

Cluster Three: The Natural World
Cluster Assessment Results and Interpretation

Spring 2007 Assessment Results

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Cluster 3 Assessment Report

Spring 2007

Executive Summary

- NW-8 test results from 1,163 students with between 45-70 credit hours were analyzed using three assessment strategies.
- Scores on the NW-8 test were higher for students who had taken more JMU Cluster 3 courses. This occurred regardless of whether the students had AP/Transfer credits for Cluster 3 courses.
- Scores on the NW-8 were positively correlated with Cluster 3 course grades. A few courses had near zero correlations with NW-8, but grades for the majority of courses were positively correlated with NW-8 scores.
- Students who completed their Cluster 3 requirement gained more in NW-8 scores than students who had not completed Cluster 3.

Spring 2007, Cluster 3 Assessment Report

Introduction

This report describes the results of the Spring 2007 Assessment Day administration of the Natural World test version 8 (NW-8). The NW-8 assessment was designed by faculty and assessment specialists at JMU to measure the objectives of Cluster 3 (CL3), the Natural World segment of JMU's general education program. Spring 2007 was the second time the NW-8 was administered to second-year JMU students. This report contains the results of statistical analyses that describe the relationship between the CL3 program and NW-8 scores. These analyses lend support to the perception that students are learning as a result of participation in CL3 program.

Sample and Data collection procedures

1,180 students participated in the Cluster 3 assessment during the Spring 2007 assessment day. The responses from 17 students were deleted because these students either omitted 50% or more of the items or did not provide a valid JMU id. The data collected in Spring 2007 completes the second cycle of students to complete the Natural world test version 8 (NW-8) as first-year students and then again as students with 40-75 credits. The test was administered in two formats; 769 students completed the test using paper and pencil and 394 students completed the test on a computer.

Assessment Strategies Overview

Assessment results are examined in multiple ways. First, scores on each of the subscales are reported for the sample overall. Then, test scores are analyzed by the number of cluster, AP and transfer courses taken, the relationship with course grades, and score differences from when students completed the test as first-year students. Currently, scores are not examined in relation to a standard of proficiency because standards for performance on the NW-8 are still being established.

Reliability and Scores

The table on page 2 shows the learning objectives assessed by the NW-8 along with the average number of items correct and percent correct scores for the overall sample. Reliability information (Cronbach's coefficient alpha α) is provided for each objectives scale. Reliability values range from 0 to 1 and indicate the degree to which the scores are free from random error. In general, reliabilities above .70 are considered adequate for program evaluation or research. Scores for scales with reliabilities lower than .60 should not be interpreted, and thus scores for scales with low reliability are not reported.

Comparability of scores

Scores from the computer-based administration of the NW-8 for Spring 2007 are based on 64 items since item 63 was unintentionally not administered. Thus, in order to combine data from paper-based and computer-based administrations, item 63 was omitted from analyses of the paper-based data as well. Due to this difference in test administration, raw scores reported in Table 2 are not comparable to previous semesters. However, the percent correct scores reported in Table 2 can be compared to previous semesters. Results for the computer-based and paper-based administrations are reported separately in the Appendix. Raw scores and percent correct scores for the paper-based administration only (see appendix) can be compared to previous years.

Nw-8 Scores for Spring 2007 (N = 1,163)

