

Instructional Program/Discipline Review

Program/Discipline: Mathematics

TOPS Code: 1701.00

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1. Program Description and Scope

The Mathematics program's primary function is to serve students in the completion of their General Education math requirements. In addition, the department plays a fundamental role in serving the Natural, Life, and Physical Science majors' mathematical needs, both with transfer and non-transfer level courses. The Mathematics department also serves the needs of other majors with courses such as Statistics, Finite Math, and Business Calculus.

Overall, the spectrum of courses within the Mathematics "program" is quite diverse, and as such may be better viewed as a combination of programs. For the purpose of this Program Review, the Math faculty chose to view the program divided into three main subgroups: (1) Developmental Mathematics, (2) Transfer Level: Business, Liberal Arts, & Statistics, and (3) Transfer Level: Math/Science. These are further discussed in the remainder of this document. However it is worth pointing out right from the start that these are not necessarily three distinct groups of students. Many of our students begin in the Developmental Math group and progress into one of the Transfer Level groups, and additionally there are students who would primarily identify themselves with one of the Transfer Level groups but would also take some classes within the other group.

The department currently has 15 fulltime instructors and 28 part time instructors, with approximately two-thirds of the sections being taught by full time instructors. Over the past 3 years the department has averaged over 250 sections taught and over 6500 student enrollments annually, as seen on the Mathematics Program Review data sheets (see Appendix A). In addition, the department's WSCH/FTEF is consistently over 400 when looking only at credit classes, and consistently over 500 (sometimes even above 600) when looking at both credit and non-credit classes. This increase observed with non-credit classes is due to the FTES earned through the Math Learning Center.

During the Summer sessions, student retention and success are high, presumably due to the higher number of motivated high school students and university students that tend to enroll in Ohlone's math classes during their summer "vacations." During the Fall and Spring semesters, the retention and success rates in math are approximately 10 percentage points below the college-wide rates. This is not surprising given the rigorous nature of the material combined with the fact that nearly every Ohlone student is required to take at least one math class. It is expected that department efforts on student learning outcomes will lead to greater student success and thereby increase these numbers.

The department currently owns licenses for the mathematical software Matlab and Mathematica and teaches computer based Statistics courses using Microsoft Excel and Fathom. Self-paced Basic Math classes have been offered at Ohlone for many years. In addition, in 2002 the department started offering self-paced sections of all Algebra courses using instructional software. Students in these classes can work at their own pace and, if they do not finish by the end of the semester, they can pick up where they left off the next semester.

The Math faculty have been involved with the on-campus tutor training (which trains tutors for all of Ohlone's tutoring labs) and teaching courses at NUMMI and the Montessori school. One member of the department taught a group of students at Newark Junior High School all of the courses from Algebra I through Calculus. Several of our part time faculty are full time instructors at the local high schools. The Math faculty are also very active in committee work at the college, including but not limited to involvement in Faculty Senate, CAPAC, the General Education committee, the United Faculty of Ohlone, SOAR, and the Ohlone Foundation Board.

2. Relationship to Ohlone College Mission and Goals

Goal 2: Develop across the curriculum the Learning College Model, utilizing methods and technologies that hold the most promise for improving student course and program completion success rates.

The Mathematics program has a long-standing practice of continuously exploring new ways to improve student learning and success. The Math Learning Center has supported student learning through tutoring and computer applications since its inception. The move to Hyman Hall in 2002 provided the space to accommodate more students in a more student-friendly environment, as well as providing newer computers and software that have supported technologically enhanced learning in a wider variety of courses.

The opening of Hyman Hall also created the opportunity for the department to expand its self-paced format from the long-standing Basic Math course (Math 190) to the Algebra courses (the various versions of Math 151 and 152). Other students that have benefited greatly from the computerized classrooms include those in Statistics (Math 159), most sections of which are now offered in Hyman Hall. This move has allowed the study of statistics to move from tedious number crunching with calculators into further exploring the deeper meaning of statistics as the computers handle the more tedious work. And, the Math faculty continue to find new ways to utilize technology throughout the curriculum, thereby allowing more students to reach a deeper level of understanding of the concepts while simultaneously exposing the students to technological tools that they can apply in other areas.

Of course, the Math program's implementation of a Learning College Model is not limited to the technological side of learning techniques but also, and just as importantly, incorporates the human side. The Math department has further improved the self-paced courses by hiring student tutors that work during the classes, providing additional contact and support with the students in those courses. The Math department has been instrumental in developing and guiding tutor-training programs that have supported student learning even in areas outside of the Math curriculum. The "Overcoming Math Anxiety" course was renamed "Success in Math" (Math 199) and continues to be a positive resource for students. And, most importantly, the Math faculty as a whole (both full time and adjunct) have remained student-focused in the development of curriculum, in staff development activities, and in the day-to-day endeavors of student learning.

