

*Measuring Learning Outcomes  
in Higher Education Using  
the Measure of Academic  
Proficiency and Progress (MAPP)*

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*September 2008*

*ETS RR-08-47*



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## **Abstract**

The Secretary of Education's Commission on the Future of Higher Education emphasizes accountability in higher education as one of the key areas of interest. The Voluntary System of Accountability (VSA) was developed to evaluate the effectiveness of general public college education. This study examines how student progress in college, indicated by the performance difference between freshmen and seniors after controlling for admission scores, can be measured using the Measure of Academic Proficiency and Progress (MAPP) test. A total of 6,196 students from 23 institutions were included in this study. Results indicated that MAPP was able to differentiate the performance between freshmen and seniors after controlling for SAT<sup>®</sup>/ACT scores. The institutions were classified into 10 groups on the basis of the difference in the actual vs. expected MAPP performance. This study provides an example of how MAPP can be used to evaluate value-added performance in college education. Issues such as student sampling and test-taking motivation are discussed.

**Key words:** Higher education, MAPP, outcome assessment, value-added, voluntary system of accountability

## **Acknowledgments**

This study was a collaborative effort between the Research and Development and the Higher Education and School Assessments divisions at ETS. The Data Collection and Scoring, Reporting, & Technology groups were also involved in this process. The following personnel (in alphabetical order) at ETS made a significant contribution to the completion of this study: Luis Acosta, Brent Bridgeman, Lawrence McFarlane, Steve Meshanko, Kathy Miller, Kathy O’Neil, David Payne, Kathi Perlove, Vanessa Thompson (intern), Namrata Tognatta, Sailesh Vezzu, Michael Walker, Cathy Wendler, William Wynne, John Young, Mary Ann Zaborowski, and Wenmin Zhang. The author is also grateful to the 23 institutions for their participation in this study.

As the No Child Left Behind Act (NCLB; No Child Left Behind Act of 2001, 2002) brought unprecedented attention to accountability in K–12 education, the call for accountability in higher education has also received increasing levels of attention. The urgency to evaluate the effectiveness of college education and demonstrate student learning is symbolized by the formation of a Commission on the Future of Higher Education, founded by Secretary of Education Margaret Spellings, in September 2005. Accountability is one of the four key areas emphasized in the Commission’s first report released in September 2006 (U.S. Department of Education, 2006), with the other three being access, affordability, and the standards of quality in instruction. The report commented on the nation’s “remarkable absence of accountability mechanisms to ensure that colleges succeed in educating students” (p. x) and pointed out that accountability is vital to ensuring the success of reforms in the other three key areas. This report called for solid evidence of how much students have learned in colleges and emphasized that the evidence should be comparable across institutions.

Accountability in higher education is needed for both internal and external reasons. As tuition costs and other college expenses continue to climb, students, parents, and policy makers want to know whether their investment is paying off and if the money can be spent more effectively. Internally, institutions need the evaluation to correct shortcomings in instruction and to better prepare students for the global marketplace. Externally, accountability results are needed for transparency and public credibility.

Against this backdrop, the American Association of State Colleges and Universities (AASCU) and the National Association of State Universities and Land-Grant Colleges (NASULGC) developed an initiative, the Voluntary System of Accountability (VSA; <http://www.voluntarysystem.org>), to evaluate core educational outcomes in higher education and improve public understanding of how universities and colleges operate. The AASCU and the NASULGC are two leading organizations in public higher education. Collectively they have more than 525 member institutions representing 7.5 million students in the United States, and they award 70% of bachelor's degrees in the United States each year.

To measure the learning outcomes of general college education, VSA selected three standardized assessments to evaluate student abilities in critical thinking, analytical reasoning, and written communication. These three assessments are the Collegiate Assessment of Academic Proficiency (CAAP), the Collegiate Learning Assessment (CLA), and the Measure of Academic

Proficiency and Progress (MAPP). These instruments were carefully selected from 16 candidate instruments because they were believed to adequately measure improvement in the core skill areas emphasized by VSA. The focus of VSA is on institutional-level learning outcomes when students enter an institution and graduate from an institution, as well as on the learning gained through the college years. The change occurring between entering and exiting is referred to as the *value-added*. The method VSA adopts to calculate value-added is based on the methodology employed by the Council for Aid to Education (CAE), the organization that offers the CLA, and VSA requires that the same method be used to measure value-added for the CAAP, CLA, and MAPP.

### **Purpose of This Study**

The purpose of this study is to examine the capability of MAPP in measuring value-added outcomes using the method recommended by VSA. In the following section, the analysis method is described at greater length. This study also introduces the MAPP test, samples included in the analysis, and key findings.

### ***Method***

#### ***Instrument***

The MAPP is an integrated test of general education skills that measures college-level skills in critical thinking, reading, writing, and mathematics. It is designed to measure the academic skills developed through general education rather than focusing on the knowledge taught in specific courses. The test has two forms: the standard form and a short form. The standard form has 108 items with 27 items in each of the four skill areas it measures and takes two hours to complete. The short form has 36 items and takes about 40 minutes to complete. All items are in multiple-choice format, and each item is associated with a particular academic context: humanities, social sciences, or natural sciences. Both the standard form and the short form are suitable for VSA because institutions can receive summaries for each skill area from both forms. The reliabilities of all four MAPP skills scores are in the .80 to .89 range, even for the short form. Both forms of the MAPP are delivered via a paper/pencil format or an online version. Scores from the two delivery formats are equated so that the scores are comparable (ETS, 2007).

Eight scaled scores are reported for students who take the standard form, including a total MAPP score, four skills subscores (critical thinking, reading, writing, and mathematics), and

three content-based subscores (humanities, social sciences, and natural sciences). Similar information is provided at the group level for students who take the short form but not at the individual student level in order to achieve acceptable scale reliability.

