

# **APPENDIX U**

## **MCAS VALIDITY EVIDENCE**

*Gathered by the Massachusetts Department of Elementary and Secondary Education*

## MCAS Validity Evidence

### Purpose

Each year, assessment researchers at the Massachusetts Department of Elementary and Secondary Education produce and evaluate validity evidence associated with the MCAS tests. This evidence and the methods selected for conducting each study and analysis are reviewed by the MCAS TAC for methodological soundness and for appropriateness in responding to the research questions.

### Validity Evidence from Concurrent Measures

This research examines the extent to which MCAS results are correlated with or explain important educational indicators in the same year that the test was taken. The concurrent validity research uses students' course grades, courses taken, and credits earned as educational indicators.

We conducted three sets of validity analyses with concurrent measures:

- First, we looked at the relationships between MCAS scaled scores in ELA and Mathematics and students' course grades in grades 6, 7, 8, and 10, and we compare those relationships to relationships with other student demographic variables.
- Second, we looked at the relationships among MCAS achievement levels and students' course grades in grades 6, 7, 8, and 10.
- Third, we looked at the incidence of taking higher-level math courses in grades 8 and 10 by MCAS achievement levels and by MCAS scores on the Mathematics exams.

### Data Used

The numbers of students included in each grade, by subject, ranges from about 68,000 to almost 72,000. Subjects studied in this analysis include ELA and Mathematics, only.

*Table 1. Total Number of Students by Grade and Subject*

<b>Grade</b>	<b>ELA</b>	<b>Mathematics</b>
3	67,716	67,810
4	69,570	69,556
5	71,789	71,792
6	71,882	71,845
7	70,735	70,714
8	70,194	70,183
10	70,213	69,802

Classroom achievement indicators used in this analysis included course grades and course names. Weighted and unweighted course grades are generated for each student. Weighting was done with respect to the proportion of course credits earned within each subject, such that for each student, the course credits earned summed to "1." Because course credits were not available for many courses, particularly the middle school, the weighted course grades omitted up to 80% of students in middle school and 15% of students in grade 10.

More than 80% of students in all grades took only one course in each of these subjects. For students who took multiple courses within a subject, each of the multiple courses was represented using one average course grade. When weighted and unweighted averages are used, each student is represented only once per subject.

As shown in Table 2, the majority of students in grades 6, 7, 8, and 10 have course grades associated with the courses they took. Hence, this analysis focuses on students in those grades.

Table 2. Percentage of Students with Course Grades Available by Grade and Subject

Grade	ELA	Mathematics
3	4%	3%
4	7%	6%
5	22%	22%
6	72%	72%
7	85%	83%
8	87%	84%
10	74%	70%

Differentiation with respect to the academic difficulty of math courses was identified by mathematics course names in grades 8 and 10. Table 3 shows the math course names which are coded as “Advanced Math Courses.”

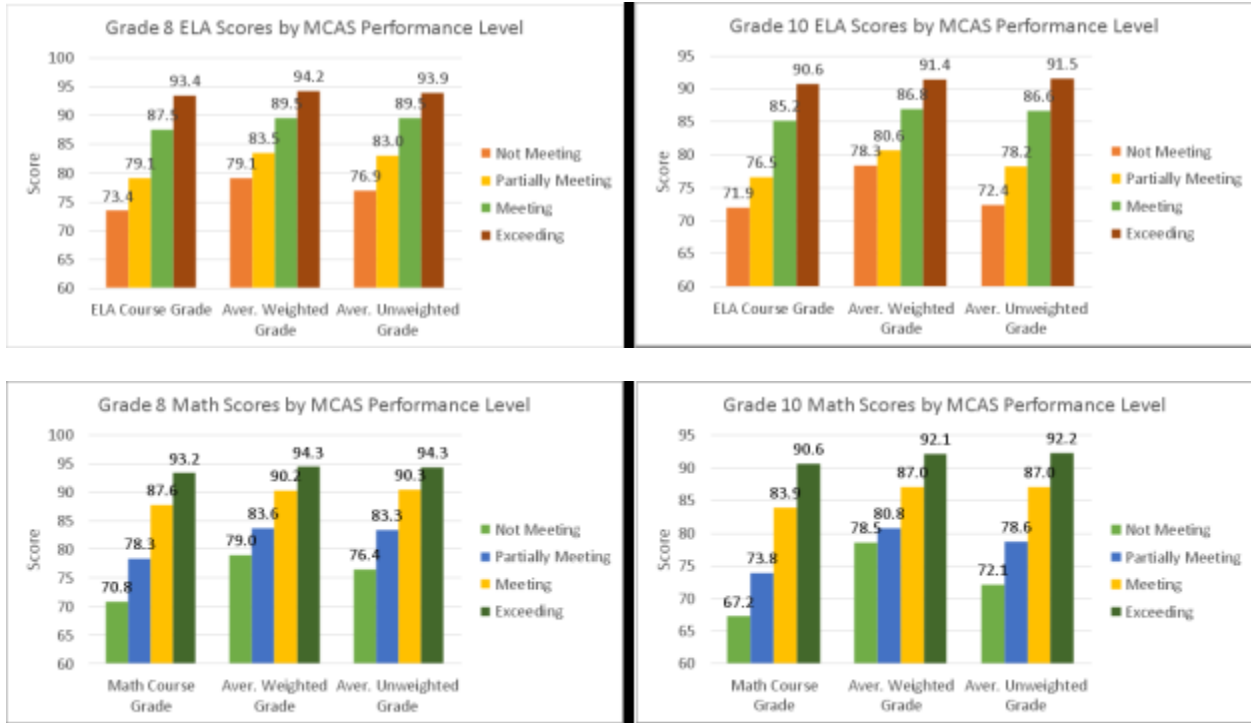
Table 3. Advanced Math Classes—Grades 8 and 10