The new approach to Program Review initiated this past year has provided the department with the opportunity and motivation to more scientifically study the impact of our efforts in reaching students. The Student Learning Outcomes that have been developed reflect the student-focused approach that the department has always taken. It is expected that, as we continue the assessment process after this report has been finished, the results of this work will lead to more exploration and refinement of learning methods and approaches, with the end result being the support of more student success.

3. Program Student Learning Outcomes

The Mathematics department met in the Fall Semester of 2004 to begin the discussion on department Student Learning Outcomes (SLO's). After a brainstorming session, all suggestions were grouped into four SLO's that can be applied to all courses in the department.

1. Students should improve their attitude towards math.
2. Students should have problem solving skills at an appropriate level.
3. Students should retain information from course to course.
4. Students should be completing the Math certificates and degree.

The notes from our brainstorming session describing each of the four SLO's can be found in Appendix B.

The department divided all Mathematics courses into three groups with each member of the department participating in one of the groups.

- *Developmental Mathematics* – Basic Math (Math 190), all Algebra classes (Math 151, 151A & B, 152, 152A & B, 153)
Faculty members: Ilene Katz, Linda Messia, Mylene Pelimiano, VP Singh, Ron Staszko
- *Transfer Level: Business, Liberal Arts, and Statistics* – Finite Math (Math 166), Business Calculus (Math 167), Statistics (Math 159), and Math for Liberal Arts (Math 156)
Faculty members: Steve Bitzer, Curtis Bressler, Geoff Hirsch, Anh Nguyen, Jeff O'Connell
- *Transfer Level: Math/Science* – Trigonometry (Math 181), Pre-Calculus (Math 188), all Calculus classes (Math 101A, B & C), Linear Algebra (Math 103), and Differential Equations (Math 104)
Faculty members: Bob Bradshaw, Chieko Honma, Victoria Loukianoff, Tania Munding, Rob Smedfjeld

Each group has chosen one SLO to focus on this year:

- Developmental Mathematics – Students should improve their attitude towards math.
- Transfer Level: Business, Liberal Arts, & Statistics (BLAST) – Students should have problem solving skills at an appropriate level.
- Transfer Level: Math/Science – Students should retain information from course to course.

What is being described in this report is the work for this year. The department intends to continue this work throughout the time until our next program review, with each subgroup expanding their efforts into additional SLO's. The focus of our work will remain the continuous improvement of student learning in math.

On the following pages, there are detailed descriptions of the types of assessment to be measured for these SLO's.

Developmental Mathematics –

Basic Math (Math 190), all Algebra classes (Math 151, 151A & B, 152, 152A & B, 153)

SLO: Students should improve their attitude towards math.

This group decided that there were two aspects to measure :

- I. The student should show a positive attitude toward mathematics by:
 - a) realizing that he/she can succeed in learning mathematics.
 - b) being willing to take the mathematics courses required in attaining his/her educational goals.
 - c) thinking that math is enjoyable.

- II. The student should develop a positive work ethic in mathematics by:
 - a) completing assignments.
 - b) getting extra help when needed.
 - c) studying for exams and quizzes.

To address both aspects, this group created surveys based on the “like it” scale (strongly agree, agree, disagree, strongly disagree) to be given to all Math 190, 151, 152, and 153 classes throughout the semester starting in the Fall 2005. At the beginning of the semester, a three question survey will be given to measure the students’ attitudes about math. In the middle and end of the semester, additional surveys will be given to measure the students’ attitudes about math as well as the students study habits. The purpose of these surveys is to keep track of trends throughout the semester and from semester to semester.

Transfer Level: Business, Liberal Arts, and Statistics –
 Finite Math (Math 166), Business Calculus (Math 167), Statistics (Math 159), and Math for Liberal Arts (Math 156)

SLO: Students should have problem solving skills at an appropriate level.

To measure this outcome, this group decided to put one common question on each final exam for Finite Math (Math 166), Business Calculus (Math 167), and Statistics (Math 159) and grade them using the following rubric. The purpose for this assessment is to determine if the students are finishing the course with the necessary knowledge. These questions were first implemented in Spring 2005 for Math 167 and will be implemented for Math 159 and Math 166 starting in Fall 2005.