### *Sample*

A total of 6,196 students from 23 institutions were included in the analysis. The sample consisted of 4,373 freshmen and 1,823 seniors. The freshmen and seniors were not the same groups of students. Therefore, the design of this study was cross-sectional instead of longitudinal. Thirty-nine institutions were contacted to participate in this study. These institutions were considered because they (a) belonged to the VSA target institutions (e.g., 4-year public colleges and universities), (b) had administered MAPP to at least 50 freshmen and 50 seniors, and (c) had admission scores (e.g., SAT, ACT) for the students who took MAPP. Of the 39 institutions that were contacted, 23 expressed interest in participation. Students who took the MAPP test between 2006 and 2008 were recruited by each institution primarily on a voluntary basis. The MAPP scores were obtained from ETS, the organization responsible for the development, administration, and scoring of MAPP. The admission test scores were provided by an institution administrator.<sup>1</sup>

### *Analysis*

Value-added is required by VSA to be computed based on the learning differences between entering freshmen and graduating seniors for each institution after controlling for the SAT/ACT scores.<sup>2</sup> As mentioned earlier, the current method adopted by CAE for their CLA is recommended for use in calculating VSA value-added. Following the CAE method (Council for Aid to Education, 2007), an ordinary least squares regression model is estimated between mean SAT scores and mean MAPP scores for freshmen and seniors, respectively. Note that the unit of analysis is at the institutional level instead of at the student level, so the outcome variable is the mean of the MAPP scores.

Based on differences between expected and actual MAPP scores, five performance levels were constructed for freshmen and seniors, respectively. These five levels were Well Above Expected, Above Expected, At Expected, Below Expected, and Well Below Expected (see the appendix). Institutions with actual scores within one standard error from their expected scores were categorized as being At Expected. Institutions with actual MAPP scores larger than one but



less than two standard errors from their expected scores were categorized as being either Above Expected or Below Expected. Institutions with actual MAPP scores larger than two standard errors from their expected scores were categorized as being either Well Above Expected or Well Below Expected. Because the VSA focuses on writing and critical thinking abilities, this study examined only these two skill areas as well as the MAPP total score.

The differences between actual versus expected score differences between freshmen and seniors were referred to as the *final value-added*. Institutions were classified into 10 decile groups on the basis of value-added. If an institution was in Decile Group 5, it performed better than 40% of the 4-year institutions included in this analysis. Similarly, if an institution was in Decile Group 10, it scored higher than 90% of the 4-year institutions included in this analysis.

## Results

### *Descriptive Statistics and Correlations*

Table 1 presents the descriptive statistics for the MAPP total test, the two MAPP subscales, and the SAT. The mean MAPP scores of this sample were compared to the mean MAPP scores calculated using all MAPP users. The mean (standard deviation) was 438.69 (7.62) for MAPP freshmen and 448.99 (9.58) for MAPP seniors. No significant score difference existed in the means between these samples and the MAPP general population ( $p = .11$  for freshmen and  $p = .08$  for seniors). It was assumed that these samples were representative of the general users.

**Table 1**

***Descriptive Statistics of the Measure of Academic Proficiency and Progress (MAPP) Total Score, MAPP Subscales, and SAT***

	Freshmen ( $N = 4,373$ )		Seniors ( $N = 1,823$ )		<i>D</i>
	Mean	<i>SD</i>	Mean	<i>SD</i>	
MAPP total	438	7.30	448	9.30	1.20
Critical thinking	110	1.90	113	2.30	1.40
Writing	113	1.70	115	1.80	1.10
SAT	1,001	72	1,049	94	0.57

Table 1 shows that seniors performed better than freshmen on the total MAPP test and on the critical thinking and writing scores. Note that seniors also had a higher mean SAT score than freshmen, which is probably because students with lower admission test scores dropped out of

college. An effect size is provided for each comparison, indicating the magnitude of the performance difference. The effect size was calculated by dividing the mean difference by the pooled standard deviation. In social science contexts, effect sizes between .50 and .80 are considered medium, while effect sizes larger than .80 are considered large (Cohen, 1988). According to this rule, the performance difference in SAT between freshmen and seniors is a medium effect, while the differences in MAPP performance is a large effect at both the test and skill levels.

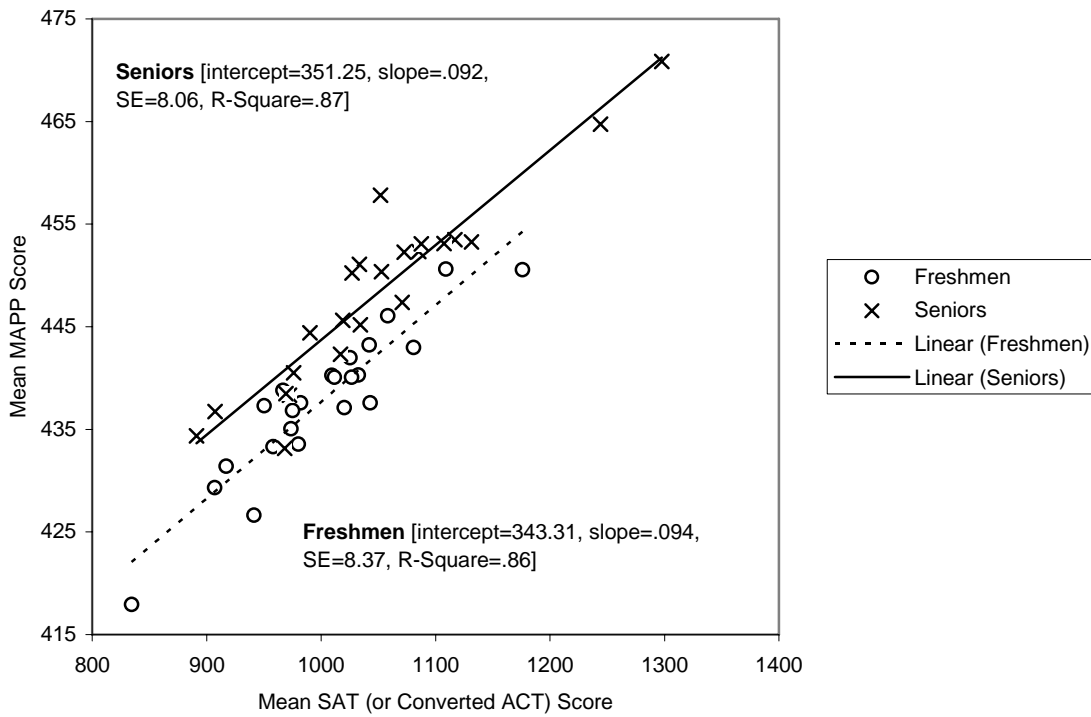
Table 2 summarizes the Pearson correlations between MAPP scores and the SAT at the student and institution levels. At the student level, for freshmen the correlation between MAPP scores and SAT ranged from .50 to .72. The correlation was slightly higher for senior students, ranging from .54 to .77. As expected, the institution level correlations were substantially higher than student level correlations since the within-institution variation was ignored when the correlation was computed at the school level. The correlation between MAPP and SAT scores ranged from .83 to .93 for freshmen and from .80 to .93 for seniors.