Grade 8 Advanced Mathematics Classes		Grade 10 Advanced Mathematics Classes	
Title	#	Title	#
Algebra I	20,710	Algebra II and III	19,202
Algebra-Other	1,676	Calculus and Pre-Calculus	1,987
Geometry	512	Trigonometry/Algebra	1,233
		Analytic Geometry	702
		AP Statistics	457
		Trigonometry	224
		Trigonometry/Geometry	185
<b>Total</b>	<b>22,898</b>	<b>Total</b>	<b>23,990</b>

#### Comparison of MCAS Scores to Course Grades

As shown in Figures 1-4, there is a distinct pattern repeated throughout the grades and subjects (only grades 8 and 10 pictured below), in which the course grades, and the average weighted and unweighted grades, substantially increase by achievement level. For example, in Grade 8 ELA, the average ELA course grade per achievement level increased from an average ELA grade of 73.4 for the students in the “Not Meeting” achievement level to a grade of 93.4 for the students in the “Exceeding” achievement level.

Figures 1-4. Comparison of Average Student Academic Indicators by MCAS Achievement Level Grades 8 and 10—ELA and Mathematics



To evaluate the relationships among MCAS test scores within a subject and grade with student demographic variables and the students' course grades, we conducted a series of linear regression analyses. In each analysis that examined the relationship between MCAS test scores and course grades, we regressed a series of variables on the course grade in ELA and Mathematics. Variables were entered in blocks such that the relevant MCAS test score (in ELA or Math) was entered in the last block. This allowed the scaled score to explain the remaining unexplained variance. The first group of covariates entered was the level of course difficulty (ranging from '01' or below grade level to '05' or advance/college level). Next, student demographic variables were entered (EL/English learners, FormerEL/Former English learners, IEP/student is on an IEP, "ecodis"/economic disadvantage, and highneeds/students who are EL, on an IEP, and "ecodis"). The last covariate added was the MCAS scaled score.

To illustrate the relationship of MCAS scaled scores to the course grade (in ELA and Math), Table 4 first provides the overall R Square, and then the change in R Square associated with adding the MCAS scaled score. In almost all cases, the change in R Square approaches or exceeds 50% of the overall R Square, indicating the strong explanatory relationship between MCAS scores and course grades. The second two values in Table 4 show a) the standardized Beta for the MCAS scaled score (beta statistics allow us to evaluate the unique contribution of each covariate used in the model, as expressed in standardized units), and b) the comparison of the MCAS Beta to the absolute value of the "ecodis"/economic disadvantage Beta. The MCAS beta is compared to the beta for "ecodis" because economic disadvantage exhibits the second-strongest relationship to course grades in our model. In ELA, the relationship between MCAS test scores and course grades are about four times stronger than the relationship between "ecodis" and course grades. In math, the relationship between MCAS test scores and course grades is about six times stronger than "ecodis" in grades 6-8 and ten times stronger than "ecodis" in grade 10. Information on all of the model coefficients is provided in Table 9 at the end of this document. This analysis shows that the relationship between the MCAS score and the concurrent course grade is strong.