To what extent do students have problem solving skills at the appropriate level?	
4	The student is proficient at applying mathematical interpretations to real life and other areas of study AND is proficient at performing calculations & mathematical manipulations. The student's approach to solving mathematical problems is efficient and accurate, and he/she demonstrates a clear understanding of the significance of his/her calculations.
3	The student is proficient at applying mathematical interpretations OR performing calculations & manipulations, but not both. The student's mathematical manipulations are correct, but the student does not understand how these calculations are used/applied (or vice versa).
2	The student can only perform some calculations & manipulations and has a limited understanding of the interpretations of these. The student may exhibit gaps in his/her knowledge (i.e., be able to perform some kinds of calculations accurately and others not at all) or may exhibit consistent kinds of inaccuracies in problem solving and/or inability to complete problems.
1	The student can perform very few of the calculations & manipulations and does not understand how to apply these concepts.

Transfer Level: Math/Science –

Trigonometry (Math 181), Pre-Calculus (Math 188), all Calculus classes (Math 101A, B & C), Linear Algebra (Math 103), and Differential Equations (Math 104)

SLO: Students should retain information from course to course.

This group decided that there were two aspects to measure:

1. To what extent can students explain the importance of retaining information and skills?
2. To what extent do students retain key information and skills from course to course?

To address the first aspect, this group created a survey to be given to classes in Algebra II (Math 152), Pre-Calculus (Math 188), and Calculus II (Math 101B). To address the second aspect, the group created pre-tests to be given to classes in Calculus I (Math 101A), and Calculus III (Math 101C). Both the surveys and the pre-tests were implemented within the first two weeks of class in Fall 2005.

Following are the rubrics that were created to measure this outcome.

1. To what extent can students explain the importance of retaining information and skills?	
4	The student believes it is necessary to retain knowledge and skills from course to course in order to be successful.
3	The student believes it is only important to retain some of the knowledge and skills - important information and concepts will be reviewed and re-taught in the current course.
2	The student believes the prerequisite courses are just requirements that are imposed by the college. Once the student has passed a course, that proves that he/she is ready for the next course and he/she is no longer expected to retain that information.
1	The student has no knowledge of the sequence of courses to take - he/she does not think beyond the current course he/she is in.

2. To what extent do students retain key information and skills from course to course? (This should be measured at the beginning of a course, and the following descriptions refer to the knowledge and skills that should have been learned in the combined prerequisite courses.)	
4	The student is proficient at applying mathematical interpretations to real life and other areas of study AND is proficient at performing calculations & mathematical manipulations. The student's approach to solving mathematical problems is efficient and accurate, and he/she demonstrates a clear understanding of the significance of his/her calculations.
3	The student is proficient at applying mathematical interpretations OR performing calculations & manipulations, but not both. The student's mathematical manipulations are correct, but the student does not understand how these calculations are used/applied (or vice versa).
2	The student can only perform some calculations & manipulations and has a limited understanding of the interpretations of these. The student may exhibit gaps in his/her knowledge (i.e., be able to perform some kinds of calculations accurately and others not at all) or may exhibit consistent kinds of inaccuracies in problem solving and/or inability to complete problems.
1	The student can perform very few of the calculations & manipulations and does not understand how to apply these concepts.

4. Assessment of Student Success in Reaching Program Outcomes

Developmental Mathematics

This subgroup decided to focus on the learning outcome that students should improve their attitude toward math. We separated the learning outcome into student attitude and work ethic. To determine if our developmental mathematics program has a positive effect on student attitudes, we first needed to have some baseline data on our developmental math students. At the start of the 2005 Fall semester, 680 developmental mathematics students were surveyed with three statements and asked if they strongly agree, agree, disagree, or strongly disagree. The statements and a summary of the results of Survey I are shown in the following table.

1. I realize that I can succeed in mathematics.	strongly agree (38.5%)	agree (58.5%)	disagree (2.8%)	strongly disagree (0.4%)
2. Avoiding mathematics courses has made me change future goals.	strongly agree (7.1%)	agree (28.1%)	disagree (50.4%)	strongly disagree (14.1%)
3. I do not like math.	strongly agree (19.7%)	agree (35.5%)	disagree (37.1%)	strongly disagree (7.4%)

From the data we can see that most of our developmental mathematics students feel that they can succeed. About 35% of them agree that avoiding math courses has made them change future goals. About 55% of them do not like math. This baseline data will help us determine if our developmental math courses and suggested interventions and contracts with students can improve student attitudes (see Section 5).

Survey II will be given in the middle of the Fall 2005 semester with the same three questions as Survey I and three additional statements on the work ethic of developmental students. The additional statements are given below but results are not yet available.

4. In this class, approximately what part of the assignments have I completed.
 all most some none
5. If you had difficulty learning a concept in this class, did you get outside-of-class help:
 all the time most of the time some of the time none of the time
6. The average amount of time I spent studying for a chapter exam in this class was:
 more than 4 hrs 3 – 4 hrs 1 – 2 hrs less than 1 hr

The response to these three questions should give us a baseline on the work ethic of our developmental mathematics students. At the end of the semester, Survey III will contain only the last three statements from Survey II. The results should help us determine if our developmental courses and suggested interventions and contracts can improve student work ethic.

