

Conclusions Drawn from Data:

The AAC&U rubrics are written in a language that is rooted in the humanities. We have had to work with students to translate/clarify the meaning of some aspects of the rubric, assignment and our expectations. They are generally meeting our expectations. We however still have work to do.

Our students have been meeting the benchmark on the ETS exam. The variability has to do with the small sample size.

Changes to be Made Based on Data:

We are providing the students with the critical thinking rubric as part of the instructions for the assignment and starting in 2014-15 we began having them self-assess their work with the rubric before submission. We expect to need to further modify the rubric to use language that is better understood by our students.

Rubric:

MICS Critical Thinking Rubric (2/6/13)
Adapted from the AAC&U Value Rubric

	Capstone – 4	Milestone -3	Milestone - 2	Benchmark -1
Explanation of issues	Issue/problem to be considered critically is stated clearly and described comprehensively, delivering all relevant information necessary for full understanding.	Issue/problem to be considered critically is stated, described, and clarified so that understanding is not seriously impeded by omissions.	Issue/problem to be considered critically is stated but description leaves some terms undefined, ambiguities unexplored, boundaries undetermined, and/or backgrounds unknown.	Issue/problem to be considered critically is stated without clarification or description.
Evidence <i>Selecting and using information to investigate a point of view or conclusion</i>	Information is taken from source(s) with enough interpretation/evaluation to develop a comprehensive analysis or synthesis. Viewpoints of experts are questioned thoroughly.	Information is taken from source(s) with enough interpretation/evaluation to develop a coherent analysis or synthesis. Viewpoints of experts are subject to questioning.	Information is taken from source(s) with some interpretation/evaluation, but not enough to develop a coherent analysis or synthesis. Viewpoints of experts are taken as mostly fact, with little questioning.	Information is taken from source(s) without any interpretation/evaluation. Viewpoints of experts are taken as fact, without question.
Conclusions and related outcomes (implications and consequences)	Conclusions and related outcomes (consequences and implications) are logical and reflect student’s informed evaluation and ability to place evidence and perspectives discussed in priority order.	Conclusion is logically tied to a range of information, including opposing viewpoints; related outcomes (consequences and implications) are identified clearly.	Conclusion is logically tied to information (because information is chosen to fit the desired conclusion); some related outcomes (consequences and implications) are identified clearly.	Conclusion is inconsistently tied to some of the information discussed; related outcomes (consequences and implications) are oversimplified.

Assessment Data Mathematical, Information and Computer Sciences

Learning Outcome: Students will be able to understand and create arguments supported by quantitative evidence, and they can clearly communicate those arguments in a variety of formats (Quantitative Reasoning).

Outcome Measure: Annual: Each student will participate in the ETS Proficiency Profile exam.

Criteria for Success: 95% of the students will be Marginal or Proficient at Level 2.

Aligned with DQP Learning Areas (circle one or more):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning, and
5. Civic and Global Learning

Longitudinal Data:

	Percent 2.5 or Higher	
MICS Rubric	2014-15	2015-16
Students will be able to formulate a mathematical model from a verbal description of a problem.	44%	94%
Students will be able to solve non-routine problems using logic and quantitative techniques.	100%	94%
Students will be able to construct solutions to problems using computational techniques.	89%	82%

	Percentage at Marginal or Proficient			
ETS Proficiency Profile	2012-13	2013-14	2014-15	2015-16
ETS Percentage - Level 2	100%	100%	100%	100%

Conclusions Drawn from Data:

When scoring the activity problems in 2014-15, we realized that some of the students had misinterpreted the question related to “formulate a mathematical model from a verbal description.” This made the problem difficult to score. The assignment was revised in 2015-16. The university is using the ETS test to measure core competencies and that data is presented here as well. The students have done well in meeting benchmarks with both measures.

Changes to be Made Based on Data:

Revise the QL class activity. This was done and the students were more successful in 2015-16. Because of the nature of the disciplines in our department, our curriculum focuses a great deal on quantitative skills. We have found that a single rubric can not be created in a way that allows for the breadth of quantitative thinking and skills that we see in our senior projects and creating a class activity has seemed artificial. So we will be using the ETS exam as a measure of the core competency going forward.

