Analysis and Use of Evidence of Student Learning
Mathematical, Information and Computer Science Programs
2012-13 Academic Year

In the 2011-12 academic year the Mathematical, Information and Computer Sciences Department expanded its assessment efforts to include some formative assessment as well as measuring additional learning outcomes. This expansion is part of the department's multi-year assessment plan which was revised after Program Review. The continuation of this process can be seen in the department's 2012-13 data.

The department is home to three majors:

- Computer Science
- Computer Information Systems
- Mathematics

However, there is a fair amount of overlap between the three majors particularly in the first two years of coursework. The department takes a collective approach to developing and assessing the learning outcomes in all three programs.

In the pages that follow, the evidence of student learning data is interleaved with a brief commentary about the data and the how the department has made use of the data. This includes data gathered from signature assignments in the following classes:

- CSC254 Data Structures
- CSC314 Operating Systems
- CSC324 Software Engineering (new this year)
- CSC493 Software Project (assessment added this year)
- MTH242 Number Theory with Proofs
- MTH352 History of Mathematics
- MTH382 Mathematical Statistics
- MTH444 Abstract Algebra (new this year)
- CSC481/ISS481/MTH481 Senior Seminar

The senior seminar forms the core of our assessment efforts and that is where we have the richest data.

The department collectively discusses and develops signature assignments and rubrics. We use a system of two-reader agreement for all items scored with a rubric. The one exception is the students' senior oral presentation which is graded by a jury comprised of all the faculty in our department.

Many of the actions resulting from our use of assessment can be seen in the APC Proposals and the Program Review Part I and Part II documents.

CSC254 Longitudinal Data
Fall 2012

Learning Outcome: Students will be able to write correct and robust software (CS and CIS)

Students will be able to use technology to solve problems (MTH)

	Percentage of Class at 2.5 or Higher	**Percentage of class at 2 or higher for runtime correctness, and 2.5 or h for the others**
	2012	**2013**
Compilation	100%	100%
Runtime Correctness	57%	58%
Problem Solving	93%	83%

Scale Used:

Unsatisfactory	1
Low Satisfactory	2
High Satisfactory	3
Outstanding	4

Criteria for Success: 80% of the class will be at or above 2.5 in each of the three areas
We have changed the benchmark for runtime correctness to 2 because of the nature of how the score is computed.

CSC254 Data Structures Commentary

This is a computer programming course that is required of all three majors in department (Computer Science, Computer Information Systems and Mathematics). This was the first year in which we assessed a signature assignment in the course. The assignment involved writing a computer program.

The students met our criteria for success in two of the three areas. The department discussed the outcome in the area of “runtime correctness” and realized that it is impossible for students to score a 2.5 since this is not a subjective measure. Thus the benchmark was changed to be a 2 or higher. Student scores are still low in this area and this data will be discussed in the department assessment meeting in the fall of 2013.

The course will be taught and assessed again in the fall of 2013.

CSC314 Longitudinal Data
Spring 2013

Learning Outcome: Students will analyzie the interaction between hardware and software.

	Percentage of Class at 7 or Higher	
	2012	**2013**
Hardware/software interaction understanding	85%	89%

Scale Used:

System based on a maximum of 10 points.

Unsatisfactory	6 or below
Low Satisfactory	7
High Satisfactory	8
Outstanding	9 or 10

Criteria for Success: 80% of the class will score 7 or more points (satisfactory or higher)

CSC314 Operating Systems Commentary

This course in operating systems is required of all Computer Science and Computer Information Systems majors. This was the first year that we used a signature assignment to assess the students' understanding of the interaction between hardware and software. The students met our criteria for success in both years.

The course will be taught and assessed again in the spring of 2014.

CSC324 Teamwork Assessment

	Fall 2012 % students with average at least 3.0
Contributes to team meetings	86%
Encourages team members	93%
Contributes individually outside of team meetings	93%
Attitude	100%
Fosters constructive team climate	100%
Responds to conflict	100%

Scale Used:

Unsatisfactory	1
Low Satisfactory	2
High Satisfactory	3
Outstanding	4

Criteria for Success: 80% of the class will be at or above 3.0 in each area.
Our target was met.

CSC324 Software Engineering

This is a course that helps our students to be prepared to design and create a significant piece of software (the project is in CSC493 Software Project). We are assessing students' abilities to be productive members of teams in this course. The students met our criteria for success.