It is our feeling that if we can improve our developmental mathematics students' attitude and work ethic, they will be more likely to succeed. It is our hope that the efforts this year will help us lay the groundwork for improving our developmental mathematics program.

Transfer Level: Business, Liberal Arts, and Statistics

During the 2005 calendar year, the BLAST group addressed the Student Learning Outcome that students should have problem solving skills at an appropriate level. Specifically, we decided for our courses, that there would be one question that would be common on every final given for our courses.

At the end of the Spring 2005 semester a common question was put on all Math 167 finals that tied together at least 3 major concepts from this course: functions, derivatives and integrals. This question was given to 30 students. Subsequent to the end of the semester, two instructors independently applied the rubric (detailed in Section 3 of this report) to these 30 finals. The results are shown in the following table.

Rubric Value	Number of Students	
	As Rated by Instructor #1	As Rated by Instructor #2
4	6	10
3	6	5
2	15	7
1	3	8

Since these results are quite different and we firmly believe that the rubric needs to be able to be applied with results that are consistent independent of the instructor applying the rubric, we have decided that the rubric needs to be refined. As an example, to score a “4” it is unclear whether minor calculation errors are allowed for the student to be judged as “proficient at performing calculations & mathematical manipulations.” This discrepancy will be addressed before we continue to assess this SLO.

Common questions to be given on all finals have already been developed for the Math 159 and the Math 166 classes and will be implemented in Fall 2005.

Although this group focused on the problem solving skills SLO, there were also initial discussions on the SLO about retaining information from course to course. So far, we have agreed that different approaches seem to be needed for the different courses in our group. Students entering Math 156 and 159 do not need as much retention of information from Math 152 or Math 153. However, this retention of Math 152 information is much more crucial for the Math 166 and especially the Math 167 students. Each student entering Math 166 or Math 167 may need to take a web-based Algebra asset exam. We have decided to wait to see what the college-wide computerized math asset exam will look like as a possibility to use for Math 156, 159 and 166. In the meantime, we have developed a shortened version of a Math 152 final that we are adapting to assess the students beginning Math 167.

Transfer Level: Math/Science

As described in Section 3, this group worked on the SLO about students retaining information from course to course.

To address the first aspect of this SLO, measuring to what extent students understand the importance of retaining information and skills, a questionnaire was given to four sections of Math 101B, five sections of Math 152, and five sections of Math 188 during the first two weeks in Fall, 2005 (this included one late-start class). A total of 368 students participated in the survey. (Note: Even though Math 152 is not one of the courses specifically listed in the Transfer Level Math/Science group, it was included in this survey since it is the prerequisite for Math 181.)

Again, the purpose of the questionnaire was to assess to what extent the students are aware of and understand the importance of retaining the information, knowledge, and skills from the previous classes. However, the survey also included questions assessing the students' willingness to spend time and effort on studying and on their attitudes towards mathematics in general. (See Appendix C for the full survey.)

The following table shows the questions that are specifically about retaining information, showing the number and percentage of answers given. The answer "unknown" is due to responses that were either blank or unreadable by the scanner used to compile the surveys.

Retention Questions	Number/Percentage of Answers				
	A Strongly Agree	B Agree	C Disagree	D Strongly Disagree	Unknown
It is important for me to succeed at the prerequisite course before taking the next course.	234 63.6%	104 28.3%	23 6.3%	1 0.3%	6 1.6%
The recency of taking the prerequisite course will affect my success in the next course.	192 52.2%	140 38.0%	27 7.3%	1 0.3%	8 2.2%
Algebra skills are important in Calculus and above subjects.	240 65.2%	113 30.7%	7 1.9%	1 0.3%	7 1.9%
Total	666 60.3%	357 32.3%	57 5.2%	3 0.3%	21 1.9%

On the retention questions, 91.9% of the students agree that succeeding in the prerequisite course is important before proceeding to the next course, and 90.2% agree that the recency of taking the prerequisite course is important as well. 95.9% agree that algebra skills are important in Calculus and above subjects.

The total percentages of the answers were applied to the rubric for this aspect (see Section 3 for the full rubric). The survey answers that were "strongly disagree" and "unknown" were combined together and assigned a rubric value of 1. As shown in the following table, the average rubric value is 3.5, which is higher than we expected. Based on their responses to the survey, the students do understand that they need to retain the information and skills that they acquire in prerequisite courses.