Rubrics

Activity Rubric (attached)

ETS Proficiency Profile (no rubric involved)

Quantitative Reasoning Rubric (this is the same rubric we use for general education)

	Unsatisfactory	Low Satisfactory	Satisfactory	High Satisfactory	Outstanding
Students will be able to formulate a mathematical model from a verbal description of a problem (#1 up to filling in formula).	Completely incorrect	Missed more than one key step or concept	Missed one key step or concept	Made a minor error	Completely correct
Students will be able to solve non-routine problems using logic and quantitative techniques (#2).	Completely incorrect	Missed more than one key step or concept	Missed one key step or concept	Made a minor error	Completely correct
Students will be able to construct solutions to problems using computational techniques (#1 computation of payment).	Completely incorrect	Missed more than one key step or concept	Missed one key step or concept	Made a minor error	Completely correct

Translation between AAC&U Value Rubric and MICS Quantitative Literacy Rubric

Note that the main reason that our department has chosen to not use the AAC&U rubric is that the underlying assumption of the rubric is that students are working with statistical information and are writing text about that statistical information. There is a great deal more to quantitative literacy than statistics and writing about data.

MICS Category	AAC&U Category
	Interpretation <i>Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>
Students will be able to formulate a mathematical model from a verbal description of a problem	Representation <i>Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>
Students will be able to construct solutions to problems using computational techniques	Calculation
	Application / Analysis <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>
	Assumptions <i>Ability to make and evaluate important assumptions in estimation, modeling, and data analysis</i>
	Communication <i>Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)</i>
Students will be able to solve non-routine problems using logic and quantitative techniques	

AAC&U Value Rubric

	Capstone 4	Milestones 3	Milestones 2	Benchmark 1
Interpretation <i>Ability to explain information presented in mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Provides accurate explanations of information presented in mathematical forms. Makes appropriate inferences based on that information. <i>For example, accurately explains the trend data shown in a graph and makes reasonable predictions regarding what the data suggest about future events.</i>	Provides accurate explanations of information presented in mathematical forms. <i>For instance, accurately explains the trend data shown in a graph.</i>	Provides somewhat accurate explanations of information presented in mathematical forms, but occasionally makes minor errors related to computations or units. <i>For instance, accurately explains trend data shown in a graph, but may miscalculate the slope of the trend line.</i>	Attempts to explain information presented in mathematical forms, but draws incorrect conclusions about what the information means. <i>For example, attempts to explain the trend data shown in a graph, but will frequently misinterpret the nature of that trend, perhaps by confusing positive and negative trends.</i>
Representation <i>Ability to convert relevant information into various mathematical forms (e.g., equations, graphs, diagrams, tables, words)</i>	Skillfully converts relevant information into an insightful mathematical portrayal in a way that contributes to a further or deeper understanding.	Competently converts relevant information into an appropriate and desired mathematical portrayal.	Completes conversion of information but resulting mathematical portrayal is only partially appropriate or accurate.	Completes conversion of information but resulting mathematical portrayal is inappropriate or inaccurate.
Calculation	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem. Calculations are also presented elegantly (clearly, concisely, etc.)	Calculations attempted are essentially all successful and sufficiently comprehensive to solve the problem.	Calculations attempted are either unsuccessful or represent only a portion of the calculations required to comprehensively solve the problem.	Calculations are attempted but are both unsuccessful and are not comprehensive.
Application / Analysis <i>Ability to make judgments and draw appropriate conclusions based on the quantitative analysis of data, while recognizing the limits of this analysis</i>	Uses the quantitative analysis of data as the basis for deep and thoughtful judgments, drawing insightful, carefully qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for competent judgments, drawing reasonable and appropriately qualified conclusions from this work.	Uses the quantitative analysis of data as the basis for workmanlike (without inspiration or nuance, ordinary) judgments, drawing plausible conclusions from this work.	Uses the quantitative analysis of data as the basis for tentative, basic judgments, although is hesitant or uncertain about drawing conclusions from this work.
Assumptions <i>Ability to make and evaluate important assumptions in estimation, modeling, and data analysis</i>	Explicitly describes assumptions and provides compelling rationale for why each assumption is appropriate. Shows awareness that confidence in final conclusions is limited by the accuracy of the assumptions.	Explicitly describes assumptions and provides compelling rationale for why assumptions are appropriate.	Explicitly describes assumptions.	Attempts to describe assumptions.
Communication <i>Expressing quantitative evidence in support of the argument or purpose of the work (in terms of what evidence is used and how it is formatted, presented, and contextualized)</i>	Uses quantitative information in connection with the argument or purpose of the work, presents it in an effective format, and explicates it with consistently high quality.	Uses quantitative information in connection with the argument or purpose of the work, though data may be presented in a less than completely effective format or some parts of the explication may be uneven.	Uses quantitative information, but does not effectively connect it to the argument or purpose of the work.	Presents an argument for which quantitative evidence is pertinent, but does not provide adequate explicit numerical support. (May use quasi-quantitative words such as "many," "few," "increasing," "small," and the like in place of actual quantities.)