Table 4. R Square (R<sup>2</sup>) and Change in R<sup>2</sup>, Beta and % Beta of Economic Disadvantage for Linear Regression Models

Grade	ELA				Mathematics			
	Total R <sup>2</sup>	R <sup>2</sup> Change	Beta ELA SS	% Beta Ecodis	Total R <sup>2</sup>	R <sup>2</sup> Change	Beta ELA SS	% Beta Ecodis
6	.312	.154	.482	357%	.388	.232	.580	572%
7	.329	.188	.531	471%	.369	.227	.580	605%
8	.331	.192	.538	493%	.353	.220	.573	564%
10	.260	.122	.453	422%	.324	.193	.581	1061%

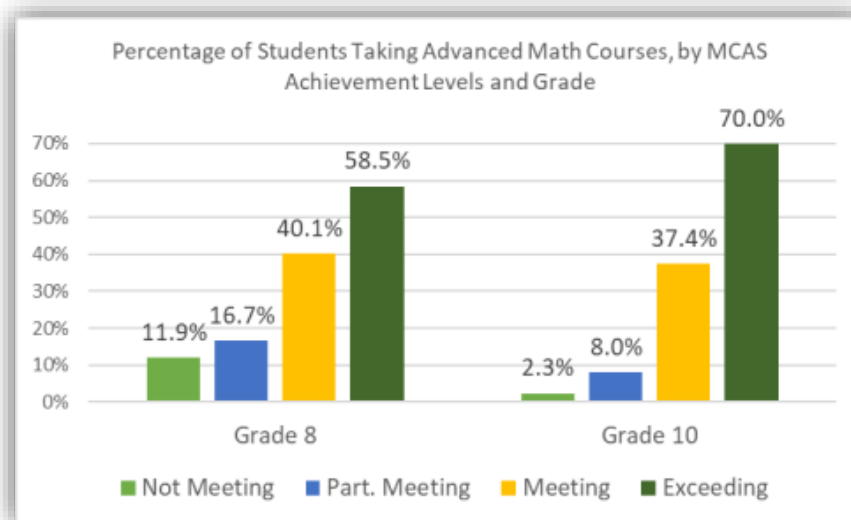
Comparison of Math MCAS Achievement Levels and Taking Advanced Math Courses in Grades 8 and 10

The pattern of students taking advanced mathematics courses in grades 8 and 10, by the Math MCAS achievement level, is shown in Table 5 and Figure 5. Here it is shown that higher proportions of students scoring within the Meeting and Exceeding levels on MCAS are taking advanced math classes.

Table 5: Percentage of Students Taking Advanced Math Courses by MCAS Achievement Level and Grade

Achievement Level	Grade 8			Grade 10		
	N Adv. Courshed	% Total N	Total N	N Adv. Courshed	% Total N	Total N
Not Meeting	966	11.9%	8,099	130	2.3%	5,559
Partially Meeting	4,826	16.7%	28,968	1,819	8.0%	22,623
Meeting	10,456	40.1%	26,051	11,888	37.4%	31,817
Exceeding	3,913	58.5%	6,693	6,480	70.0%	9,259

Figure 5. Percentage of Students Taking Advanced Math Courses by MCAS Achievement Level and Grade



The relationship between MCAS scores and the proportion of students taking advanced math scores is statistically significant, as indicated in an ANOVA that uses the proportion of students taking advanced math courses as the dependent variable and the MCAS math scaled score as the independent variable. The between group F statistics for the MCAS math scaled score covariate for grades 8 and 10 are 8,743 and 20,740, respectively, at alpha .05,  $p < .001$  for both grades.