To what extent do students understand the importance of retaining information and skills?		
Rubric Value	Percentage	Rubric Value x Percentage
4	60.3%	2.413
3	32.2%	0.970
2	5.2%	0.103
1	2.2%	0.022
	Average	3.508

To address the second aspect of the SLO, measuring to what extent students actually retain key information and skills from course to course, pretests were given to all of the Fall 2005 sections of Math 101A and Math 101C.

The Math 101A pretest consisted of 10 questions, divided into 8 main questions and 2 more difficult extra-credit questions. The first of the two extra-credit questions asked the students to find an equation of a rational function from its graph; the second extra-credit question asked the students to factor an expression with negative rational exponents. Only 1 person attempted the first extra-credit question and only 8 people attempted to answer the second. Since these extra-credit questions were labeled as such, they are not included in the following analysis of the SLO. Also, since none of the 8 main questions specifically addressed applications to real life (an oversight on our part), we chose to combine the rubric values of 3 and 4 together, calling it 3.5 instead.

The following table shows descriptions of the Math 101A pretest questions, the percentages of students answering the questions correctly, and the number of students with the rubric values associated with each question. (For consistency, all of the Math 101A pretests were graded by the same faculty member.)

Question Number	Description of the question	Percent Correct	Rubric Value		
			3.5	2	1
1	Given 2 points, find the linear equation.	49.1	53	17	38
2	Find the domain.	50.1	55	3	50
3	Find the exact value of a trigonometric function.	59.3	64	3	41
4	Graph one cycle of a trigonometric function.	29.6	32	2	74
5	Find and simplify the difference quotient of a given function.	27.8	30	1	67
6	Prove a trigonometric identity.	60.2	65	1	42
7	Inverse of a trigonometric function.	0.0	0	33	75
8	Find asymptotes and intercepts from a graph.	47.2	51	1	56
Total			350 41%	61 7%	443 52%

Only 41% of all students' answers demonstrated proficiency in performing calculations and mathematical manipulations, while another 7% demonstrated some limited level of accurate calculations. More than half of the students' answers (52%) were at the lowest level of our rubric, demonstrating significant gaps in the prerequisite knowledge for this course.

The second pretest conducted by the Transfer Level Math/Science group was a Math 101C pretest, designed to indicate whether students remembered specifically the material from Math 101A and 101B that is most useful in Math 101C. The first five questions were intended to obtain a measure of the skill level of the students in a variety of the main topics from the earlier courses. The sixth question was intended to measure if the students recognized a situation that required the use of technology rather than traditional mathematical methods.

As with the Math 101A pretest, an oversight led to a lack of questions on the Math 101C pretest that specifically addressed real life applications. Given the smaller sample of students, it was decided that the rubric would be set aside for this pretest, and instead each of the questions were scored on a scale of 0 to 10 (as a normal test question would be graded). Again, to provide consistency, all of the Math 101C pretests were graded by the same faculty member. The results of these pretests are shown in the following table (on the next page), including question descriptions and categories.

Category	Question Description	Score			
		9 - 10	7 - 8	5 - 6	0 - 4
Manipulation/geometric	Find equation of tangent line	18	2	10	12
Manipulation	Indefinite Integral	34	4	2	2
Manipulation	Definite Integral	38	1	1	2
Manipulation/geometric	Find enclosed area	15	1	7	19
Explanation	Find graph using calculus	3	7	17	15
Explanation/Technology	Find graph using technology	3	0	0	39

On the skills questions, the students performed best on problems that involved only symbolic manipulation. They performed less well on questions that required a geometric understanding of the problem in addition to the symbolic manipulations. On the question intended to measure if the students recognized the need to use technology, the students did very poorly.

We usually find that the students in Math 101C are talented students with a strong aptitude for mathematics. However, as in any community college class, the students demonstrate a wide range of abilities. The results of the pretest verified this anecdotal observation. The pretest also indicates that some of the students do not remember basic concepts from calculus.

However, the lack of students understanding when to apply technology indicates that either

- there is a disconnect between students and faculty in the instruction of technology at the levels of Math 101A and Math 101B.
- or
- the diverse background of students (foreign countries, high schools, different college instructors) does not bring students to Math 101C with uniform training in this area.

Both the Math 101A and the Math 101C pretests were given at the beginning of a fall semester. There is a possibility that students temporarily forgot material during the summer and, once they were further into the semester, their memories were refreshed and they were actually able to catch up and do well in the course. At this time, we don't have enough data to draw any statistically significant conclusions. We will be administering these same pretests again in Spring 2006 to provide more comparative data.