Scale / Objective	Item #	% test	Included items	Raw score		Percent Correct		α
				Mean	SD	Mean	SD	
1 Describe the methods of inquiry that lead to mathematical truth and scientific knowledge and be able to distinguish science from pseudo-science.	9	14	9,15,20,34-38,41					.47
2 Use theories and models as unifying principles that help us understand natural phenomena and make predictions.	0	0	NA					
3 Recognize the interdependence of applied research, basic research, and technology, and how they affect society.	9	14	1, 16-18,44-48					.57
4 Illustrate the interdependence between developments in science and social and ethical issues.	10	15	2, 21-24, 42, 58-61					.54
5 Use graphical, symbolic, and numerical methods to analyze, organize, and interpret natural phenomenon.	13	20	8, 10-14, 27-29, 53-55, 62	8.29	2.48	63.78	19.10	.61
6 Discriminate between association and causation, and identify the types of evidence used to establish causation.	7	11	3, 25, 30-33, 57	12.11	3.10	67.25	17.22	.66
7 Formulate hypotheses, identify relevant variables, and design experiments to test hypotheses.	10	15	10-14, 26, 49-52	14.59	3.08	76.81	16.22	.71
8 Evaluate the credibility, use, and misuse of scientific and mathematical information in scientific developments and public-policy issues.	7	11	35-38, 64-65	13.52	2.60	79.51	15.27	.65
Q R Quantitative Reasoning (Objectives 5 and 6)	20	31	3, 8, 10-14, 25, 27-33, 53-55, 57, 62	18.11	4.34	67.07	16.08	.73
S R Scientific Reasoning Subtest (Objectives 1,2,3,4,7,8)	47	74	1,2,5,6,9,10-18,20-26,34-42,44-52,56-61,64,65	34.89	6.52	74.24	13.87	.82
N W Total Natural World (JMU Scientific Reasoning) test	64	100	all	45.85	8.66	71.64	13.53	.86

I. Average scores by number of courses.

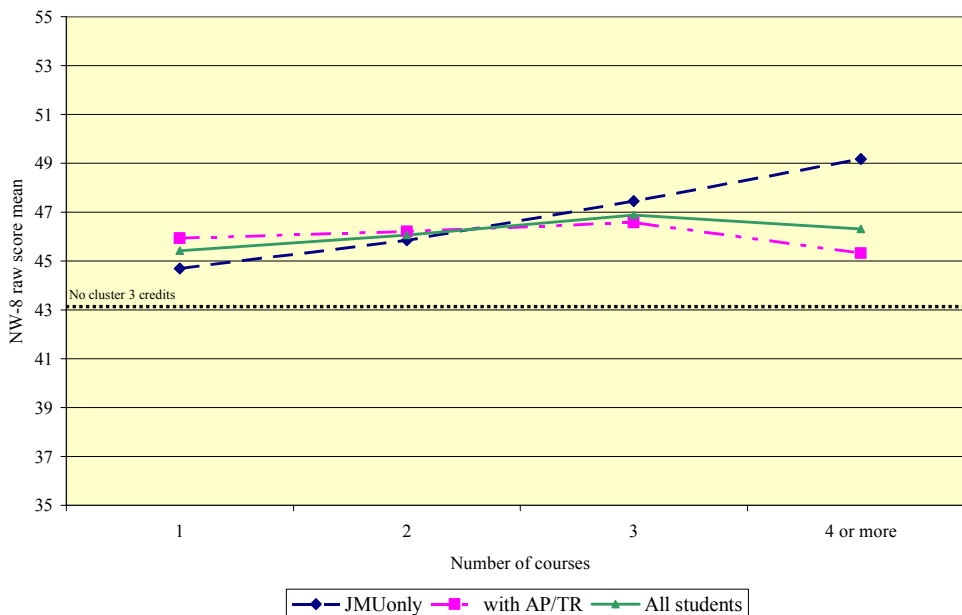
Do students learn or develop more if they have taken more cluster-related courses?

Students who have completed more courses in the cluster should score or perform higher than students who have taken fewer courses in the cluster. Students who have a combination of credits earned at JMU and credits earned through AP or other colleges/universities make score comparisons complicated.

Scores by Number of JMU Courses Taken

# of CL3 credits	N	Raw score Mean	Raw score SD	Percent correct Mean	Percent correct SD
All with no credit	55	44.35	9.81	69.29	15.33
No Credits, enrolled	36	43.78	9.38	68.40	14.65
No credits, not enrolled	19				
Students who do NOT have AP or Transfer Credits					
1	140	44.69	8.07	69.83	12.61
2	140	45.85	8.19	71.64	12.80
3	76	47.45	8.61	74.14	13.46
4 or more	33	49.18	6.75	76.85	10.55
Students who have AP or Transfer Credits					
1	199	45.94	9.15	71.78	14.30
2	219	46.21	8.51	72.21	13.30
3	144	46.58	9.07	72.78	14.17
4 or more	95	45.32	8.62	70.81	13.46
All students in Sample					
1	339	45.42	8.73	70.98	13.65
2	359	46.07	8.38	71.99	13.09
3	220	46.88	8.90	73.25	13.91
4 or more	128	46.31	8.33	72.36	13.01

