Analysis and Use of Evidence of Student Learning
General Education and Teacher Preparation Courses
2011-12 Academic Year

The Department of Mathematical, Information and Computer Sciences teaches the General Education mathematics requirement for the entire university. To meet the requirement students have three options:

- MTH144 Calculus with Applications
- MTH164 Calculus I
- MTH303 Problem Solving

The department developed a set of common learning outcomes that are expressed differently in each of the three classes. Early in the data set, there was not consistency across sections and across semesters in the problems being used to measure the outcomes. This can be seen in the data. Over the last 18 months the department has developed a set of standard questions that are being incorporated into the final exams for each section of each course each semester.

In addition, the department has gathered attitudinal data about MTH303 Problem Solving for many years.

A random sample of student worked is selected and then scored using a rubric with two-reader agreement.

The department also teaches two courses for prospective elementary school teachers MTH213 Fundamentals of Elementary Mathematics I and MTH223 Fundamentals of Elementary Mathematics II. The department developed learning outcomes for these courses that align with the State of California Standards as well as the learning outcomes for the Liberal Studies program. Because of the portfolio system used by the PLNU School of Education the rubric is applied to the work of all students in MTH213 and MTH223.

The data for each assessment is interleaved with commentary.

MICS GE Learning Data
21-May-12

		Students will be able to formulate a mathematical model from a verbal description of a problem.	Students will be able it solve non-routine problems using logic and quantitative techniques.	Students will be able to construct solutions to problems using computational techniques.
MTH144	Spring 2010	3.27	3.17	3.37
MTH144	Spring 2011	2.05	1.88	3.10
MTH144	Summer 2011	3.67	2.83	3.50
MTH144	Spring 2012	1.79	2.77	3.46
MTH164	Fall 2009	2.92	2.85	1.62
MTH164	Fall 2010	2.48	2.52	1.24
MTH164	Fall 2011	1.30	2.93	3.02
MTH303	Fall 2007	2.19	3.14	2.22
MTH303	Spring 2008	3.32	2.82	3.42
MTH303	Fall 2008	3.63	3.30	3.50
MTH303	Spring 2009	3.37	3.07	2.93
MTH303	Fall 2009	2.78	2.78	3.22
MTH303	Spring 2010	3.16	3.26	3.61
MTH303	Fall 2010	3.28	2.73	3.55
MTH303	Spring 2011	2.66	2.79	2.96
MTH303	Fall 2011	3.02	3.23	3.25
MTH303	Spring 2012	2.69	2.95	2.71

Scale Used:

0 Unsatisfactory - Completely Incorrect
1 Low Satisfactory - Missed more than one key concept or step
2 Satisfactory - Missed one key concept or step
3 High Satisfactory - Made a minor error
4 Outstanding - Completely correct

Criteria for Success: **Average sample score of 2.5 or higher for each problem**

Comments:

The question that we have been using to assess #1 for MTH144 and MTH164 has varried over time. It has produced inconsistent results. We will be changing this question to an interest problem which more closely matches one of the questions in the MTH303 assessment for #1.

Problem Solving Attidudinal Survey

	Fall 2006			Spring 2007			Fall 2007			Spring 2008			Fall 2008			Spring 2009			Fall 2009			Spring 2010		
	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree
In this class, we have been directly involved in problem solving activities.	97%	3%	0%	98%	2%	0%	95%	3%	2%	99%	1%	0%	95%	3%	2%	99%	1%	0%	96%	4%	0%	97%	2%	1%
This class has contributed to my ability to solve different types of problems.	82%	13%	5%	82%	14%	4%	82%	11%	7%	93%	7%	1%	86%	11%	3%	93%	7%	1%	86%	9%	5%	82%	12%	6%
This class has expanded my methods of exploration in problem solving.	82%	12%	6%	80%	14%	6%	76%	16%	7%	89%	9%	2%	81%	15%	4%	89%	9%	2%	82%	10%	8%	76%	20%	4%
This class has contributed to my ability to make educated guesses and check their correctness by analyzing their implications.	75%	20%	6%	80%	16%	4%	75%	21%	4%	82%	15%	3%	76%	21%	3%	82%	15%	3%	78%	14%	7%	71%	23%	6%
This class has helped me to understand major concepts, methods and applications of critical thinking.	76%	17%	7%	79%	18%	3%	81%	14%	5%	86%	11%	3%	84%	12%	4%	86%	11%	3%	78%	16%	7%	68%	23%	9%
This class has helped me to see the importance of problem solving in our modern society.	79%	13%	8%	79%	17%	4%	85%	10%	5%	86%	10%	3%	79%	15%	6%	86%	10%	3%	82%	9%	9%	81%	12%	6%