Looking simultaneously at the overall trends in the surveys done by our group and at both sets of pretest results, there appears to be a disconnect between students knowing that prerequisite knowledge is important and then actually retaining that knowledge. As we continue to work on these student learning outcomes, we will need to analyze this apparent inconsistency in more detail, but we can speculate as to possible explanations. The responses to survey question #22 indicate that the students understand they need to spend time and effort to be successful. However, students may have overextended themselves by taking too many classes or working fulltime jobs that will prevent them from having time to study properly. Another explanation may be related to survey question #4, which indicates that almost 40% of students are uncomfortable with mathematical concepts. Consciously or unconsciously, then, they may be avoiding remembering some important concepts. To further explore the inconsistency, we will be working on fine-tuning the survey questions to more specifically address this issue. We also plan on moving the survey to a more manageable web-based format and conducting it in Fall 2006.

Students should be completing the Math certificates and degree

Although not specifically focused on by any of the subgroups in the Math department's Program Review work this year, the fourth student learning outcome is currently aimed at students in the "Transfer Level: Math/Science" part of the Math program, since these are the courses that are required as part of the A.S. degree and both certificates in Math ("Applied" and "Pure").

The Mathematics Program Review data sheet (see Appendix A) shows that the number of A.S. degrees awarded has increased, although the number of certificates has decreased. In general, this might be observed as a positive change since the degree has more coursework involved and is of more value to the student than a certificate. However, the data sheet demonstrates that the overall number of program awards in Math has steadily decreased in the last three years. By looking at the Chancellor's Office Data Mart website, the number of Ohlone Math certificates awarded for 2000-2001 and 2001-2002 were 81 and 67, respectively. This suggests that the number of certificates has decreased for only the last two years.

More data analysis (possibly related to more specific data about student enrollments) will be necessary in order to determine the cause of the lower number of certificates in the last two years. While the data sheet shows that student enrollments have decreased by less than 10% during that time, it's possible that the enrollments have gradually shifted away from the Transfer Level Math/Science courses, which would in turn lead to fewer Math certificates awarded.

5. Assessment of Program Through Review of the Teaching Learning Process

Developmental Mathematics

The developmental mathematics subgroup cannot assess the results of our efforts to improve student attitudes and work ethic at this time. Even though assessments have not been completed, the following strategies have been developed. Faculty may have mandatory one-on-one meetings with students whose overall response to Surveys I or II does not demonstrate a positive attitude or whose scores on tests and quizzes and completion of homework are not adequate. At the mandatory meeting the faculty may make a contract with the student. An example of a contract is shown in Appendix D along with other intervention strategies proposed. Future surveys, interventions and contracts initiated by instructors, and the variety of formats in our developmental mathematics classes will show if we are successful in the learning outcome of improving students' attitudes.

Transfer Level: Business, Liberal Arts, and Statistics

As stated in Section 4 only a limited amount of data has been collected at this point and more assessment will need to be done. Additionally work needs to be done on the rubric to improve its usability and consistency. Once this is done, the subgroup will explore strategies on improving the students' problem solving skills.

Transfer Level: Math/Science

Despite the fact that the surveys demonstrated students' awareness of the importance of retaining knowledge and skills from prerequisite courses, the pretests given revealed that a significant percentage of Transfer Level Math/Science students are underprepared. When a significant number of students are lacking the prerequisite information, this puts a burden not just on the students that are underprepared but on the entire teaching-learning experience.

The following strategies will be explored as possible ways to facilitate improving student success in retaining information as they progress through successive courses:

- Create detailed curriculum guides for each course, specifying the exact skills needed from previous and successive courses. These curriculum guides could clarify, for both the faculty teaching the courses and the students taking them, what the topics are that need to be especially emphasized for use in later courses. It is anticipated that these guides will be developed in conjunction with Course Review next year.
- Strongly recommend that students who will be completing a Math certificate and/or degree work as a tutor in the Math Learning Center. This will help ensure that students receiving Math certificates and degrees have an opportunity to constantly review material from previous courses.
- Invite successful students from higher level courses such as Math 101C, Math 103, and Math 104 to speak to the other Transfer Level Math/Science classes. They could share their experiences in those classes and the impact that the prerequisite knowledge had on their success.
- Create a series of web pages that students can print and cut into flash cards including separate pages for trig identities, derivative formulas, etc.
- Create a series of technology based assignments that can be used in all calculus courses, exposing students to several of the available options - graphing calculators, spreadsheets, Mathematica, etc.
- Give computerized standard tests at the end of each semester in Math 152, Math 181, and Math 188. It's possible that such a test could be based on the new computerized placement exams that will be used at the college, perhaps using the same system.