This course will be taught and assessed again in the fall of 2014.

Software Project CSC 493 Longitudinal Data
Spring 2013

Learning Outcome: Students will be able to apply their technical knowledge to solve problems

	Percentage of Class at 70% or Higher
	2013
Hardware/software interaction understanding	50%

Scale Used:
System based on a maximum of 20 points.

Unsatisfactory	less than 70%
Low Satisfactory	70 to less than80%
High Satisfactory	80 to les than 90%
Outstanding	greater than 90%

Criteria for Success: 80% of the class will score 7 or more points (satisfactory or higher)

Students did not seem aware that a detailed response was expected for questions 2, 3 and 4.
This confusion caused lower scores.
The prompt for the assignment has been modified to address this.

CSC493 Software Project

In this course, our Computer Science students design and create a significant piece of software. In this course we are assessing their ability to use their knowledge to solve technical problems.

The students did not meet our criteria for success. This is the first year that we have assessed this course in this manner. After assessing the outcome of the signature assignment, it has become clear that our prompts need to be modified to make expectations for answers more specific. These modifications have been made and they assignment will be used again in the spring of 2015 when the class is next taught.

MTH242 Longitudinal Data
Spring 2013

Learning Outcome: Students will be able to write proofs.

	Percentage of Class at 2.5 or Higher		
	2011	**2012**	**2013**
Statement of Problem	100%	100%	100%
Logic	100%	88%	100%
Symbolism	100%	100%	100%
Justification	86%	75%	100%

Scale Used:

Unsatisfactory	1
Low Satisfactory	2
High Satisfactory	3
Outstanding	4

Criteria for Success: 80% of the class will be at or above 2.5 in each of the four areas

MTH242 Number Theory with Proofs Commentary

All students majoring in Mathematics are required to take this course in the basics of proof writing. Students typically take this course in their sophomore year so we are using this as a formative assessment. This year we began assessing the students' proof writing ability near the end of their academic career as well (see MTH444 data).

The students are the weakest in the area of providing justification for individual steps in their proofs. This is to be expected at this point in their development as mathematicians. In 2012-13 100% of the students achieved a score of 2.5 or higher and our criteria for success is 80% of the students at that level. However given the small sample size, we expect variation in the data.

The class will taught and assessed again in the spring of 2014.

MTH352 Teamwork Assessment

	Spring 2013 % students with average at least 3.0
Contributes to team meetings	91%
Encourages team members	91%
Contributes individually outside of team meetings	82%
Attitude	100%
Fosters constructive team climate	91%
Responds to conflict	91%

Scale Used:

Unsatisfactory	1
Low Satisfactory	2
High Satisfactory	3
Outstanding	4

Criteria for Success: 80% of the class will be at or above 3.0 in each area.
Our target was met.

MTH352 History of Mathematics Commentary

This is a required course for all Mathematics majors. The students in this course study the history of mathematics and have one large assignment that is a group project. We are assessing their ability to work in teams in the course. The students all met our expectations for their ability to work in teams.

This class will be taught and assessed again in the spring of 2015.

MTH444 Longitudinal Data
Fall 2012

Learning Outcome: Students will be able to write proofs.

	Pecentage at 2.5 or higher
	Fall 2012
Statement of Problem	92%
Logic	92%
Symbolism	100%
Justification	77%

Scale Used:

Unsatisfactory	1
Low Satisfactory	2
High Satisfactory	3
Outstanding	4

Criteria for Success: 80% of the class will be at or above 2.5 in each of the four areas

Note there was some abiguity about criteria 4 (justification in the statement of the problem).

MTH444 Abstract Algebra Commentary

This is a required course for all Mathematics majors. The students in this course study the abstract algebra and do a significant of proof writing. We assess for a second time students proof writing ability in this upper division course (we assessed it in MTH242 as well).

This is the first year that we have used this particular signature assignment in the course. The students met our expectations in three of the four areas. The one area with a small amount of difficulty was the justification of the steps in the proof. Departmental review indicated that there was some ambiguity in the prompt. This will be modified for future assessments.

This course will be taught and assessed again in the fall of 2014.

Education Fieldwork Evaluations
May-13

	Percentage of Students Scoring 2.5 or Higher					
	2007-08	2008-19	2009-10	2010-11	2011-12	2012-1
Overall Score	100%	71%	N/A	N/A	N/A	100%
Number of Students	4	7	0	0	0	3

Targets met for all years with student data.