Assessment Data Mathematical, Information and Computer Sciences

Learning Outcome: Mathematics graduates will be adequately prepared for graduate study, teaching and careers using Mathematics.

Outcome Measure:

Annual: Require students to take the ETS Major Field Test in Mathematics as the mid-term exam for the capstone course, Mathematics 481, Senior Seminar in Mathematics.

Annual: Fieldwork evaluations of prospective teachers in EDU304. The students are rated in several areas of competence using a three point rubric (weak =1, acceptable =2 and strong =3). From these scores an overall rating is computed by taking the mean.

Every 5 Years: Alumni will be surveyed every five years. They will be asked at least the following questions:

1. If you have a job in industry: On a scale of 1 to 5, 1 being outstanding and 5 being poor, how well do you think that the undergraduate Mathematics curriculum at PLNU prepared you for your work in the field?
2. If you are going to graduate school or went to graduate school: On a scale of 1 to 5, 1 being outstanding and 5 being poor, how well do you think that the undergraduate Mathematics curriculum at PLNU prepared you for graduate school?
3. If you are in a teaching credential program or working as a teacher: On a scale of 1 to 5, 1 being outstanding and 5 being poor, how well do you think that the undergraduate Mathematics curriculum at PLNU prepared you for teaching?

Criteria for Success: 1) 50% of our students achieve above the 50th percentile on the exam.
2) 80% of the students will have an average score of 2.5 or higher.
3) An average response of 2 for each question.

Aligned with DQP Learning Areas (circle one or more):

1. Specialized Knowledge
2. Broad Integrative Knowledge
3. Intellectual Skills/Core Competencies
4. Applied and Collaborative Learning, and
5. Civic and Global Learning

Longitudinal Data:

ETS Major Field Test:

Most recent 10 years of data.

	Overall Benchmark Met	Calculus	Algebra	Routine	Non-Routine	Applied
Year		Percentile	Percentile	Percentile	Percentile	Percentile
2005-06	Y	75	95	90	95	75
2006-07	Y	90	80	90	70	75
2007-08	Y	80	80	70	75	60
2008-09	Y	90	80	75	25	95
2009-10	Y	90	65	75	20	85
2010-11	Y	70	90	85	35	70
2011-12	Y	99	85	98	99	96
2012-13	Y	38	72	69	72	60
2013-14	Y	72	49	57	51	39
2014-15	Y	*	*	*	*	*
2014-15	N	16	42	32	36	55

* Insufficient students for score to be calculated

Note the ETS changed the Mathematics test in 2004-05

Note the ETS changed the Mathematics test in 2012-13

School of Education Fieldwork:

This data is based on assessment conducted by the supervising teachers for students engaging in classroom fieldwork.

	Percentage of Students Scoring 2.5 or Higher								
	2007-08	2008-19	2009-10	2010-11	2011-12	2012-13	2013-14	2014-15	2015-16
Overall Score	100%	71%	N/A	N/A	N/A	100%	N/A	N/A	100%

Alumni Data:

In the spring of 2010, the department surveyed alumni who had graduated in the last 15 years. The response rate on the survey was 31.7% with the majority (80.9%) of the respondents having graduated in the last decade. A detailed summary analysis of the data can be found in Appendix: 2010 Alumni Survey Results Summary of our department's Program Review. Below are the components of the survey relevant to our assessment plan.

How well did the undergraduate curriculum prepare you for:

	Well or higher	OK	Poorly
Work in the field (if went into the field)	85.2%	14.8%	0.0%
Graduate school	76.5%	5.9%	17.6%
Teaching	80.0%	20.0%	0.0%

Conclusions Drawn from Data:

ETS Results:

Our scores show that our benchmark is being met for overall performance on the test. We are continuing to evaluate the changes made by ETS in 2012-13 to determine if we are concerned about any the changes in student results. It may be that they are now including questions on some material that we do not teach. We have noticed a cyclical patten in some subscore results and are investigating to if this correlates with our two year rotation of upper division courses. Reviewing the exam and the data is part of the work that we will undertake as part of our next program review.