**Table 2**  
*Pearson Correlations Between Measure of Academic Proficiency and Progress (MAPP) and SAT Scores*

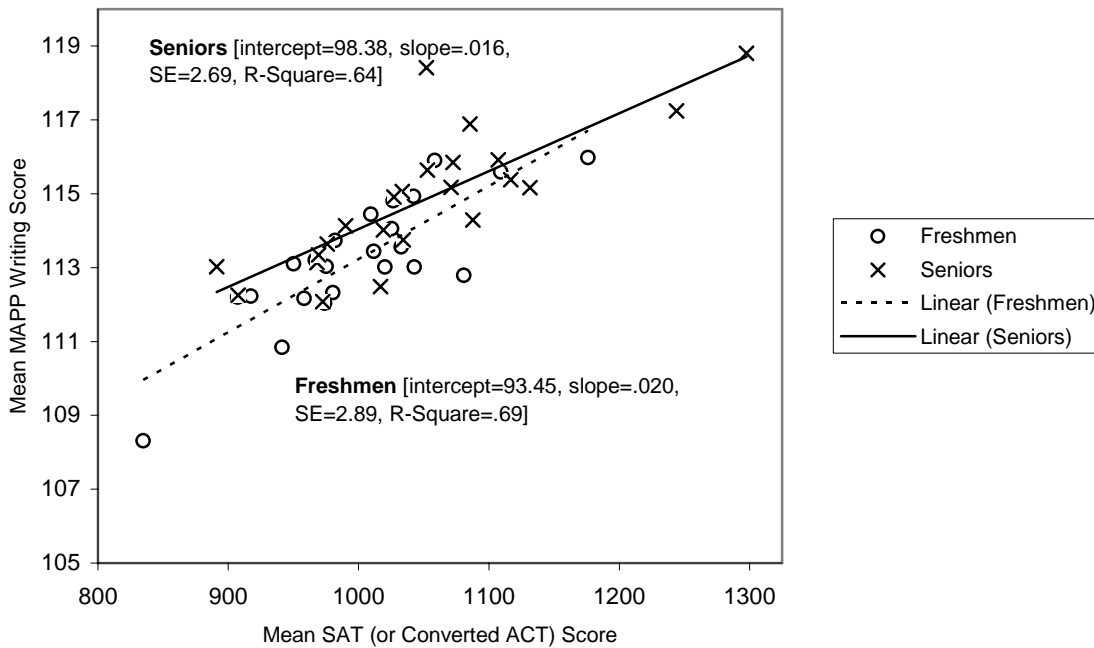
	Institution level		Student level	
	Freshmen	Seniors	Freshmen	Seniors
MAPP total	.93	.93	.72	.77
Writing	.83	.80	.50	.59
Critical thinking	.85	.88	.54	.54

***Value-Added***

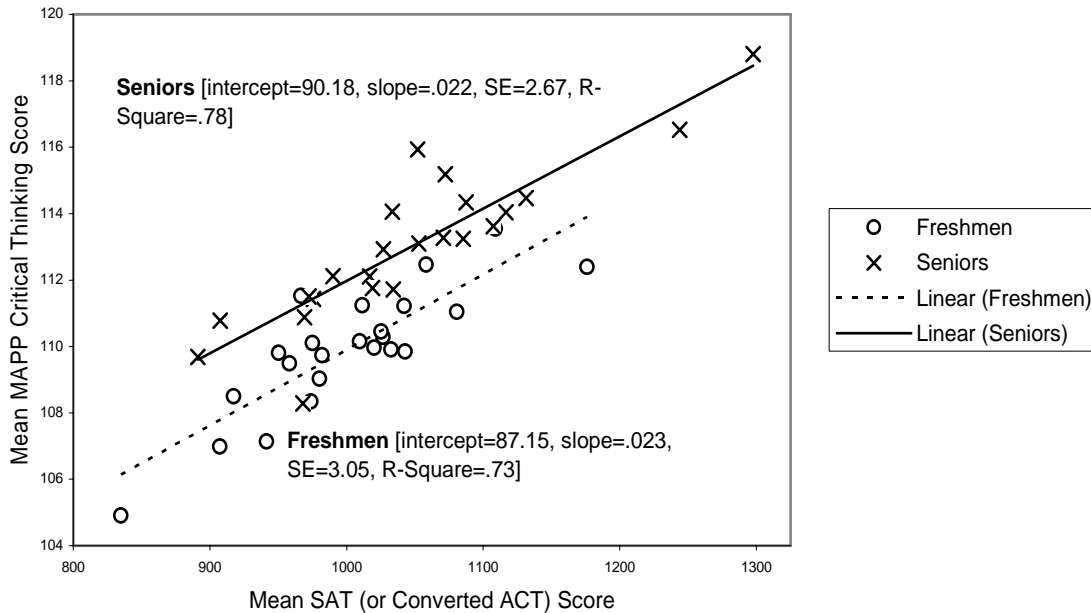
Figures 1 to 3 show the predictive relationship between mean SAT scores and the mean MAPP total score, mean MAPP writing score, and mean MAPP critical thinking score. In general, after controlling for the admission scores, seniors performed better on MAPP total than freshmen. The performance difference between these two classes was fairly similar across all possible mean SAT scores so that the two regression lines were almost parallel. This pattern was also true for student performance on MAPP critical thinking. Results on MAPP writing were somewhat different. Figure 2 shows that entering freshmen with high SAT scores (i.e., higher than 1,200) performed as well as seniors with the same SAT scores on MAPP writing.



**Figure 1. Relationship between MAPP performance and college admission scores.**



**Figure 2. Relationship between MAPP writing performance and college admission scores.**



**Figure 3. Relationship between MAPP critical thinking performance and college admission scores.**

SAT mean score was a significant predictor of MAPP mean total score, writing mean score, and critical thinking mean score. SAT mean scores accounted for 87%, 64%, and 78% of the variance in mean MAPP total mean, writing mean, and critical thinking mean scores.

