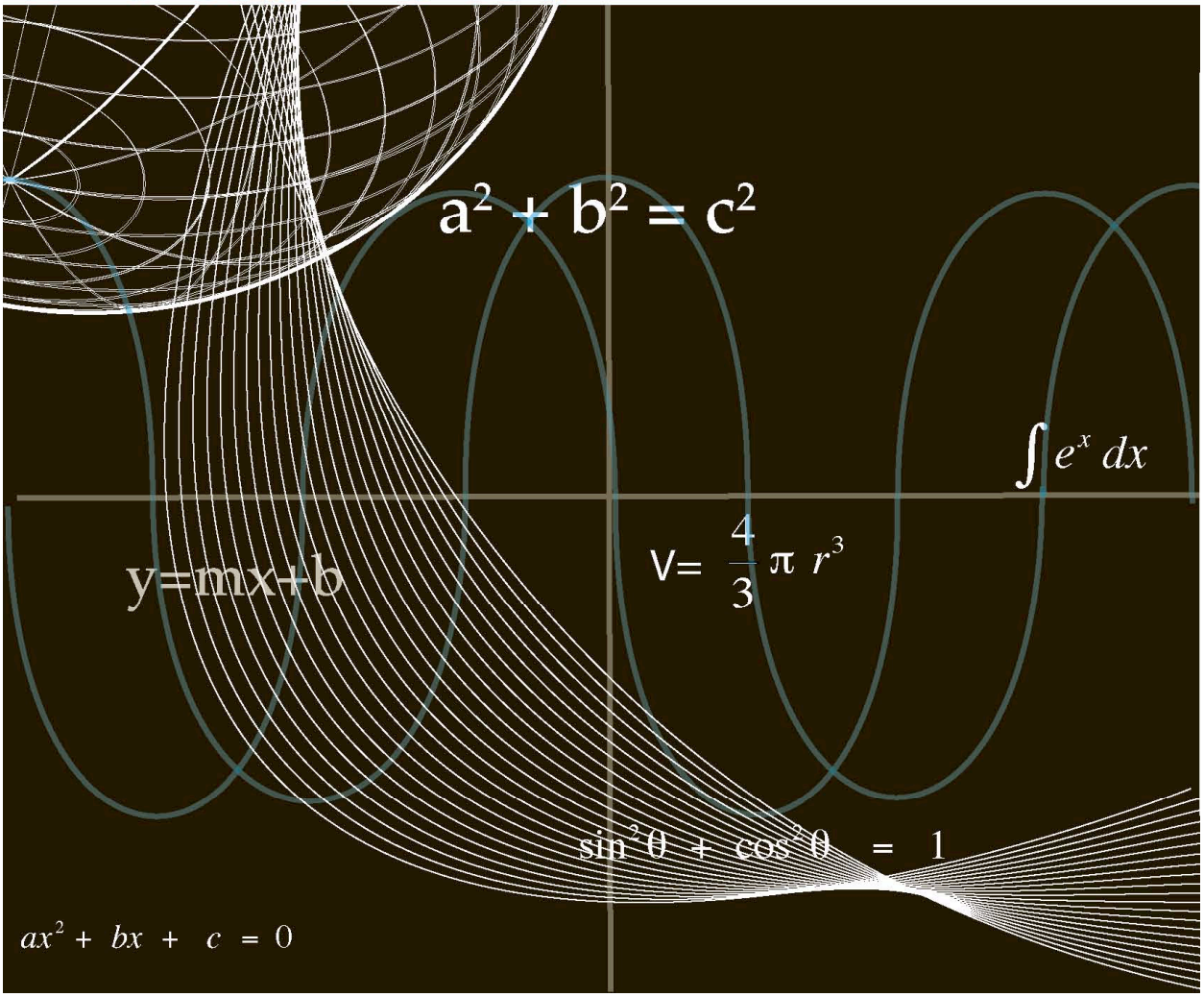
Making the Transition from High School to College

MaTHSC Project Survey Committee Publication



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MaTHSC Project
Survey Committee
Publication

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Survey Committee Members

Dr. Beverly J. Ferrucci, Chair
Professor of Mathematics
Keene State College

Paul L. Bartolomucci
Assistant Superintendent
Conval School District

Alan Hallee
Mathematics Department Chair
Nashua North High School

Deborah Payne
Mathematics and Science Director
Salem High School

Eileen Phillips
Director of Developmental Mathematics Programs
Keene State College

Shanyun (Shirley) Wang
Professor of Mathematics
New Hampshire Community Technical College at Manchester

Dr. Joseph Witkowski
Professor of Mathematics
Keene State College

Dr. Richard Evans, Co-Director of the NH-IMPACT Center at Plymouth State University and PI for this grant, served as an ex-officio member.