	Fall 2010			Spring 2011			Fall 2011			Spring 2012		
	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree	Agree/ Strongly Agree	Neutral	Disagree/ Strongly Disagree
In this class, we have been directly involved in problem solving activities.	91%	5%	4%	98%	2%	1%	90%	5%	5%	87%	6%	7%
This class has contributed to my ability to solve different types of problems.	71%	18%	11%	77%	16%	7%	69%	21%	11%	71%	12%	17%
This class has expanded my methods of exploration in problem solving.	76%	13%	11%	74%	20%	7%	68%	21%	11%	69%	14%	17%
This class has contributed to my ability to make educated guesses and check their correctness by analyzing their implications.	65%	21%	13%	70%	20%	10%	63%	25%	12%	67%	21%	13%
This class has helped me to understand major concepts, methods and applications of critical thinking.	67%	23%	10%	75%	15%	10%	68%	20%	12%	65%	17%	18%
This class has helped me to see the importance of problem solving in our modern society.	71%	17%	12%	80%	11%	9%	63%	21%	16%	68%	15%	17%

Longitudinal Agree/Strongly Agree

	Fall 06	Spring 07	Fall 07	Spring 08	Fall 08	Spring 09	Fall 09	Spring 10	Fall 10	Spring 11	Fall 11	Spring 12
In this class, we have been directly involved in problem solving activities.	97%	98%	95%	99%	95%	99%	96%	97%	91%	98%	90%	87%
This class has contributed to my ability to solve different types of problems.	82%	82%	82%	93%	86%	93%	86%	82%	71%	77%	69%	71%
This class has expanded my methods of exploration in problem solving.	82%	80%	76%	89%	81%	89%	82%	76%	76%	74%	68%	69%
This class has contributed to my ability to make educated guesses and check their correctness by analyzing their implications.	75%	80%	75%	82%	76%	82%	78%	71%	65%	70%	63%	67%
This class has helped me to understand major concepts, methods and applications of critical thinking.	76%	79%	81%	86%	84%	86%	78%	68%	67%	75%	68%	65%
This class has helped me to see the importance of problem solving in our modern society.	79%	79%	85%	86%	79%	86%	82%	81%	71%	80%	63%	68%

GE Learning Outcomes Commentary

GE Learning Data:
Some of the variability in the data is based on the fact that initially there was some variability in the problems used to assess learning outcomes. This variability is most evident in the two calculus classes (MTH144 and MTH164).

In the last 18 months the department has been developing and testing a consistent set of questions to use to assess the learning outcomes. The questions were modified again in May of 2012 after completing the assessment on all the data from the 2011-12 academic year. We believe that we have a solid set of questions that will accurately assess student learning in the three key areas.

Over the last two years, the department has placed a greater emphasis on financial literacy in all of its GE courses and starting in the fall of 2012, outcome #1 will be assessed using a financial literacy question in all GE mathematics courses.

We continue to make content and pedagogical shifts based on what is seen from both the GE learning data and the MTH303 attitudinal data. One of those shifts has been to increase the training in and use of Excel to solve problems in all classes.

MTH303 Attitudinal Data:
Looking at the attitudinal data it is clear that students affirm that the class is engaging them in solving problems.

In the last year we have tightened some of the requirements in the problem solving class. This includes asking all students to complete a budget for their first year after graduation (students in MTH303 are juniors and seniors). We conjecture that the decrease in some of the attitudinal scores may be related to the increased expectation for the course including more detailed computations and research into their student loan and credit card debt. We will need to watch this trend to see what happens.

Based on the learning data scores, this spring's group of students was weaker than some we have seen in the past and that may be linked with the lower scores in the attitudinal survey.

Longitudinal Liberal Studies Scores
21-May-12

MTH213

	Students will be able to demonstrate a facility with operations on the integers (1b, 1c).	Students will be able to demonstrate a facility with operations on the rational numbers (1b, 1c).	Students will be able to apply concepts from number theory to solve problems (1a, 1b, 1c).
Fall 2008	3.40	2.96	3.16
Fall 2009	3.96	3.67	3.00
Fall 2010	3.78	4.00	3.66
Fall 2011	3.07	3.61	2.70

MTH223

	Students will be able to construct geometric figures using a compass and straight edge (1b, 1c).	Students will be able to select and use the appropriate units for computing length, area and volume (1b, 1c).	Students will be able to distinguish between the appropriate uses of probability and statistics to solve problems (1a, 1b, 1c).
Spring 2009	4.00	3.11	3.78
Spring 2010	2.32	3.25	3.86
Spring 2011	3.29	3.03	1.81
Srping 2012	2.78	2.50	2.30

Note the problem in 2010 was not a construction but a description

Scale Used:

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3 High Satisfactory - Made a minor error
4 Outstanding - Completely correct

Criteria for Success: **Average class score of 2.5 or higher for each problem**

Comments:
Students appear to need some additional instruction in the are of probability and statistics.

Liberal Studies Data Commentary

This data was built over time from a set of variable questions. The department has been working on refining a consistent set of questions to ask students. We believe that we now have a workable set of questions.

Reviewing the data, it is clear that the students need additional learning in probability and statistics. Those changes will be made in the Spring of 2013 when the class is next taught.