Table 3 presents an example of a value-added summary for MAPP total scores. In this example, seniors had a higher mean SAT score than freshmen (1,088 vs. 1,081). Based on the regression equation in Figure 1, the freshmen were expected to score 445 on MAPP. Their actual mean MAPP performance was 443. The difference in standard errors was -.90, which placed the freshmen at the At Expected performance level. Similarly, the seniors were expected to score 452 on the MAPP test, and their actual mean MAPP score was 453, resulting in a standard error of .40. This residual also placed the seniors at the At Expected level. The difference in the residual in standard errors between freshmen and seniors was 1.3 (.40 to -.90), which determined that this institution was in Decile Group 9 and suggested that it would perform better on MAPP than 80% of the other institutions included in the analysis. Note that a school can be placed in a lower decile group even if its seniors performed better than its freshmen. If the score gain in an institution is not as large as the score gains in other institutions, it is likely that the institution will have a lower value-added number. Therefore, the value-added is relative to other institutions. That is, the performance rank of any institution depends on the performance of the other

institutions in the cohort. A similar example is also provided for MAPP writing and critical thinking scores in Tables 4 and 5.

**Table 3**

***Sample Institutional Report for Freshmen, Seniors, and Value-Added Based on Total Measure of Academic Proficiency and Progress (MAPP) Score***

	Freshmen	Seniors	Value-added
Mean SAT (or converted ACT) score	1,081	1,088	
Expected MAPP score	445	452	7
Actual MAPP score	443	453	10
Actual versus expected <sup>a</sup> (difference in score points)	-2.3	1.3	3.6
Actual versus expected <sup>b</sup> (difference in standard errors)	-0.9	0.4	1.3
Performance level <sup>c</sup>	Well Above	Well Above	10
	Expected	Expected	9
	Above	Above	8
	Expected	Expected	7
	At	At	6
	Expected	Expected	5
	Below	Below	4
	Expected	Expected	3
	Well Below	Well Below	2
Expected	Expected	1	

*Note.* The shading represents the performance level of that institution.

<sup>a</sup> This is the residual, which equals the scaled score difference between actual and expected MAPP scores. <sup>b</sup> This is the standardized residual, which is the residual divided by the standard error of the residual. <sup>c</sup> See the appendix for an explanation of performance levels.

**Table 4*****Sample Institutional Report for Freshmen, Seniors, and Value-Added on Writing Score***

	Freshmen	Seniors	Value-added
Mean SAT (or converted ACT) score	950	990	
Expected MAPP writing score	112	114	2
Actual MAPP writing score	113	114	1
Actual versus expected <sup>a</sup> (difference in score points)	0.9	0.2	-0.6
Actual versus expected <sup>b</sup> (difference in standard errors)	0.9	0.2	-0.7
Performance level <sup>c</sup>	Well Above	Well Above	10
	Expected	Expected	9
	Above	Above	8
	Expected	Expected	7
	At	At	6
	Expected	Expected	5
	Below	Below	4
	Expected	Expected	3
	Well Below	Well Below	2
	Expected	Expected	1

*Note.* The shading represents the performance level of that institution.

<sup>a</sup>This is the residual, which equals the scaled score difference between actual and expected MAPP scores. <sup>b</sup>This is the standardized residual, which is the residual divided by the standard error of the residual. <sup>c</sup> See the appendix for an explanation of performance levels.

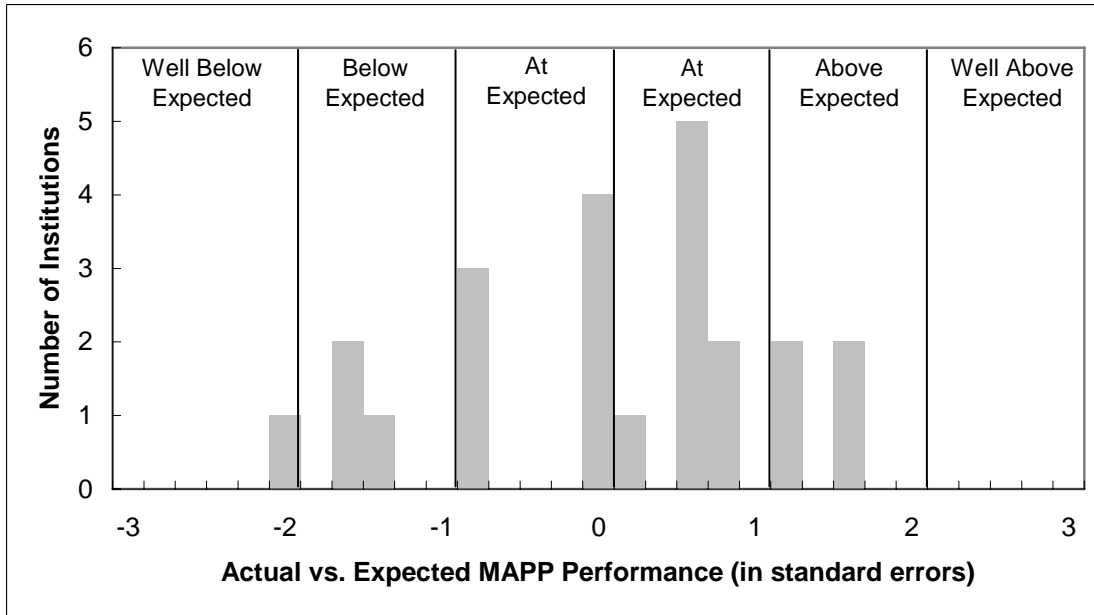
**Table 5*****Sample Institutional Report for Freshmen, Seniors, and Value-Added on Critical Thinking Score***

	Freshmen	Seniors	Value-added
Mean SAT (or converted ACT) score	1043	1107	
Expected MAPP critical thinking score	111	114	3
Actual MAPP critical thinking score	110	114	4
Actual versus expected <sup>a</sup> (difference in score points)	-1.0	-0.7	0.3
Actual versus expected <sup>b</sup> (difference in standard errors)	-1.0	-0.6	0.4
	Well Above Expected	Well Above Expected	10 9
	Above Expected	Above Expected	8 7
Performance level <sup>c</sup>	At Expected	At Expected	6 5
	Below Expected	Below Expected	4 3
	Well Below Expected	Well Below Expected	2 1

*Note.* The shading represents the performance level of that institution.