NW-8 scores by number of Cluster 3 courses credited



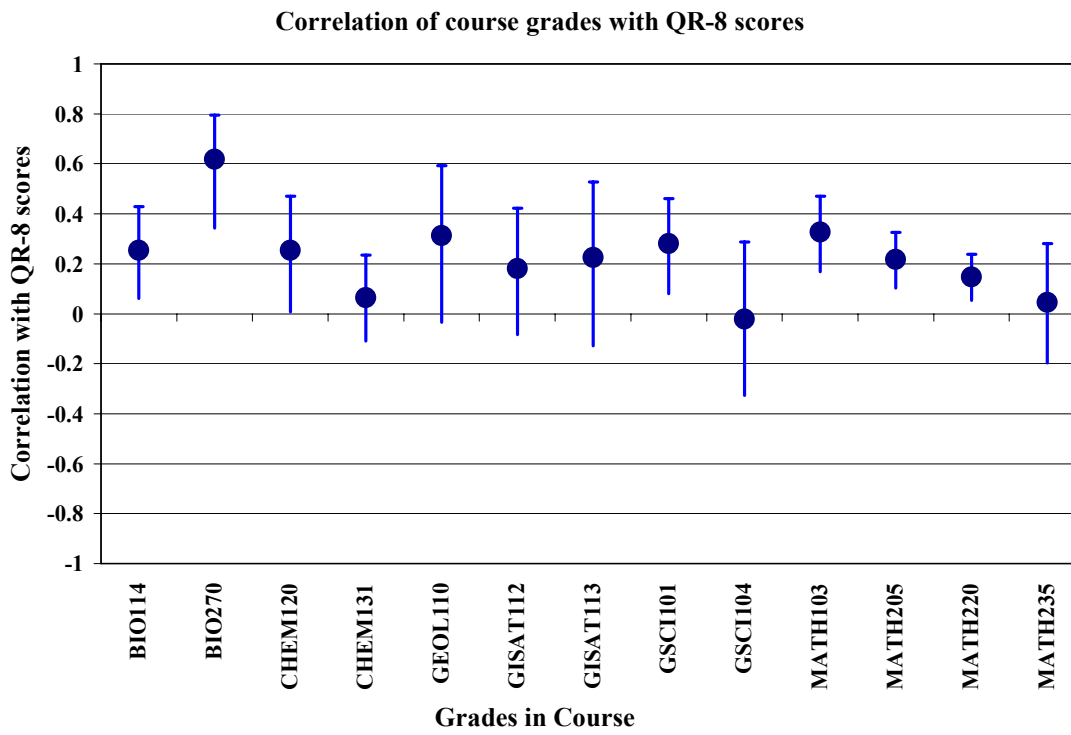
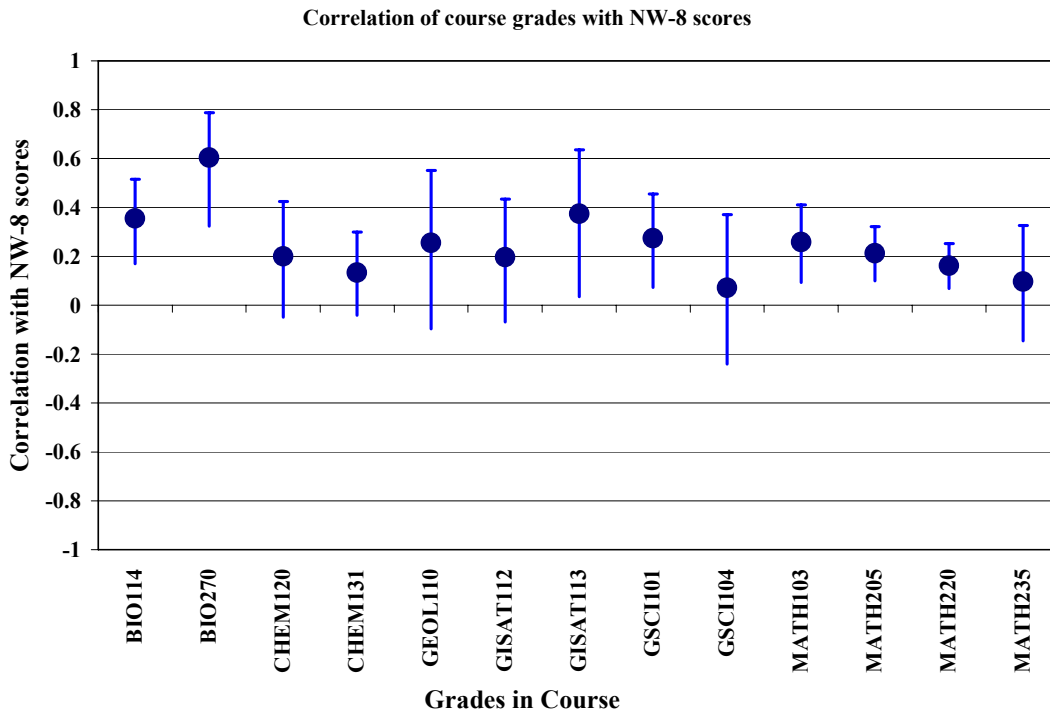
II. Correlations between test and course grades. *What is the relationship between course grades and outcomes?* A moderate positive relationship should exist between course grades and cluster scores/ratings if both course grades and the cluster test assess the objectives of the cluster.