Table 6. ANOVA Table: Explaining the Proportion of Students Taking Advanced Math Courses by MCAS Math Achievement Levels

Tests of Between-Subjects Effects									
Dependent Variable: AdvancedMath									
Grade	Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared	Noncent. Parameter	Observed Power <sup>b</sup>
8	Corrected Model	1598.185 <sup>a</sup>	1	1598.185	8742.689	.000	.112	8742.689	1.000
	Intercept	1324.110	1	1324.110	7243.396	.000	.094	7243.396	1.000
	Mscalds	1598.185	1	1598.185	8742.689	.000	.112	8742.689	1.000
	Error	12710.435	69531	.183					
	Total	20145.000	69533						
	Corrected Total	14308.620	69532						
10	Corrected Model	3340.064 <sup>c</sup>	1	3340.064	20740.140	.000	.227	20740.140	1.000
	Intercept	2923.445	1	2923.445	18153.139	.000	.204	18153.139	1.000
	Mscalds	3340.064	1	3340.064	20740.140	.000	.227	20740.140	1.000
	Error	11379.654	70662	.161					
	Total	20903.000	70664						
	Corrected Total	14719.718	70663						

a. R Squared = .112 (Adjusted R Squared = .112)

b. Computed using alpha = .05

c. R Squared = .227 (Adjusted R Squared = .227)

### Correlations between MCAS Domain Scores and Item Types

This analysis examines the correlational patterns of portions of the MCAS tests across academic domains. Here we expect higher correlations among test portions within each academic subject and lower correlations across different academic subjects. The tests are portioned according to item type (SR or selected response items and CR or constructed response or essay items). In Tables 7 and 8, we see the within-subject correlations shaded peach for ELA, green for Math, and blue for Science. High correlations (equaling or exceeding .8) are bolded. Across grades, high correlations (bolded) are shown most often within the academic subject (shaded) areas, providing evidence of convergent validity. However, in some grades and subjects, particularly in grade 10, we do see some high correlations shown across academic subjects. One test portion that does not show high correlations within the tested domain is the criterion-referenced items in ELA; here, the correlations between ELA SR and ELA CR are in the moderate range.

Tables 7. Convergent Validity Evidence: Correlations by Academic Subject and Test Portion—Grades 3–5

	Grade 3								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.588								
Escaleds	<b>0.922</b>	<b>0.839</b>							
Math SR	0.665	0.563	0.680						
Math CR	0.700	0.583	0.722	<b>0.839</b>					
Mscaleds	0.703	0.593	0.733	<b>0.733</b>	<b>0.963</b>				
Sci SR									
Sci CR									
sscaleds									
	Grade 4								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.631								
Escaleds	<b>0.916</b>	<b>0.867</b>							
Math SR	0.697	0.605	0.709						
Math CR	0.710	0.624	0.732	<b>0.851</b>					
Mscaleds	0.717	0.635	0.750	<b>0.939</b>	<b>0.957</b>				
Sci SR									
Sci CR									
sscaleds									
	Grade 5								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.621								
Escaleds	<b>0.891</b>	<b>0.893</b>							
Math SR	0.620	0.591	0.662						
Math CR	0.691	0.635	0.731	<b>0.816</b>					
Mscaleds	0.691	0.643	0.739	<b>0.920</b>	<b>0.957</b>				
Sci SR	0.750	0.575	0.725	0.707	0.746	0.755			
Sci CR	0.725	0.620	0.739	0.675	0.755	0.749	<b>0.786</b>		
sscaleds	0.772	0.618	0.769	0.725	0.780	0.795	<b>0.966</b>	<b>0.901</b>	

Tables 8. Convergent Validity Evidence: Correlations by Academic Subject and Test Portion—Grades 6–8, 10

	Grade 6								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.685								
Escaleds	<b>0.914</b>	<b>0.909</b>							
Math SR	0.694	0.659	0.731						
Math CR	0.706	0.681	0.753	<b>0.881</b>					
Mscaleds	0.710	0.682	0.760	<b>0.964</b>	<b>0.947</b>				
Sci SR									
Sci CR									
sscaleds									
	Grade 7								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.654								
Escaleds	<b>0.905</b>	<b>0.897</b>							
Math SR	0.670	0.609	0.701						
Math CR	0.723	0.670	0.766	<b>0.883</b>					
Mscaleds	0.728	0.667	0.770	<b>0.942</b>	<b>0.966</b>				
Sci SR									
Sci CR									
sscaleds									
	Grade 8								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.670								
Escaleds	<b>0.908</b>	<b>0.903</b>							
Math SR	0.668	0.648	0.711						
Math CR	0.716	0.693	0.768	<b>0.880</b>					
Mscaleds	0.704	0.685	0.764	<b>0.948</b>	<b>0.961</b>				
Sci SR	0.752	0.605	0.736	0.754	0.784	0.782			
Sci CR	0.738	0.645	0.753	0.733	0.786	<b>0.973</b>	<b>0.819</b>		
sscaleds	0.772	0.641	0.774	0.770	<b>0.807</b>	<b>0.813</b>	<b>0.973</b>	<b>0.914</b>	
	Grade 10								
	ELA SR	ELA CR	Escaleds	Math SR	Math CR	Mscaleds	Sci SR	Sci CR	sscaleds
ELA SR									
ELA CR	0.694								
Escaleds	<b>0.906</b>	<b>0.856</b>							
Math SR	0.688	0.632	0.729						
Math CR	0.723	0.657	0.764	<b>0.898</b>					
Mscaleds	0.718	0.656	0.768	<b>0.959</b>	<b>0.958</b>				
Sci SR	0.798	0.699	0.795	0.782	<b>0.811</b>	<b>0.809</b>			
Sci CR	0.735	0.702	0.778	0.791	<b>0.823</b>	<b>0.817</b>	<b>0.845</b>		
sscaleds	0.766	0.653	0.782	0.799	<b>0.822</b>	<b>0.830</b>	<b>0.975</b>	<b>0.916</b>	