Prospective Teacher Fieldwork

Students in our department who are considering being secondary school mathematics teachers take some general courses from the school of education. One component of these courses is a specified number of hours (35) of fieldwork in a classroom. Our department looks at the master teachers' assessment of our students.

All students met our criteria in 2012-13.

MICS Oral Presenation and Written Report Data
Senior Seminar Updated Spring 2013

Learning Outcomes: Students will be able to speak about their work with precision, clarity and organization.

Students will be able to write about their work with precision, clarity and organzation.

Oral Presentation	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Background	92%	80%	94%	94%	88%	100%	95%	100%	100%
Organization	92%	80%	94%	94%	94%	100%	85%	100%	100%
Oral presetnation skills (2010)						100%	90%	100%	100%
Presentation Tools	83%	80%	94%	88%	94%	100%	100%	100%	100%
Ability to field questions	92%	80%	94%	81%	100%	100%	100%	83%	100%

Written Report	2004-05	2005-06	2006-07	2007-08	2008-09	2009-10	2010-11	2011-12	2012-13
Bibliography and support	82%	60%	88%	69%	75%	88%	55%	93%	100%
Organization	91%	87%	94%	100%	88%	63%	65%	93%	100%
Grammar and Spelling	91%	73%	88%	94%	75%	81%	60%	79%	100%
Depth of Information	82%	60%	88%	81%	88%	88%	50%	93%	91%
Clarity of Writing	82%	80%	94%	94%	69%	81%	70%	79%	91%

Criteria for Success: 80% of the students will earn a 2.5 or higher (on a scale of 1-4) in each element.

Comments:
Changes over time:
Over time we have increased our standards and expanded the rubric to increase clarity for students and to push them to speak and write at a professional level. Looking at the scores, it is possible to see the times when alterations have been made:

2008-09 Standards tightened
2009-10 Rubric expanded to include more detailed instruction
2010-11 Standards in writing tightened
2011-12 Change in accountability for writing showing improvement in the final product.

MICS Critical Thinking and Information Literacy Data
Senior Seminar Updated Spring 2013

Learning Outcomes: Students will be able to write about their work with precision, clarity and organzation.

Critical Thinking	2012-13
Explanation of issues	100%
Evidence	100%
~~Influence of context and assumptions~~	
~~Student's position (perspective, thesis/hypothesis)~~	
Conclusions and related outcomes (implications and consequences)	100%

Information Literacy	2012-13
Determine the Extent of Information Needed	100%
Access the Needed Information	91%
~~Evaluate Information and its Sources Critically~~	
Use Information Effectively to Accomplish a Specific Purpose	91%
Access and Use Information Ethically and Legally	91%

Criteria for Success: 80% of the students will earn a 2.5 or higher (on a scale of 1-4) in each element.

Comments: MICS modified the AAC&U Critical Thinking and Information Literacy rubrics to match our assignments and other assessments.
Gray indicates the portion of the AAC&U rubrics that we did not use.

ETS MFT Longitudinal Summary 2012-13

Score of 200 is possible

Note that the data reads right to left. This is for ease of department review of most recent data.

CS Learning Outcomes:

Graduates will have a coherent and broad based knowledge of their discipline and graduates will be prepared for careers that use computer science in business, industry, government and the non-profit sector and will be prepared for graduate study in fields related to computer science.
Students will use the theory of algorithms and computation to solve problems.
Students will analyze the interaction between software and hardware.

Criteria for Success:

ETS CS Exam: 50% of the students will achieve above the 50th percentile in the exam.
ETS CS Exam Structures and Algorithms Subscore: The department subscore will be at the 65th percentile or higher.
ETS CS Exam Computer Organization, Architecture and Operating Systems Subscore: The department subscore will be at the 65th percentile or higher.

	2012-13		2011-12		2010-11		2009-10		2008-09		2007-08		2006-07		2005-06		2004-05		2003-04		2002-03	
Computer Science	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Department Average	139	14	155.3	64	156.3	70	153.5	65	162.8	90	167.3	95	166.3	95	158.6	80	152.3	55	163.7	85	159.5	83
Percent of Students Above 50th Percentile		0%		57%		71%		60%		100%		100%		100%		75%		100%		83%		75%
Number of Students Taking the Test		2		7		7		5		4		3		3		8		3		6		8

	2012-13		2011-12		2010-11		2009-10		2008-09		2007-08		2006-07		2005-06		2004-05		2003-04		2002-03	
Assessment Indicator Scores:	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Programming Fundamentals	*	*	51	46	64	65	65	70	73	95	68	85	73	85	*	*	*	*	66.7	85	65.4	83
Computer Org/Arch/Oper Sys	*	*	53	89	39	65	49	90	54	95	52	44	52	90	*	*	*	*	39.2	75	40.9	83
Structures and Algorithms	*	*	43	63	56	90	49	70	50	70	77	95	59	90	*	*	*	*	65.7	95	42.9	54

* Sample size too small to be given indicator scores.
ETS changed the CS exam in 2011-12.