Students should be completing the Math certificates and degree

As mentioned in Section 4, additional data analysis will be necessary in order to understand the decrease in the number of Math certificates awarded during the past two years. It would also be worthwhile to determine if faculty's promotion of the degrees and certificates had lessened during that time period, or if perhaps faculty put more emphasis on promoting the degree (since it was new) and students lost sight of the certificates. Attempts should be made by the faculty to promote both the degree and the certificates, and to ensure that students are aware that earning and receiving one does not preclude receiving others.

In addition, the department has plans to create a third Math certificate that would be aimed at students majoring in Business. Similar promotion strategies will need to be taken when this certificate is in place.

6. Assessment of Program Improvement Since Previous Program Review

This step will be implemented during the next program review cycle using the new guidelines.

7. Describe Review and Dissemination Team Involvement

The Math department has chosen the following people to be on the program's Review and Dissemination Team, and these people have graciously volunteered their time to participate in this process.

Division Dean: Ron Quinta

As Dean of the Math, Science, & Technology Division, Dr. Quinta has participated in the Math department's Program Review discussions from their beginnings in the Fall of 2004.

Faculty members in the program: Jeff O'Connell, Rob Smedfjeld

As members of the Math department, Jeff and Rob have been actively involved in the development of the student learning outcomes for the Math program. They are the primary preparers of this report, coordinating and incorporating input from the entirety of the Math faculty, as well as from the rest of this Team.

Faculty member outside of the program: Susan Myers

As a member of the Counseling faculty, Susan is very familiar with the sequence of Math courses offered at Ohlone and provides valuable feedback about improving student learning. In addition to her Counseling work, Susan has made significant contributions on the Faculty Senate and the College Council.

Student enrolled in the program: David Zimmermann

Now in his fourth year as a Math student at Ohlone, David has steadily worked his way through the sequence of courses in "Transfer Level: Math/Science" as well as taking Statistics (which is part of "Business, Liberal Arts, and Statistics"). In addition to succeeding in his classwork here, David has also been a valued tutor in the Math Learning Center.

Community member: Jim Klent

Having retired from Ohlone last year after 38 years of teaching Chemistry here, Jim Klent is now a member of our community. His immense love for education and value of student learning are a great resource for this review.

The Review and Dissemination Team received the Math Program Review report for consideration during the first week of November, and met to review and discuss the report on November 15. The Team felt that the Math Program Review was exceptionally well done with a great deal of documentation and data. The team commends the department's goal to continue these efforts. The team was please to see the inclusion of subjective data such as attitudes about Math. It also seemed apparent to the team that this was a departmental effort. The team recommends for the department to consider the possibility of the developmental math survey being anonymous to see if there is any change in the results. Also, they would like to see this survey given to students who have tested into developmental math but have not enrolled in any math courses.

Appendix A: Mathematics Program Review Data Sheets

Appendix A: Mathematics Program Review Data Sheets (continued)

Appendix B: Notes from a Math Department brainstorming session in November, 2004

Math Department SLO's: It is important that outcomes should be measurable goals over which we have some influence.

1. Instill a positive attitude towards math. Measure it on the "like it" scale at the beginning and the end of the class.
 - Have more confidence in math abilities
 - Not hate math
 - Appreciate beauty of mathematics
 - Instill curiosity
 - Read technical/scientific material
2. Students should have problem solving skills at an appropriate level
 - Does an answer make sense?
 - Relationship of math to real life (math models)
 - Solve word problems
 - Recognize use of variables to solve problems
 - Understand concepts
 - Non-science transfer students learn everything they need
 - Independent thinker / better thinker
 - Independent learner
 - Learn basic skills to function in real world
 - Be able to follow directions
 - Listen better
 - Better learning skills, study skills, work habits
3. Students should retain information from course to course
 - Understand appropriate choice of technology/brain
 - Remember basic formulas
 - Life-long learner
 - Recognize right math type of problem
 - Recognize patterns
 - Better prepared transfer students as compared to university students
4. Students should be completing the math certificate and degree
 - Earn math certificate / AA degree

Appendix C : Transfer Level; Math/Science Questionnaire Results

This questionnaire was given to four sections of Math 101B, five sections of Math 152, and five sections of Math 188 at the beginning of the Fall 2005 semester.