Graphic Design by Keene State College Graphics Art Major - Stacy Trudo

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Executive Summary

MaTHSC Survey Committee

Description of the Project

In January 2005, the Making the Transition from High School to College (MaTHSC) project began. MaTHSC is a collaborative project of the University System of New Hampshire (Keene State College, Plymouth State University, University of New Hampshire), the New Hampshire Community Technical College System, the New Hampshire Department of Education, and several school districts throughout the state of New Hampshire. It is important to note that the data collected and analyzed in this report are from a small but representative sample of school districts throughout New Hampshire.

The primary goal of the MaTHSC project is to help students make a successful transition from high school to institutions of higher education in New Hampshire. In order to better understand the mathematics content and courses students are exposed to during their high school years, as well as to insure that the goal of the project is met, a Survey Committee was formed. The first task of the Survey Committee was to develop several surveys to be sent to all the constituencies of the grant.

The Survey Committee met from Fall 2005 through Spring 2007. The first two meetings of the committee focused on the design of the survey and specific questions that would be included within it. The next four meetings focused on analyses of the survey data, development of learner outcomes for specific courses, and discussions of perceived gaps within high school mathematics courses and among courses taken by students at institutions of higher education within New Hampshire. The last two meetings involved the alignment and analysis of topics reported covered in each course and the final completion of this publication.

Design of the Surveys

One of the tasks of the committee was to collect and analyze information about the current status of mathematics courses taken by the high school students attending the school districts participating in this project. This task was accomplished with the construction of two surveys. The first survey created by the Survey Committee was sent to the High School Mathematics Department Chairpersons of the schools participating in this project. This survey was both quantitative and qualitative in nature. It asked for the names of specific courses taught within each school as well as the number of students enrolled in each course by grade level and the number of students, if any, who were repeating the course. It also included questions pertaining to the school's policy on standardized testing, exit requirements, and summer school mathematics offerings. (See Appendix A on page 59 for the Mathematics Department Chairperson Survey – Year 1).

At the completion of the first year of the grant, a similar survey was sent to each of the High School Mathematics Department Chairpersons. The purpose of this survey was to compare the number of students taking mathematics courses in the academic

years 2004-2005 with those of years 2005-2006. (See Appendix B on page 62 for the Mathematics Department Chairperson Survey – Year 2).

A third survey was created and sent to individual mathematics teachers within the participating high school mathematics departments. In this survey, the teachers were instructed to list the courses they taught with the names of accompanying textbooks, whether they have a teaching certification in secondary mathematics, academic degrees earned, and any gaps that they perceived in their students' mathematical knowledge between high school and post secondary education. (See Appendix C on page 67 for the Mathematics Teachers' Survey).

The fourth survey was a list of topics typically taught in high school courses and was constructed from the Grade Span Expectations (GSEs) issued by the New Hampshire Department of Education. This survey was sent to each teacher from the participating schools. Each teacher was instructed to check the topics from the list that students would demonstrate an understanding of at the end of the course. The survey was divided into the five categories of the GSEs: (1) Number and Operations,(2) Geometry and Measurement, (3) Algebra and Functions, (4) Data, Statistics, and Probability, and (5) Advanced Mathematical Topics. (See Appendix D on page 70 for the Mathematics Topics List).