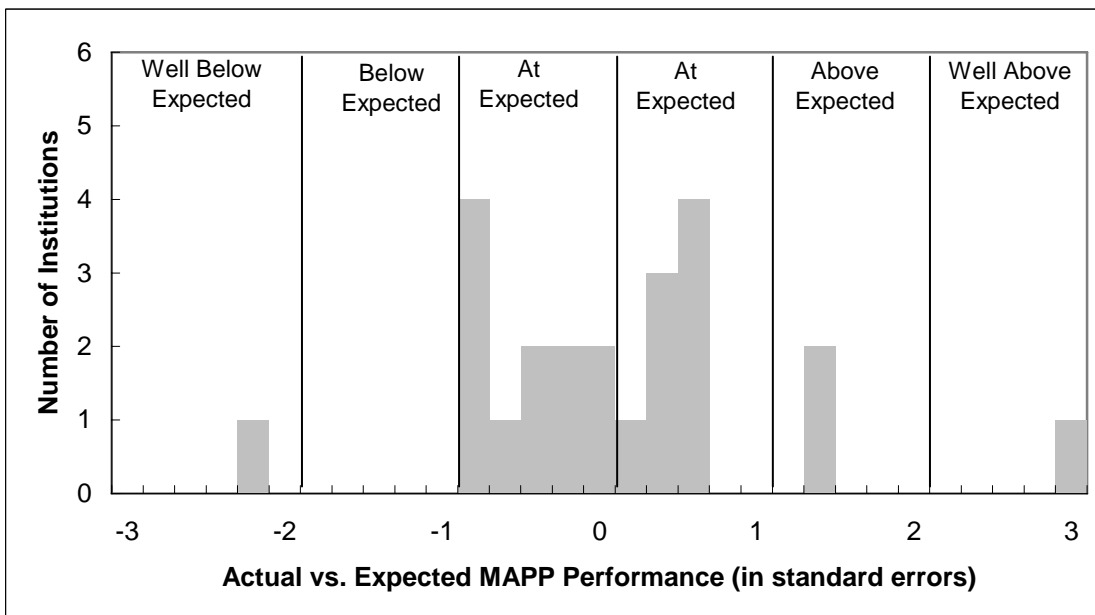
<sup>a</sup>This is the residual, which equals the scaled score difference between actual and expected MAPP scores. <sup>b</sup>This is the standardized residual, which is the residual divided by the standard error of the residual. <sup>c</sup> See the appendix for an explanation of performance levels.

Histograms of numbers of institutions in terms of actual versus expected MAPP performance for freshmen, seniors, and for value-added performance are provided in Figures 4 to 6. The performance of the freshmen and seniors in most institutions was at the At Expected level, with fewer schools at the Above Expected or Below Expected levels and very few institutions at the Well Above Expected and Well Below Expected levels. Similar graphs are provided for MAPP writing and critical thinking (see Figures 7 to 12).



**Figure 4. Histogram of institutions by actual versus expected Measure of Academic Proficiency and Progress (MAPP) scores for freshmen.**

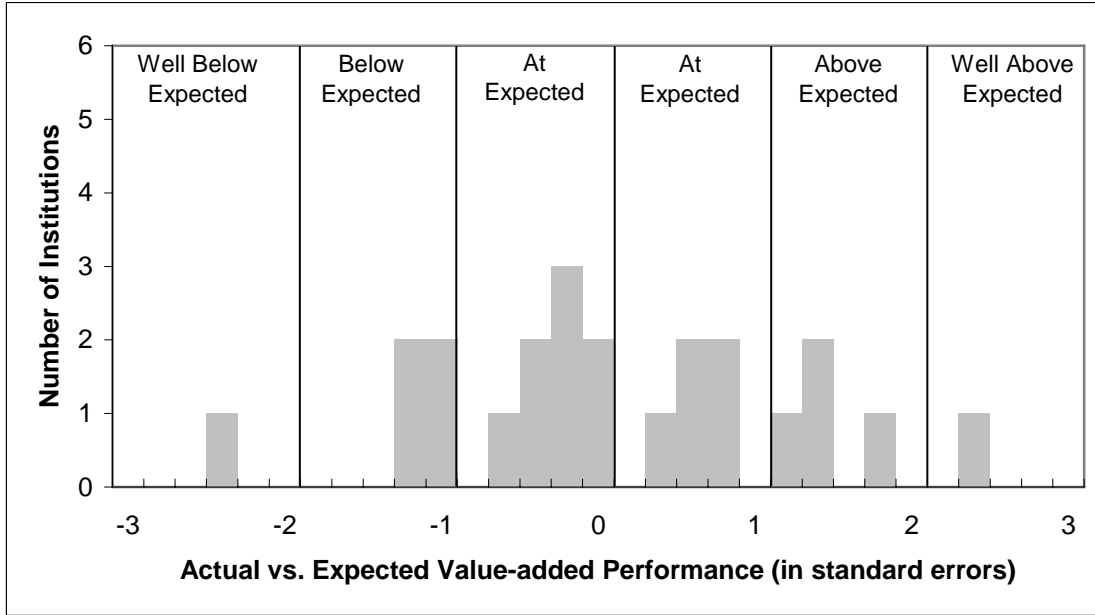
*Note.* See the appendix for an explanation of performance levels.



**Figure 5. Histogram of institutions by actual versus expected Measure of Academic Proficiency and Progress (MAPP) scores for seniors.**