These correlations give an idea of how much each course has in common with the cluster objectives measured on the test. Correlations can range from -1 to 1. Correlations close to 0 indicate no relationship, while correlations closer to 1 indicate a very high relationship between test scores and course grades (negative numbers would indicate those who scored high on the test had lower grades). In this context, correlations of about .3 seem good and correlations of .4 seem fairly high. Correlations are not reported for courses when less than 30 students completed the NW-8.

Correlations between Grades and Nw-8 raw scores, Spring 2007

COURSE	N	NW correlation	NW r^2	QR correlation	QR r^2
BIO114	100	0.35	0.13	0.25	0.06
BIO270	32	0.60	0.37	0.62	0.38
CHEM120	64	0.20	0.04	0.25	0.06
CHEM131	129	0.13	0.02	0.07	0.00
GANTH196	6				
GBIO103	30	0.73	0.53	0.75	0.56
GEOL110	33	0.26	0.07	0.31	0.10
GEOL200	0				
GEOL211	2				
GGEOL102	6				
GISAT112	57	0.20	0.04	0.18	0.03
GISAT113	33	0.37	0.14	0.23	0.05
GPSYC122	18				
GSCI101	91	0.27	0.08	0.28	0.08
GSCI102	5				
GSCI103	7				
GSCI104	41	0.07	0.01	-0.02	0.00
GSCI116	2				
GSCI115	26				
GSCI121	16				
GSCI122	0				
GSCI162	8				
GSCI163	4				
GSCI164	4				
GSCI165	7				
MATH103	135	0.26	0.07	0.33	0.11
MATH107	21				
MATH205	284	0.21	0.05	0.22	0.05
MATH220	432	0.16	0.03	0.15	0.02
MATH231	13				
MATH235	68	0.10	0.01	0.04	0.00
PHYS120	4				
PHYS121	1				
PHYS140	2				
PHYS215	0				
PHYS240	13				

The graph below illustrates instability in the correlations due to sampling error. The error bands show the 95% confidence band around the correlation estimates.



III. Pre-post Comparisons

Do students change over time in school? (value added or longitudinal change)