CIS Learning Outcomes:

Graduates will have a coherent and broad based knowledge of their discipline and graduates will be prepared for careers that use computer information systems in business, industry, government and the non-profit sector and will be prepared for graduate study in fields related to computer information systems.

Criteria for Success:

ETS CS Exam: 50% of the students will achieve above the 25th percentile on the exam (this low number is due to the fact that ETS does not have a CIS exam so the CS exam is a proxy).

	2012-13		2011-12		2010-11		2009-10		2008-09		2007-08		2006-07		2005-06		2004-05		2003-04		2002-03	
Computer Information Systems	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Department Average	126	1	136	11	140.8	20	138.8	15	137.8	10	120.0	1	133.75	15	142.3	20	122	1	145.8333	35	141.8	38
Percent of Students Above 25th Percentile		0%		0%		83%		20%		50%		0%		25%		100%		0%		83%		67%
Number of Students Taking the Test		1		2		6		5		4		1		4		3		1		6		6

	2012-13		2011-12		2010-11		2009-10		2008-09		2007-08		2006-07		2005-06		2004-05		2003-04		2002-03	
Assessment Indicator Scores:	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Programming Fundamentals	*	*	*	*	53	30	44	15	52	30	18	1	39	10	55.8	55	*	*	42.7	20	40.8	33
Computer Org/Arch/Oper Sys	*	*	*	*	25	10	27	15	19	1	13	1	30	35	37.1	65	*	*	25	15	26.3	33
Structures and Algorithms	*	*	*	*	35	15	31	10	33	15	17	1	21	1	45.4	45	*	*	39	35	32.2	33

* Sample size too small to be given indicator scores.
Note in 2007-08 and 2004-05 only one Information Systems student took the test.
ETS changed the CS exam in 2011-12.

Math Learning Outcomes:

Graduates will have a coherent and broad based knowledge of their discipline and graduates will be prepared for careers that use mathematics in business, industry, government and the non-profit sector and will be prepared for graduate study in fields related to mathematics and will be prepared for teaching mathematics and computer science at the secondary level.
Students will be able to demonstrate a facility with analytical concepts.
Students will be able to demonstrate a facility with algebraic concepts.
Students will be able to use their mathematical knowledge to solve problems.

Criteria for Success:

ETS Mathematics Exam: 50% of the students will achieve above the 50th percentile in the exam.
ETS Mathematics Exam Calculus Subscore: The department subscore will be at the 65th percentile or higher.
ETS Mathematics Exam Algebra Subscore: The department subscore will be at the 65th percentile or higher.
ETS Mathematics Exam Applied Subscore: The department subscore will be at the 65th percentile or higher.

	2012-13		2011-12		2010-11		2009-10		2008-09		2007-08		2006-07		2005-06		2004-05		2003-04		2002-03	
Mathematics	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Department Average	161.8	pending	172.6	96	163.3	80	160.3	70	162.3	75	161.3	75	166.5	85	173.4	90	157.6	65	155.3	55	169	93
Percent of Students Above 50th Percentile		pending		80%		71%		50%		67%		67%		75%		80%		50%		50%		100%
Number of Students Taking the Test		6		5		7		6		12		6		8		5		8		6		8

	2012-13		2011-12		2010-11		2009-10		2008-09		2007-08		2006-07		2005-06		2004-05		2003-04		2002-03	
Assessment Indicator Scores:	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile	Score	Percentile
Calculus	29	pending	59	99	39	70	46	90	45	90	41	80	47	90	41.2	75	42.5	80	33.3	40	45.9	91
Algebra	39	pending	45	85	49	90	42	65	45	80	45	80	46	80	56	95	35	25	50	75	56.6	90
Routine	36	pending	54	98	45	85	42	75	43	75	41	70	48	90	52.2	90	42.6	75	51.3	65	62.6	95
Non-routine	31	pending	43	99	26	35	25	20	25	25	32	75	30	70	40	95	22.8	15	21	10	32.5	92
Applied	37	pending	48	96	40	70	43	85	48	95	38	60	40	75	40	75	33.8	45	46.2	70	49.9	84

Note the ETS changed the Mathematics test in 2004-05
Note the ETS changed the Mathematics test in 2012-13. Final Comparison results will not be available until August or September.