Questions	Number of Answers				
	A	B	C	D	Unknown
1 I am A = male, B = female	219	143	0	0	6
2 My age is in the range of A = under 18, B = 18-25, C = 26-40, D = over 40 years old.	52	278	29	5	4
For questions 3-22, use the following scale: A = strongly agree, B = agree, C = disagree, D = strongly disagree					
3 I like to work with numbers	84	206	60	12	6
4 I like to deal with variables and mathematical concepts.	57	176	105	24	6
5 It is important to for me to succeed at the prerequisite course before taking the next course.	234	104	23	1	6
6 The recency of taking the prerequisite course will affect my success in the next course	192	140	27	1	8
7 Algebra skills are important in Calculus and above subjects.	240	113	7	1	7
8 I like to build my knowledge from one concept to another.	187	161	15	2	3
9 It is necessary to understand how formulas work.	190	148	22	3	5
10 It is necessary to memorize formulas.	102	156	77	27	6
11 I believe that I will use Calculus and Differential Equations past college.	85	125	100	51	7
12 I like solving word problems (applications to science and real world).	44	110	132	73	9
13 I like solving exercise problems (using formulas, algorithms and different methods).	61	182	92	27	6
14 The teacher has an influence in my attitude towards mathematics.	185	140	31	8	4
15 It is important to take notes in math class.	218	115	21	7	7
16 The textbook affects my attitude towards mathematics.	95	178	79	11	5
17 I read the textbook when I study math.	97	175	70	20	6
18 I use additional resources (internet, software) when I study math.	31	102	170	57	8
19 The attitude toward math of my fellow students influences me.	46	122	143	50	7
20 I work with other students on my math homework and projects.	57	150	125	25	11
21 It is important to do my math homework for my own learning.	214	135	9	1	9
22 It is important that I spend time and effort for me to be successful in math.	212	127	7	2	20

Appendix D: Developmental Mathematics Contract and Other Intervention Strategies

Ohlone College Math Contract

- I will start my homework within 24 hours of my next class.
- I will get my math questions answered by going to my teacher's office, the Math Center, a tutor, or asking in class.
- I will study for test at least 2 hours a day for three days before a test.
- I will do my math homework in the Math Center.
- I will do at least 3 problems similar to each problem I did not get correct on tests and quizzes.
- I will schedule time to study math.
- I will learn relaxation techniques and use it to stay relaxed when doing math.
- I am committed to improving _____ .
- Other _____ .
- I will do the things checked off beginning today.

_____ *date* _____ *Student* _____ *Instructor*

Appendix D: Developmental Mathematics Contract and Other Intervention Strategies (continued)

INTERVENTIONS

Assessing Attitudes – Interventions to employ given the results of the survey on your classes:

1. If a student responds that they do not feel that they can succeed in your class,
2. If a student feels that there are some majors that they would like, but will not pursue because they are not comfortable with math,
3. If a student is uncomfortable asking for help,
4. If a student does not understand that they can learn math if they make the necessary effort, and that hard work is necessary,

Try these interventions:

Attribution Retraining - involves modeling, and practice exercises.

The “goals are:

1. Concentrate on the tasks rather than becoming distracted by fear of failure;
2. Respond to frustration by retracing their steps to find mistakes or figuring out alternative ways of approaching a problem instead of giving up;
3. Attribute their failures to insufficient effort, lack of information, or reliance on ineffective strategies rather than to lack of ability” (Lumsden, 1994).

Also, research shows that:

A caring teacher

A relationship with a teacher

A relationship with fellow students

are effective interventions, improving student success, retention, and attitudes.

So, try some of these:

1. Have conversations with students about their interests. i.e. music, movies, books, sports, their hobbies, current events, etc..
2. Group work. Build relationships between students. Assign students problems at their seats to work on together.
3. Listen to how students feel about math, and other problems that are interfering with their studies.
4. Organize or encourage study groups.

Appendix D: Developmental Mathematics Contract and Other Intervention Strategies (continued)

You can also try:

1. When students work problems at their seats, work with students one-on-one to show them how well working with you one-on-one works. Then, invite them to do more of this during your office hours.
2. Tutors.
3. Contracts between the teacher and the student.
4. When students work in groups at their seats, scaffold. (Ask leading questions or provide supporting information so that students can then finish the problem.)
5. Don't give the entire answer.
6. Know the students' objectives for taking the class, and use them.
7. Relaxation techniques.
8. Study techniques.
9. Testing techniques.
10. If a student is strong verbally, have them write out steps or strategies in English. (or their first language.)
11. If the student is frustrated, tell them a joke or do a relaxation technique, then continue.
12. Have students schedule study time during their most effective study hours. When do they learn best?
13. Educate students on how the brain works and how they learn.
14. Allow students to demonstrate their knowledge using their strengths, not just by tests and homework from the textbook. (Multiple Intelligence)
15. Keep the environment non-threatening: use humor, utilize student designed assessment methods, know who will shut down if you call on them, have groups work on a problem which you check and then they put it on the board.
16. Small steps allow students to experience more success.
17. Make topics meaningful for students by including word applications on issues in their lives, and by showing them how studying this class will help them fulfill their goals.
18. Encouragement, not praise.
19. Assignments that can be done at a variety of levels.