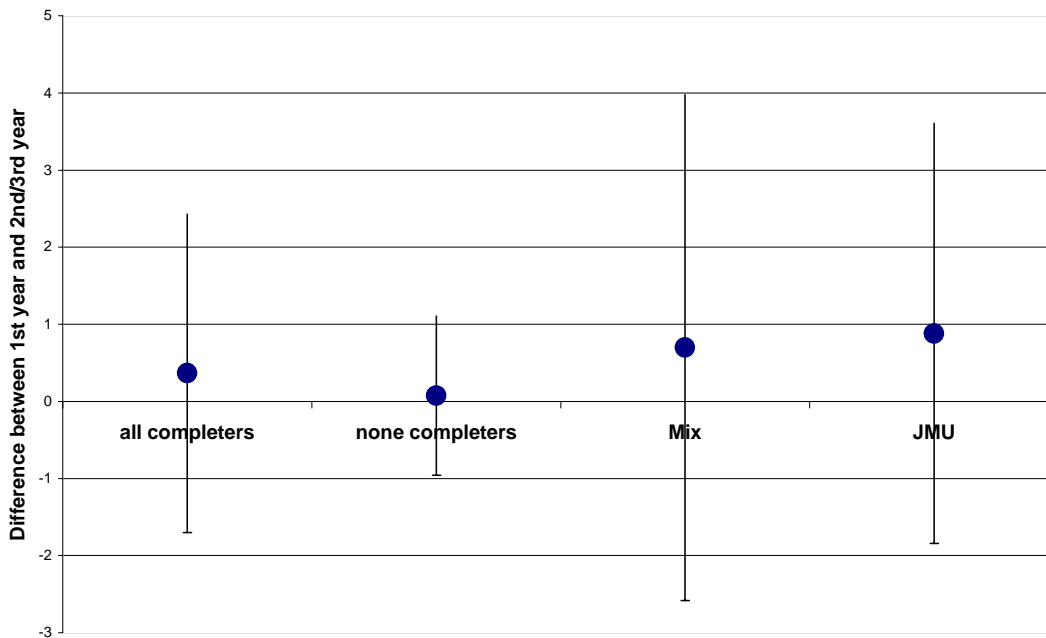
Students who have completed a package in the cluster by their sophomore/junior year should show marked improvement on the cluster test as compared to their freshmen year.

Below is a table revealing the same group of students' mean percent correct on the test at the beginning of their freshmen year and at the midpoint of their sophomore/junior year. Only students who had taken the test as both freshmen and sophomore/juniors were included. The increase in scores is greatest for those who completed their cluster 3 requirements entirely through JMU classes. The gain is smallest for students who have had no exposure to cluster 3 courses. Cohen's *d* is an effect size indicator which tells the amount of change in standard deviation units.

Level of Analysis	N	Fall Mean	Fall SD	Spring Mean	Spring SD	Score gain	Cohen's <i>d</i>
All Cluster Completers	69	71.80	10.18	78.74	9.61	6.94	.78
All JMU credits	35	71.16	9.95	78.39	9.10	7.23	.88
Mix of JMU, AP, TR credit	33	72.06	10.41	78.78	10.22	6.72	.69
Non-completers	442	70.60	10.82	74.82	12.41	4.22	.07

*In previous years, raw scores were used in this table; this year percent correct scores are used because item 63 is not included in the raw scores from this year (and was included in previous years).

The graph below illustrates instability in the pre-post differences due to sampling error. The error bands show the 95% confidence band around the estimates of the pre-post differences.



IV. Meeting a standard (expectation)

Do students meet faculty expectations? A substantial number of students who have completed the Cluster should meet the competency or academic standard.

This assessment strategy does not apply to Cluster 3 because a standard for the NW-8 is slated to be established later this year.

Conclusions/Recommendations

Overall, results from the current year's Cluster 3 assessment were as expected. All predictions of student performance were supported. Furthermore, Although this is only the second year of assessing Cluster 3 with the NW-8, it is worthwhile to note that performance on the NW-8 was similar for this Spring as it was for last Spring. A fourth type of assessment strategy (Meeting a standard) will be possible when a standard has been set for the NW-8 test. The results of this semester's assessment were limited by an administration error in which item 63 was not administered to the computer-based version of the test. Furthermore, the exchangeability of scores for the computer-based and paper-based versions of the NW-8 is still being investigated, thus comparison of scores across those two versions should be made with caution. Appendix I shows how scores differ across the two administration formats.