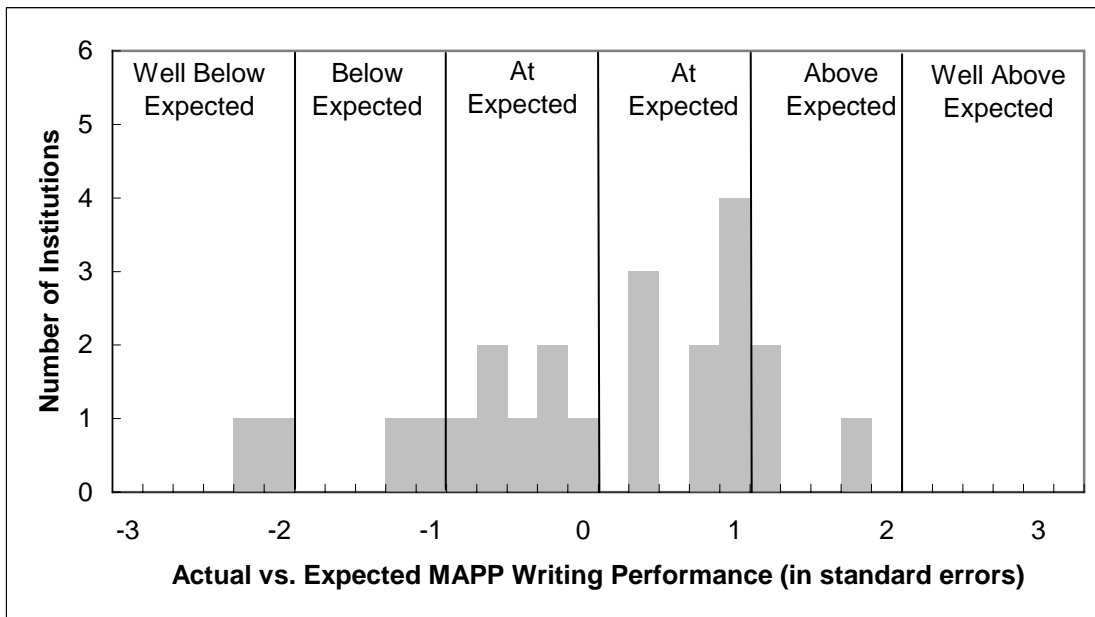
*Note.* See the appendix for an explanation of performance levels.





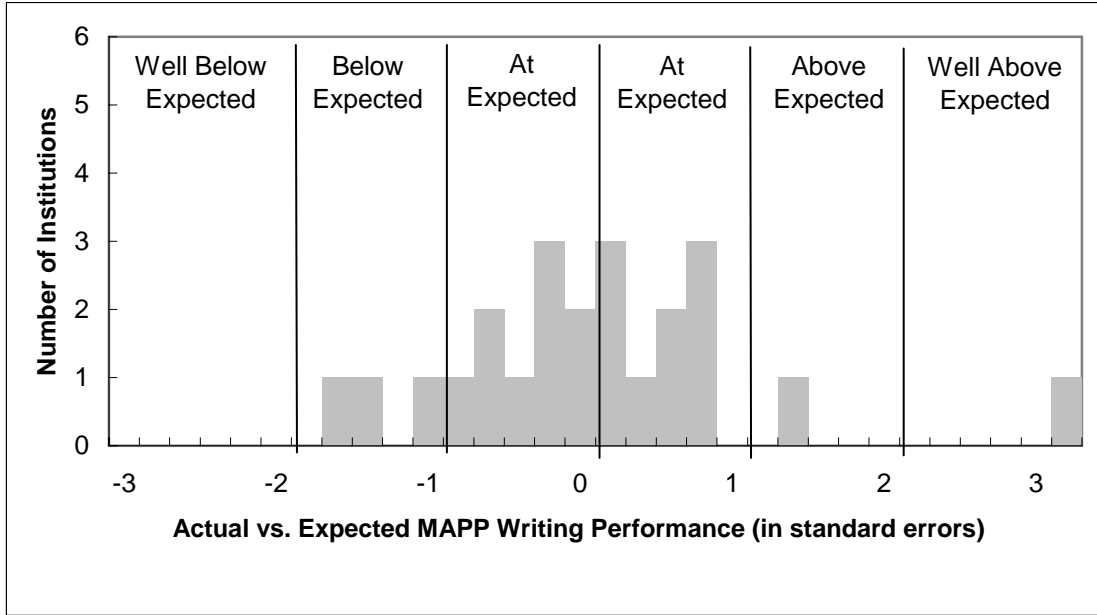
**Figure 6. Histogram of institutions by actual versus expected value-added Measure of Academic Proficiency and Progress (MAPP) performance.**

*Note.* See the appendix for an explanation of performance levels.



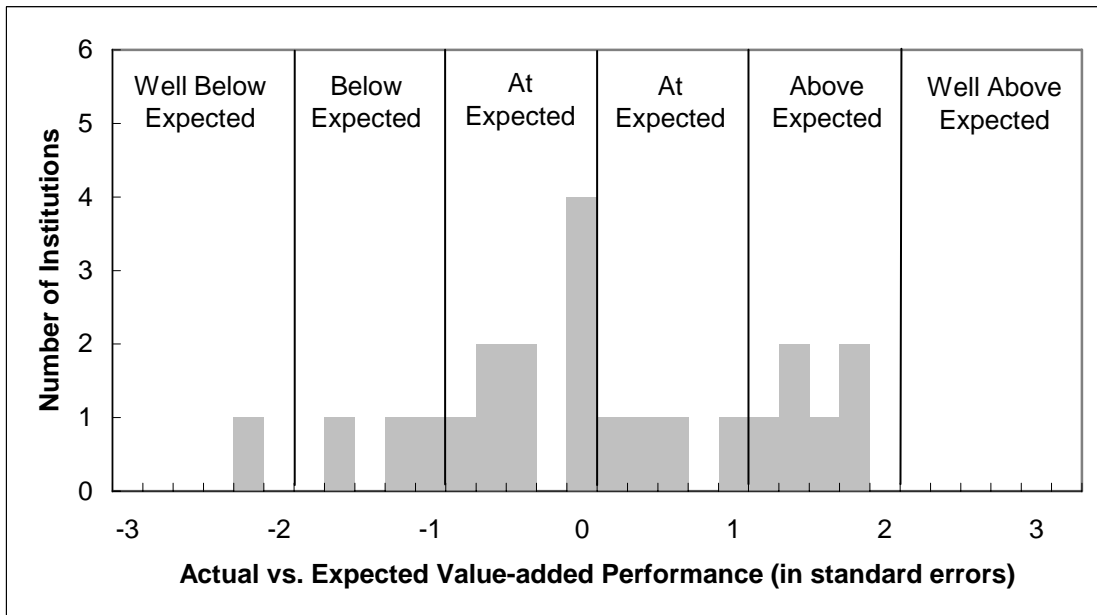
**Figure 7. Histogram of institutions by actual versus expected Measure of Academic Proficiency and Progress (MAPP) writing scores for freshmen.**

*Note.* See the appendix for an explanation of performance levels.