Alumni Survey:

Overall, our alumni believe that they were well prepared. Further investigation indicates that the students (3) who said that they were "poorly" prepared for graduate school are all mathematics majors who are employed as teachers and appear to be getting education-related masters degrees while working full-time. The hypothesis is that the "lack of preparation" may be in education coursework and not mathematics. We will be conducting another survey in 2016-17 as part of program review preparation.

Changes to be Made Based on Data:

ETS Results:

We have used ETS data to small modifications (changes in pedagogy or assignments) as well as larger curricular modifications (addition or alteration of classes). In our recent Program Review we investigated the variability of the scores on the "non-routine" problems and learned that this category is a rotating collection of problems, some of them from topics not taught in our curriculum. We did however determine that we needed to do some work to strengthen our curriculum in the area of applied mathematics. This has resulted in increasing the number of required units of linear algebra and reconfiguring our applied mathematics class to become a class in differential equations and a class in modeling both of them using a modeling paradigm. It is too early to tell if these changes have achieved our intended outcomes, but the students have been positive about the curricular rearrangement. See our APC proposals for the specific descriptions of curricular changes made.

School of Education Fieldwork:

None in MICS, but the School of Education uses this as a tool to adjust their education classes that our students take while doing fieldwork. The teachers have been satisfied with the performance in of our students.

Alumni Survey:

Work to better prepare students who plan on being teachers for graduate school in education. In particular encourage them to take more education classes while an undergraduate.

In 2005 our department instituted three changes that seem to have had an impact on developing critical skills in our graduates:

- Increasing the expectations for written and oral presentations in senior seminar (this is in addition to the writing and oral presentations that are threaded throughout our curriculum)
- Requiring all seniors in our department to take the senior seminar class
- Requiring an "integrative experience" (internship, year-long service learning project or year-long honor research project) of all of our majors.

This has a direct impact on five skills listed in the table below. The question on the survey is listed above the table.

Please tell us if your departmental course work enhanced your abilities in the listed areas:

		Very much enhanced	Much enhanced	Enhanced	Not enhanced and N/A
Think analytically and logically	2000-2004	53.8%	26.9%	15.4%	3.8%
	2005-2009	64.0%	36.0%	0.0%	0.0%
Write effectively in the discipline	2000-2004	11.5%	23.1%	42.3%	23.1%
	2005-2009	16.0%	36.0%	36.0%	12.0%
Effective oral communication	2000-2004	3.8%	23.1%	46.2%	26.9%
	2005-2009	12.0%	12.0%	60.0%	16.0%
Solve problems using technology	2000-2004	19.2%	46.2%	26.9%	7.7%
	2005-2009	32.0%	56.0%	8.0%	4.0%
Integrate knowledge from different sources	2000-2004	15.4%	34.6%	38.5%	11.5%
	2005-2009	8.0%	52.0%	32.0%	8.0%

Data from the Alumni Survey says that our graduates believe that their coursework in our department has also enhanced:

- Their ability to write effectively (88% for those who graduated in 2005-09, 77% for those who graduated in 2000-04)
- Their ability to communicate orally in the discipline (84% for those who graduated in 2005-09, 73% for those who graduated in 2000-04)
- Their ability to solve problems using technology (96% for those who graduated in 2005-09, 92% for those who graduated in 2000-04)

Rubric:

ETS:

The ETS provides the data.

Field Work:

School of Education uses the rubric shown below.

Alumni Survey:

This is not rubric scored, but the data is tabulated.

School of Education Fieldwork Rubric

	Weak Candidate	Acceptable Candidate	Strong Candidate
Cultural Sensitivity: Demonstrates respect and cultural sensitivity toward ethnically and culturally diverse students.			
Basic Skills: Models appropriate literacies.			
Attendance: Punctuality and dependability.			
Cooperation: Fulfills assignments/follows instructions.			
Initiative: Anticipates needs/assumes responsibilities.			
Attitude: Maintains poise and positive interaction with students.			
Interest: Shows enthusiasm/communicates with supervisors.			
Appearance: Dresses appropriately.			