Appendix I

Spring 2007 paper-based Natural World 8 assessment results

N = 769 randomly selected sophomore and junior students

Cluster 3 Objective	Item #	% test	Included items	Raw score		Percent Correct		α
				Mean	SD	Mean	SD	
1 Describe the methods of inquiry that lead to mathematical truth and scientific knowledge and be able to distinguish science from pseudo-science.	9	14	9,15,20,34-38,41	7.99	1.55	79.90	15.45	.43
2 Use theories and models as unifying principles that help us understand natural phenomena and make predictions.	0	0	NA					
3 Recognize the interdependence of applied research, basic research, and technology, and how they affect society.	9	14	1, 16-18,44-48	7.17	2.18	65.15	19.82	.55
4 Illustrate the interdependence between developments in science and social and ethical issues.	10	15	2, 21-24, 42, 58-61	9.91	1.91	76.21	14.68	.47
5 Use graphical, symbolic, and numerical methods to analyze, organize, and interpret natural phenomenon.	13	20	8, 10-14, 27-29, 53-55, 62	8.66	2.28	66.65	17.56	.55
6 Discriminate between association and causation, and identify the types of evidence used to establish causation.	7	11	3, 25, 30-33, 57	12.61	2.90	70.03	16.11	.63
7 Formulate hypotheses, identify relevant variables, and design experiments to test hypotheses.	10	15	10-14, 26, 49-52	15.06	2.89	79.27	15.24	.69
8 Evaluate the credibility, use, and misuse of scientific and mathematical information in scientific developments and public-policy issues.	7	11	35-38, 63-65	14.86	2.35	82.55	13.07	.60
Q R Quantitative Reasoning (Objectives 5 and 6)	20	31	3, 8, 10-14, 25, 27-33, 53-55, 57, 62	18.86	3.99	69.84	14.79	.70
S R Scientific Reasoning Subtest (Objectives 1,2,3,4,7,8)	47	74	1,2,5,6,9,10-18,20-26,34-42,44-52,56-61,64,65	37.04	5.92	77.17	12.32	.80
N W Total Natural World (JMU Scientific Reasoning) test	65	100	all	48.41	7.82	74.47	12.04	.83

Spring 2007 computer-based Natural World 8 assessment results

N = 369 randomly selected sophomore and junior students

Cluster 3 Objective	Item #	% test	Included items	Raw score		Percent Correct		α
				Mean	SD	Mean	SD	
1 Describe the methods of inquiry that lead to mathematical truth and scientific knowledge and be able to distinguish science from pseudo-science.	9	14	9,15,20,34-38,41	7.47	1.76	74.67	17.65	.50
2 Use theories and models as unifying principles that help us understand natural phenomena and make predictions.	0	0	NA					
3 Recognize the interdependence of applied research, basic research, and technology, and how they affect society.	9	14	1, 16-18,44-48	6.16	2.26	56.02	20.54	.56
4 Illustrate the interdependence between developments in science and social and ethical issues.	10	15	2, 21-24, 42, 58-61	8.73	2.33	67.12	17.89	.56
5 Use graphical, symbolic, and numerical methods to analyze, organize, and interpret natural phenomenon.	13	20	8, 10-14, 27-29, 53-55, 62	7.56	2.69	58.18	20.71	.66
6 Discriminate between association and causation, and identify the types of evidence used to establish causation.	7	11	3, 25, 30-33, 57	11.13	3.24	61.83	18.01	.66
7 Formulate hypotheses, identify relevant variables, and design experiments to test hypotheses.	10	15	10-14, 26, 49-52	13.68	3.23	72.01	17.01	.70
8 Evaluate the credibility, use, and misuse of scientific and mathematical information in scientific developments and public-policy issues.	7	11	35-38, 63-65	12.47	2.85	73.35	16.76	.65
Q R Quantitative Reasoning (Objectives 5 and 6)	20	31	3, 8, 10-14, 25, 27-33, 53-55, 57, 62	16.65	4.62	61.66	17.10	.75
S R Scientific Reasoning Subtest (Objectives 1,2,3,4,7,8)	47	74	1,2,5,6,9,10-18,20-26,34-42,44-52,56-61,64,65	32.27	6.94	68.66	14.76	.83
N W Total Natural World (JMU Scientific Reasoning) test	65	100	all	42.44	9.29	66.31	14.52	.86

Note: The raw scores are NOT comparable to previous scores or to paper-based test scores, because item 63 is not included. The % correct scores are still roughly comparable however.