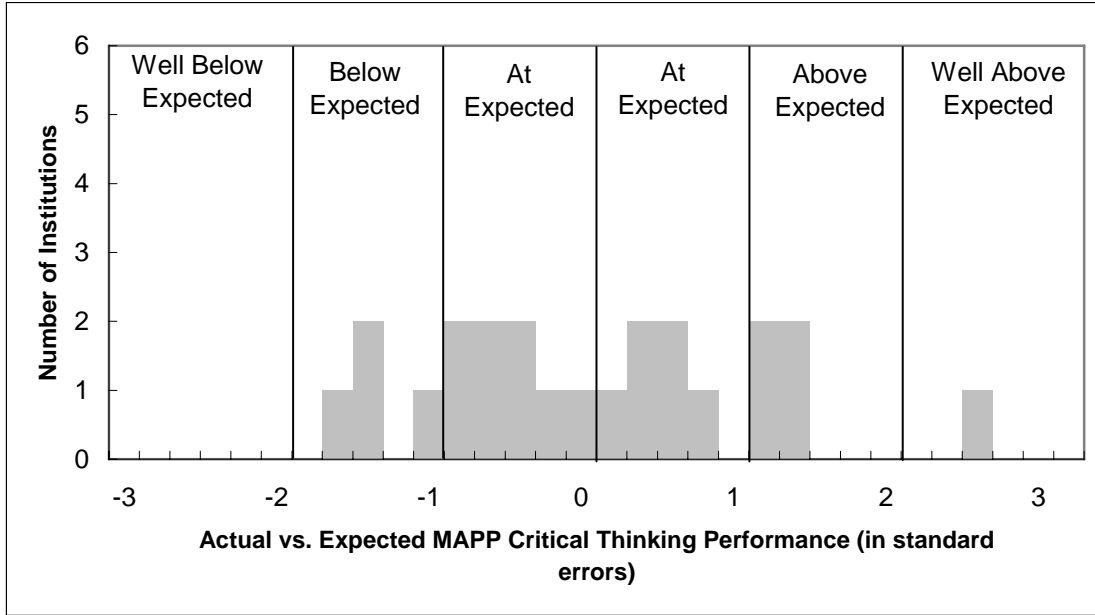
**Figure 8. Histogram of institutions by actual versus expected Measure of Academic Proficiency and Progress (MAPP) writing scores for seniors.**

*Note.* See the appendix for an explanation of performance levels.



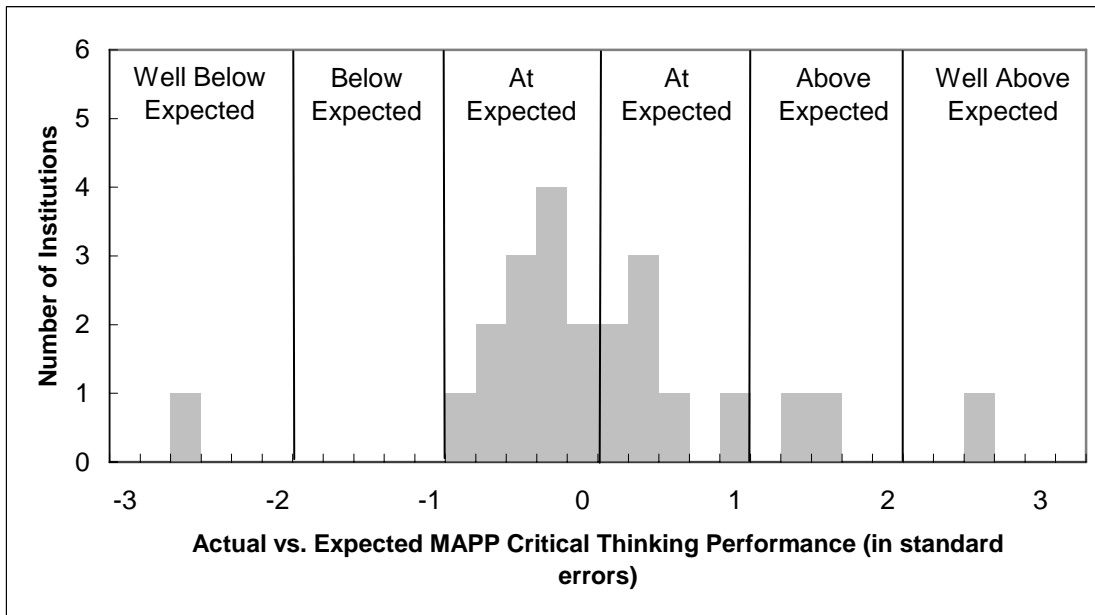
**Figure 9. Histogram of institutions by actual versus expected value-added Measure of Academic Proficiency and Progress (MAPP) writing performance.**

*Note.* See the appendix for an explanation of performance levels.



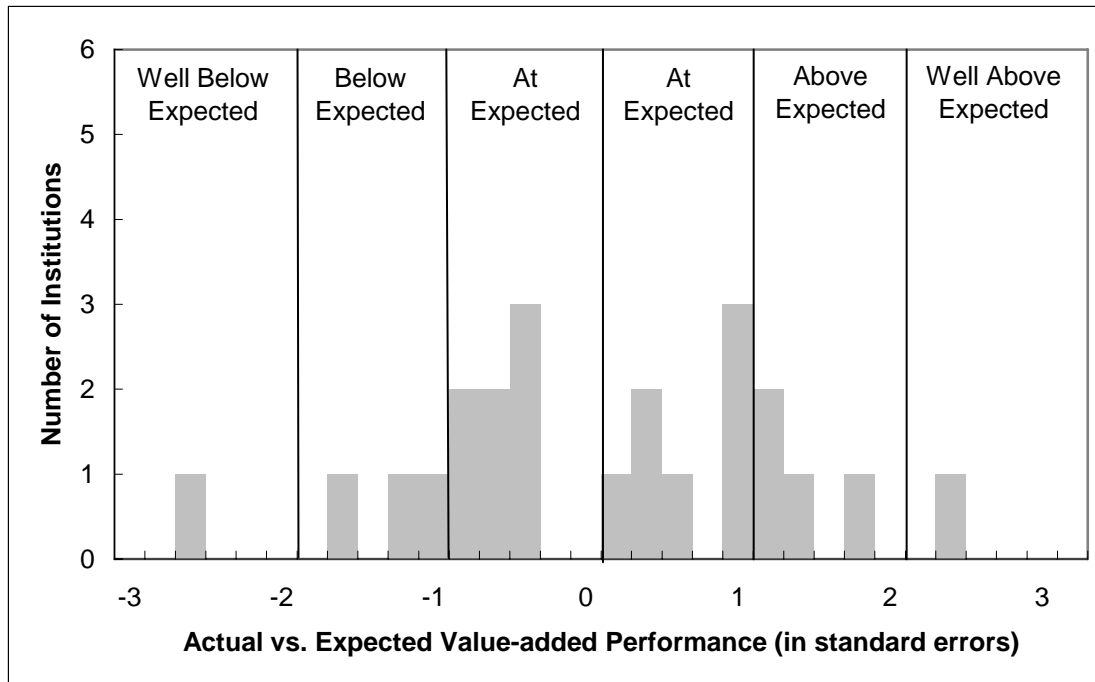
**Figure 10. Histogram of institutions by actual versus expected Measure of Academic Proficiency and Progress (MAPP) critical thinking scores for freshmen.**

*Note.* See the appendix for an explanation of performance levels.