CSC481/ISS481/MTH481 Senior Seminar Commentary

Nearly a decade ago our department developed its Senior Seminar. All the seniors in our department are part of a single class. In that class the students work on practical skills (resume writing and interviewing techniques), discuss vocation and engage in three things that are assessed for program purposes:

- Develop an oral presentation that (generally) discusses the student's cumulative experience (internship, year-long service learning project, year-long research project)
- Write a paper that provides further expansion on their oral presentation
- Take the ETS Major Field test in Computer Science (Computer Science and Computer Information Systems majors) or Mathematics (Mathematics majors). For students who are double majoring in our department we allow them to choose with of the two exams to take.

It is important to note that each student is assigned a faculty mentor with whom to work in preparing their oral and written presentation. This mentor provides a level of accountability and a sounding board but does not engage in high levels of editing of the student's work before the presentation.

Oral and Written Presentation Data:
Reviewing the longitudinal data from both the oral and written presentations, it is possible to see the department's learning process about how to best assess these two abilities in our students. Over the years we have modified the rubrics, provided greater detail and accountability for the students, and tightened the standards. This can be seen in the variation in the data. For example we tightened the standards in the academic year 2008-09 and the corresponding drop in student results can be seen.

The Senior Seminar is in the spring and each fall the department reviews the oral and written presentation data from the previous years and discusses needed adjustments in the syllabus and in our interactions with students. Our students need to become better writers and each year we consider additional ways to hone their writing skills in the senior seminar as well as in earlier classes. For example, students are now being exposed to the writing and speaking rubrics in other classes in their majors where they need to write papers or do presentations (e.g. the History of Mathematics).

Information Literacy and Critical Thinking
In 2012-13 PLNU participated in a Degree Qualification Profile (DQP) pilot test. The MICS department used the students' final written projects as the signature assignment for applying the critical thinking and information literacy rubrics. The students met our expectations.

ETS Major Field Tests
The ETS exam has provided our department with helpful information that has led to a number of curricular changes over time. We look at the data annually which has led to small modifications (changes in pedagogy or assignments) as well as larger curricular modifications (addition or alteration of classes).

Computer Science:
We had fewer than five students graduate with Computer Science degrees in 2012-13 so ETS did not send us area subscores on students. ETS change the Computer Science test in 2011 so we just recently received the benchmarking and subscores for last year's Computer Science tests. Based on that data, we need to do some investigation into what underlies the programming fundamental skills since our students' scores have dropped.

We have made curricular changes in the last few years to update our department coursework to align with new standards from the Association of Computing Machinery as well as to respond to assessment data. This has included increasing students' exposure to data bases and information security. It is too soon to see if these changes will impact ETS scores. See the Program Review Parts I and II and recent APC Proposals to see the curricular changes.

Computer Information Systems:
We had fewer than five students graduate with Computer Information Systems degrees in 2012-13 so ETS did not send us area subscores on students (this group is consistently too small for subscores). ETS change the Computer Science test in 2011 so we just recently received the benchmarking and subscores for last year's Computer Science tests. Based on that data, we need to do some investigation into what has changed about the new test.

We have made curricular changes in the last few years to update our department coursework to align with new standards from the Association of Computing Machinery as well as to respond to assessment data. As part of this process we did a compute overhaul in the curriculum in this area. It has formerly been an Information Systems major but the demand in our community is for Computer Information Systems. To that end we expanded the amount of computer science fundamentals that these students must study. It is too soon to see if these changes will impact ETS scores, however we expect with the expanded computer science material in the curriculum these majors should show overall improvement in their ETS scores. The class of 2013 will be the first class that could not earn a degree under the old Information Systems. See the Program Review Parts I and II and recent APC Proposals to see the curricular changes.

Mathematics:
The ETS has changed the Mathematics Exam so we will not have benchmarking results until August or September of 2013.

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 the Program Review Part I and Part II for further details. See also the APC Proposals from the last several years to see curricular changes.