Another task of the Survey Committee was to learn how students progressed once they entered institutions of higher education throughout New Hampshire. This task required the creation of a survey for the Mathematics Center Directors of three of the institutions of the University System of New Hampshire (USNH) namely Keene State College, Plymouth State University, and the University of New Hampshire and the seven campuses of the New Hampshire Community Technical Colleges System (NHCTCS) (NHCTC–Berlin, NHCTC–Claremont, NHTI–Concord, NHCTC–Laconia, NHCTC–Manchester, NHCTC-Nashua, and NHCTC–Stratham). This survey asked questions pertaining to such topics as mathematics placement examinations, specific mathematics courses taught, and perceived gaps in the high school courses taken by students as they relate to their future mathematics success in institutions of higher education. (See Appendix E on page 78 for the Mathematics Center Director Survey for the USNH and Appendix F on page 82 for the Mathematics Center Director Survey for the NHCTC).

Analysis of the Surveys

All the surveys were sent to the participants with a self-addressed stamped return envelope. They were all returned with a school code but with no teacher identification on them. All data were collected and coded for analysis. The data were analyzed and tabulated using SPSS.

In addition, six courses that were representative of the courses taught at the participating schools were selected for further analysis. The courses were grouped according to specific categories: (1) Calculus, (2) PreCalculus, (3) Algebra II, (4) Geometry, (5) Algebra I, and (6) Pre-Algebra. A summary report of the topics was created for each of the six courses. Within the summary, specific percentages of topics covered were listed as well as perceived gaps and points of interest found within the courses. (See pages 13 - 23 for the High School Course Summary Sheets).

Development of Learner Outcomes

Analysis of the High School Mathematics Topics Survey indicated that several courses with the same name (i.e., Algebra I) covered a multitude of different topics with not all courses covering the same content areas. In an effort to determine some commonalities among the differing courses, the Survey Committee developed Learner Outcomes for the aforementioned six courses. (See pages 24 - 56 for the Learner Outcomes.)

Alignment and Analysis of Topics to Learner Outcomes

After the development of the Learner Outcomes, the Survey Committee aligned each of the Learner Outcomes to the individual mathematics topics from the High School Mathematics Topics Survey. This allowed the Survey Committee to identify similarities and differences in the topics covered within each course. Graphs were developed from the data to show the extent that topics were reported covered under a specific learner outcome. (See pages 27 - 56 for the Alignment and Analysis of Topics to the Learner Outcomes.)

Observations

Upon analysis of the data, the Survey Committee made the following observations. There were differences in the number of years of mathematics teaching experience among the teachers responding to the surveys. There were differences in possessing certificates to teach secondary mathematics as well. The Calculus and PreCalculus teachers on average had more than 25 years mathematics teaching experience and all were certified to teach secondary mathematics. The Algebra II and Algebra I teachers on average had 14 years mathematics teaching experience and a little more than 80% of them were certified to teach secondary mathematics, while the Geometry teachers on average were slightly in excess of 17 years mathematics teaching experience with 90% of them being certified to teach secondary mathematics. The average number of years of mathematics teaching experience for the Pre-Algebra teachers was 7.5 with 75% of them being certified to teach secondary mathematics.

The Survey Committee found that there was a total lack of consensus among topics that were covered within particular courses. In order to deal with the lack of agreement regarding specific topics within each course, the Committee developed learner outcomes for six courses: Calculus, PreCalculus, Algebra II, Geometry, Algebra I, and Pre-Algebra. However, this lack of consensus was especially true for the Algebra I – type courses.

The topics “reasonableness of solutions” and “estimation” appeared to indicate a minimal inclusion within each course analyzed. The Survey Committee considered these topics to be extremely important and felt that the students’ sporadic exposure to these topics was not acceptable.

An observation was made that in some instances teachers may not have clearly understood the mathematical terminology. For example, several teachers stated that they cover “counting techniques” but not “permutations” or “combinatorics”.

Recommendations

As a result of the Mathematics Department Chairperson Surveys, the Committee recommends that high schools better prepare seniors to access higher level mathematics courses (beyond Algebra II) and that all students be required to enroll in at least one mathematics course during their senior year. The Committee also recommends that there be consistent state credit requirements for graduation, and that standardized mathematics assessments and/or competencies be required for every student as part of district graduation requirements.

The Survey Committee also recommends that all names of high school mathematics courses be standardized or at least include some identifying factors to help understand what mathematical skills students possess prior to attending institutions of higher education. In addition, the Survey Committee recommends that the New Hampshire Department of Education develop minimum focus areas similar to the National Council of Teachers of Mathematics *Curriculum Focal Points* to help with the naming of the courses.