Table 9. Linear Regression Coefficients

Grade		ELA					Math				
		Unstandardized Coefficients		Stand. Coefficient	t	Sign.	Unstandardized Coefficients		Stand. Coefficient	t	Sign.
		B	Std. Error	Beta			B	Std. Error	Beta		
6	Course Level	3.854	.208	.065	18.52	.000	1.496	.195	.025	7.67	.000
	High Needs	-1.503	.162	-.067	-9.26	.000	-1.065	.162	-.044	-6.59	.000
	EconDis	-3.133	.136	-.135	-23.12	.000	-2.529	.135	-.101	-18.74	.000
	EL	2.122	.166	.049	12.76	.000	0.055	.158	.001	0.35	.727
	FormerEL	.344	.144	.010	2.38	.017	.733	.145	.019	5.06	.000
	On an IEP	1.448	.136	.050	10.66	.000	2.330	.135	.074	17.20	.000
	Scaled Score	.209	.002	.482	113.55	.000	.304	.002	.580	149.21	.000
7	Course Level	-0.033	.154	-.001	-0.21	.832	-0.843	.125	-.022	-6.76	.000
	High Needs	-1.598	.154	-.071	-10.35	.000	-0.900	.157	-.038	-5.72	.000
	EconDis	-2.655	.129	-.113	-20.51	.000	-2.386	.132	-.096	-18.09	.000
	EL	3.864	.161	.085	23.93	.000	1.396	.157	.031	8.89	.000
	FormerEL	.925	.144	.024	6.43	.000	.920	.148	.023	6.23	.000
	On an IEP	1.806	.131	.062	13.82	.000	1.844	.132	.060	13.95	.000
	Scaled Score	.258	.002	.531	134.28	0.000	.282	.002	.580	151.91	0.000
8	Course Level	-0.505	.142	-.012	-3.55	.000	-0.570	.121	-.015	-4.70	.000
	High Needs	-1.518	.170	-.064	-8.91	.000	-0.246	.173	-.010	-1.42	.154
	EconDis	-2.735	.146	-.109	-18.72	.000	-2.638	.148	-.102	-17.82	.000
	EL	5.018	.174	.104	28.90	.000	1.508	.166	.032	9.08	.000
	FormerEL	1.891	.173	.040	10.92	.000	1.537	.178	.031	8.65	.000
	On an IEP	1.127	.144	.036	7.85	.000	1.321	.145	.041	9.13	.000
	Scaled Score	.258	.002	.538	135.03	0.000	.305	.002	.573	146.90	0.000
10	Course Level	1.681	.089	.069	18.92	.000	-0.547	.095	-.021	-5.77	.000
	High Needs	-0.681	.192	-.027	-3.54	.000	-0.749	.196	-.028	-3.82	.000
	EconDis	-2.900	.167	-.107	-17.41	.000	-1.589	.170	-.055	-9.36	.000
	EL	5.542	.200	.106	27.69	.000	2.461	.192	.046	12.84	.000
	FormerEL	1.462	.214	.025	6.83	.000	1.259	.220	.020	5.71	.000
	On an IEP	0.334	.165	.010	2.02	.043	2.550	.169	.069	15.07	.000
	Scaled Score	.240	.002	.453	106.40	0.000	.331	.002	.581	140.43	0.000

EconDis = Economic Disadvantage / EL = English Learner