 1999. The grade 6 Mathematics test was introduced to help monitor the apparent decline in mathematics performance from grade 4 to grade 8. Performance standards for both tests were established in the summer of 2001 and performance level and scaled score results are reported.

The grade 10 Science and Technology/Engineering test was suspended in 2001. Discipline-specific tests in several content areas are under development to replace the integrated science test administered in 1998-2000. The statewide tryout of items for those tests will be administered in the spring of 2002.

For a complete description of all of the MCAS tests administered in 2001, please refer to the *Overview of the MCAS 2001 Tests* (February, 2001).

RENAMING THE *FAILING* PERFORMANCE LEVEL *WARNING*

In May 2001, the Board of Education voted to change the name of the lowest performance level from *Failing* to *Warning* for MCAS tests at grades 3 through 8. The new label better reflects both the purpose of the tests and the formative nature of students' performance at the elementary and middle school levels. The name change does not indicate a change in the level of knowledge and skills that students must demonstrate to reach the *Needs Improvement* level.

GRADE 3 READING TEST PERFORMANCE LEVELS

Results on the grade 3 Reading test are reported in terms of three performance levels: *Proficient*, *Needs Improvement*, and *Warning*. Because scores on the grade 3 Reading test are based solely on multiple-choice items, there is not sufficient opportunity for students to demonstrate the level of content knowledge and skills needed to distinguish between *Proficient* and *Advanced* performance. Consequently, student performance on the grade 3 Reading test will not be reported on the 200-280 scale used for other MCAS tests. In 2001, students' positions within a performance level will be reported in terms of total raw score.

STANDARDS FOR GRADE 4 ENGLISH LANGUAGE ARTS

In response to concerns about 1998 performance level thresholds on the grade 4 English Language Arts test, the Department of Education undertook a review of the grade 4 MCAS English Language Arts test and performance standards. The process included an examination of a) the alignment of the fourth grade test passages and items with English Language Arts *Curriculum Framework*, b) the performance level definition, and c) the standard-setting process.

In August 2001, a new standard-setting meeting was held for grade 4 English Language Arts. The 2001 MCAS grade 4 ELA results are based on the new set of performance standards. Because of the change in standards, the 2001 results are not directly comparable with grade 4 ELA MCAS test results from 1998 through 2000.

REPORTING OF SCALED SCORES BELOW 200 AND ABOVE 260

To supplement information provided by performance level results, student performance on the MCAS tests is also reported in terms of scaled scores that range from 200 to 280. The purpose of the scaled scores is to indicate the relative position of a student's performance within a performance level. Scaled scores indicate whether performance classified as *Proficient* was just above the *Needs Improvement/Proficient* threshold, just below the *Proficient/Advanced* threshold, or in the middle of the *Proficient* range performance.

The MCAS reporting scale was designed so that the performance level thresholds are consistent across all MCAS tests. The raw scores at the *Warning/Needs Improvement, Needs Improvement/Proficient,* and *Proficient/Advanced* thresholds were translated to a scaled score of 220, 240, and 260, respectively. For reporting purposes the scaled range was set at 200 to 280. All scaled scores below 200 were reported as 200 and all scaled scores above 280 were reported as 280.

An unintended consequence of the implementation of the scaling and standard-setting procedures was the lack of information provided at the extreme end of the reporting scale. On some MCAS tests, a wide range of raw scores received the same scaled score of 200. On some other MCAS tests, a perfect test score was equivalent to a scaled score below 280.

Beginning with the reporting of the 2001 MCAS results, the reporting scale has been adjusted so that there is a better correspondence between raw scores and scaled scores in the *Warning (Failing)* and *Advanced* performance levels. The adjustment to the scaled scores within those levels had no impact on a student's performance level classification. However, because of the adjustment, average scaled scores in 2001 will not be directly comparable to scores from previous test administrations. The degree to which the scaled scores across years can be compared will vary based on the test and the number of students scoring at the extreme ends of the scale.

IMPLEMENTATION OF THE MCAS ALTERNATE ASSESSMENT

The MCAS Alternate Assessment was administered statewide for the first time during the 2000-2001 school year. The Alternate Assessment is intended for a small number of students with significant disabilities who are unable to take the standard MCAS tests, even with test accommodations. Approximately 5,000 students participated in MCAS through the Alternate Assessment, or 1 percent of the half-million students tested in 2001.

In accordance with state and federal requirements, test results for students who participated in the Alternate Assessment are reported with school and district results. Those results are aggregated with results of students who took the standard MCAS tests in the performance level results reported in the School Report and District Report. Although the percentage of students participating in the Alternate Assessment statewide is very small, there may be individual districts or schools with a significant percentage of students who participated in the Alternate Assessment. In those cases, their 2001 MCAS performance level results will not be directly comparable to results from previous years.

No scaled scores are reported for the MCAS Alternate Assessment. School- and district-level scaled score results from the 2001 MCAS tests are based only on students who participated in the standard MCAS tests.

Note that no decisions have been made at this time on how results from the MCAS Alternate Assessment will be included in the school and district accountability rating process.

INCLUSION OF RESULTS FOR OUT-OF-DISTRICT STUDENTS

Beginning with the 2001 MCAS administration, district performance level results include the MCAS test results of publicly funded students who attend a Chapter 766 school, an educational collaborative, or similar program outside of their home district. Those results include students who participated in either the standard MCAS tests or the MCAS Alternate Assessment. Note that test results for out-of-district students are included only in district-level results and are not included in school-level results within the sending district.

, in previous years, results for those students in out-of-district placements will also be reported to the school program that they are attending. Those schools and programs will continue to receive the same level of MCAS reporting that they received in previous years.

REPORTING OF RESULTS FOR SELECTED SUBGROUPS OF STUDENTS

Since the initial reporting of MCAS test results in 1998, schools and districts were encouraged to use the student-level data files provided to disaggregate MCAS test results by various subgroups such as gender, race/ethnicity, and academic program. School Reports and District Reports, however, only contained results disaggregated by student status (i.e., Regular Education, Students with Disabilities, and Limited English Proficient). In accordance with federal regulations, beginning with the 2001 MCAS administration, the School and District Reports will include scaled score and performance level results for the several selected subgroups of students.

The reports will include results disaggregated by student status, race/ethnicity, gender, eligibility to receive free or reduced price lunch, receipt of Title I services, and migrant student status. These data are provided to help schools and districts make better use of their MCAS test results. However, school and district personnel should continue to use caution when interpreting the MCAS test results of small groups of students. Further, the classifications included in the School and District Reports should not be considered an exhaustive list. District and school personnel should continue to analyze the results of relevant subgroups of students within their district or school.

Appendix C: Type Definitions and Characteristics