Spring 2007 Natural World 8 Assessment Results

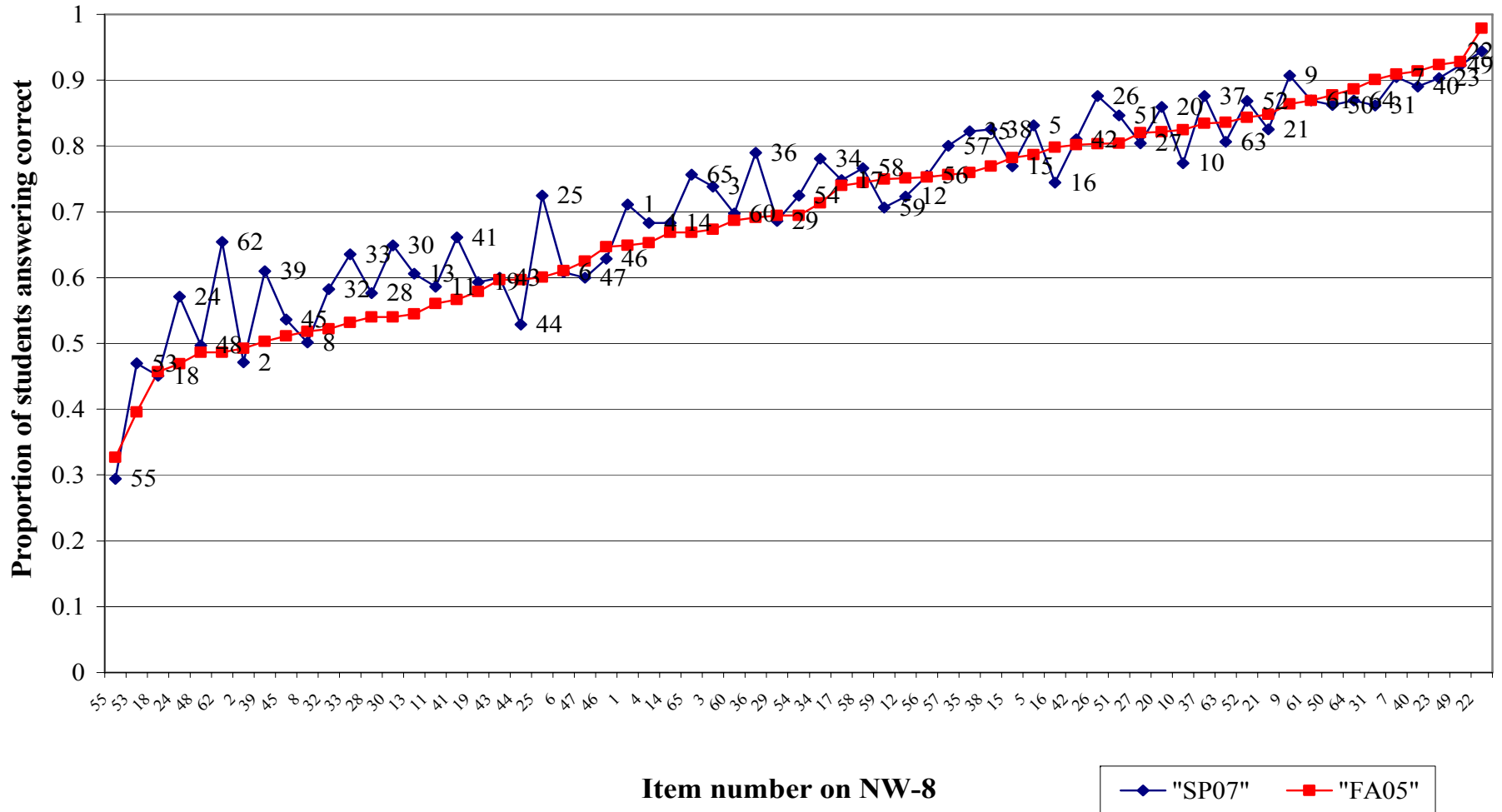
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N W Total Natural World (JMU Scientific Reasoning) test	65	100	all	45.85	8.66	71.64	13.53	.86

Note: Item 63 is not included in these scores.

Appendix II

**Proportion of Students answering each item correctly
as first-year students (FA05) and as students with 40-75 credits (SP07)**



The above plot shows the proportion of students answering each NW-8 item correctly at pre-test and post-test. More students answer the items correctly in Spring 2007 than did in Fall 2005. However, some items do not show much change, while other items show more change from Fall to Spring.