**Figure 11. Histogram of institutions by actual versus expected Measure of Academic Proficiency and Progress (MAPP) critical thinking scores for seniors.**

*Note.* See the appendix for an explanation of performance levels.



**Figure 12. Histogram of institutions by actual versus expected value-added Measure of Academic Proficiency and Progress (MAPP) critical thinking performance.**

*Note.* See the appendix for an explanation of performance levels.

### Discussion

This study described an investigation on how MAPP can be used to measure value-added performance in 4-year public colleges and universities. The method used to calculate value-added in this study was the method used by CAE (Council for Aid to Education, 2007), because VSA requires that all testing agencies use the same methodology to compute value-added to participate in the initiative. The current method used the institution as the unit of analysis. The results might have varied if students had been used as the unit of analysis. In addition, the design of this study was cross-sectional. It would be interesting to investigate the possibilities of a longitudinal study.

The institutional level analysis assumed that students sampled in this study were representative of the entire student body at each institution. The generalizability of the results depended on the extent to which random sampling was implemented in the data collection process. Establishing a trajectory for value-added performance is a long-term effort both within and across institutions. It takes more than one data collection phase to establish a value-added

performance trajectory. Also, efforts should be made to increase the likelihood of random sampling in each institution.

Student motivation could be another issue for low-stakes tests like MAPP. Banta (2008) was rightfully concerned about whether outcomes from the standardized tests could accurately reflect a student's true performance given that they are frequently enticed, particularly by some monetary incentives, to take the test. However, the high correlation between MAPP scores and SAT scores seems to provide some evidence that students did not randomly respond to the MAPP test. Otherwise, the relationship between these two tests would be far less tangible given that the SAT is an extremely high-stakes test. Students appear to have had some reason for treating the MAPP test seriously. Although the test result will not have any direct impact on individual students, the outcome may affect the general public's perception of the quality of the students' institution, thus affecting the perceived quality of their diploma.

Finally, the readers and MAPP users are cautioned about the interpretation of the value-added results. The categorization of institutions into 10 decile groups only represents each institution's relative performance gain between freshmen and seniors, as compared to other institutions included in this analysis. The current decile ranking serves as a reference for each institution to compare with other institutions for the time being. The decile ranking is subject to change as more students are sampled and as more institutions are included in this study.

Note that the method described in this study is just one of a number of possible methods that could be used to calculate value-added. Other methods should be explored as the discussion continues regarding how college effectiveness might be adequately measured and represented. For example, the current study used a cross-sectional design in that the freshmen and seniors included in the analysis were not the same group of students. A longitudinal study is of interest to see if results vary when the same group of students is tracked for 4 years and tested twice, once in their freshman and once in their senior year.

Furthermore, more discussion should be generated on whether freshmen should be included in the value-added calculation. According to the current method, the lower the admission scores for freshmen in an institution, the more likely this institution is going to be placed at a higher performance category, even if seniors at this institution achieve the same performance as seniors in other colleges. If this method is going to be adopted for value-added computation, it appears to be more reasonable to compare institutions with similar levels of

admission scores to monitor the growth in learning. This way, the very selective institutions are not penalized for the high admission scores of their freshmen or for the relatively small gain between freshmen and seniors due to the *pyramid effect*.

An alternative method of calculating value-added could just involve seniors, with value-added being the actual versus expected senior MAPP mean scores. This method excludes the freshmen from the calculation of value-added and makes sense because their MAPP performance, either above or below expected, cannot really be attributed to the institution they just enrolled in.

### **Conclusions**

In summary, MAPP has been shown to be a suitable measure for value-added performance in higher education. These scores are reasonably well correlated with SAT or converted ACT scores, and the test is also able to differentiate performance between freshmen and seniors. More importantly, MAPP scores provide an opportunity for institutions to examine the learning progress students make through general college education. Scores from MAPP can also serve as one criterion for institutions to evaluate the effectiveness of their instructional system as compared to other institutions.

## References

- Banta, T. (2008). Trying to clothe the emperor. *Assessment Update*, 20(2), 3–4, 16–17.
- Cohen, J. (1988). *Statistical power analyses for the behavioral sciences*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Council for Aid to Education. (2007). *CLA institutional report 2006–2007*. New York: Author.
- ETS. (2007). *MAPP user's guide*. Princeton, NJ: Author.
- Marco, G. L., Abdel-fattah, A. A., & Baron, P. A. (1992). *Methods used to establish store comparability on the enhanced ACT assessment and the SAT* (College Board Research Rep. No. 92-03). New York: College Board.
- No Child Left Behind Act of 2001, 20 U.S.C. § 6301 *et seq.* (2002).
- U.S. Department of Education. (2006). *A test of leadership: Charting the future of U.S. higher education*. Washington, DC: Author.

### **Notes**

<sup>1</sup> Voluntary System of Accountability (VSA) requires that all students included in the learning outcome evaluation be full-time, nontransfer students. Transfer students are those students who have transferred more than 30 credits from a previous institution to their current institution. Transfer students were excluded from this study.

<sup>2</sup> ACT scores were converted to SAT scores using a concordance table (Marco, Abdel-fattah, & Baron, 1992).



## Appendix

The performance levels, shown in Tables 3-5 and Figures 4-12, are based on actual versus expected difference in standard errors, as follows:

- Well Above Expected—more than +2.00 standard errors from the expected score
- Above Expected—between +1.00 and +2.00 standard errors from the expected score
- At Expected—between -1.00 and +1.00 standard errors from the expected score
- Below Expected—between -1.00 and -2.00 standard errors from the expected score
- Well Below Expected—more than -2.00 standard errors from the expected score