The topics of logic, proof, and optimization are not included on the Grade Span Expectation list as issued by the New Hampshire Department of Education. The Survey Committee suggests that these topics be considered for inclusion on the list.

High School Mathematics Department Chairperson Surveys

In June of 2005 mathematics department chairs at nine New Hampshire high schools were asked to complete a survey related to a number of issues pertaining to their school's mathematics program. The survey questions asked for information about the number of mathematics teachers currently teaching students in grades nine through twelve, the total number of high school students currently enrolled in mathematics classes by grade, total school enrollment and quantitative data describing mathematics courses offered by number of students by grade level. Survey questions also focused on different assessment criteria such as; grading scales used to determine passing, types and purposes of standardized tests administered at the high school level, use of a graduation exit test and mathematics credits required by the district for high school graduation. In addition, the survey also obtained information about the availability and titles of any summer mathematics programs currently being offered.

As a follow up to the first survey, in June of 2006 mathematics department chairs at the same nine New Hampshire high schools were asked to complete an additional survey. The purpose of this additional survey was to collect data for a comparative analysis of the academic years 2004 - 2005 to 2005 - 2006. Survey questions focused on comparative information about quantitative data describing mathematics courses offered by number of students by grade level and mathematics credits required by the district for high school graduation. The survey also asked how many current graduates successfully completed specific mathematics courses such as: Pre-Algebra, Algebra I, Geometry, Algebra II and Advanced Mathematics Course titles.

Discussion of data from Survey I (2004 – 2005)

The nine schools responding to the survey reported using a variety of standardized tests, included NWEA, NHEIAP, and IOWA, for the purpose of measuring student progress, identifying student strengths and needs and meeting state and national assessment requirements. None of the schools reported requiring student exit exams in mathematics. Only some of the nine schools reported offering summer mathematics programs that included General Math, Algebra I, Geometry and Algebra II. Again, there was no consistency to the types of mathematics courses offered during the summer by the nine schools.

Discussion of data from Survey II (2005 - 2006)

A summary of the data from Survey II indicates that in June 2005, 73% of the seniors (892 out of 1229) at four New Hampshire public secondary schools were enrolled in a 2004 - 2005 mathematics course. Of those seniors, 67% (594 out of 892) were enrolled in a senior level mathematics course. In the following year, June 2006, 77% of the seniors (971 out of 1265) at four New Hampshire public secondary schools were enrolled in a 2005 - 2006 mathematics course. Of those seniors, 58% (562 out of 971) were enrolled in a senior level mathematics course.

Summary

In most of the schools responding to the survey more than 75% of the students were enrolled in at least one mathematics course. During the two-year period covered by the surveys, the number of graduating seniors enrolled in courses beyond Algebra II declined. Districts within the State of New Hampshire also reported different mathematics credit graduation requirements. In addition, school districts reported using a variety of standardized tests to determine student's skills and competencies. Based on the information received from schools that responded to the end of year data, a comparative chart was created.

Survey I (end of the year data for 2004 – 2005)

School Name	# of 2005 graduates	# of seniors enrolled in a math course	# of seniors not enrolled in a math course	# of seniors enrolled in a senior level math course	breakdown of senior level courses and the # of seniors enrolled	% of seniors enrolled in a senior level math course
A	252	111	141	75	precalculus : 25 intro to calculus: 24 calculus: 26	68%
B	366	261	105	198	precalculus: 56 advanced math: 65 prob and stats: 18 calculus: 31 AP calculus: 28	76%
C	498	467	31	287	precalculus: 95 honors precalculus: 4 honors calculus: 73 AP calculus I: 19 AP calculus II: 17 stats and prob: 46 AP stats and prob I: 18 AP stats and prob II:15	61%
D	113	53	60	34	precalculus: 6 advanced math: 9 statistics: 15 calculus: 4	64%
Totals	**1229**	**892**	**337**	**594**		**67%**

Survey II (end of the year data for 2005 – 2006)

School Name	# of 2006 graduates	# of seniors enrolled in a math course	# of seniors not enrolled in a math course	# of seniors enrolled in a senior level math course	breakdown of senior level courses and the # of seniors enrolled	% of seniors enrolled in a senior level math course
A	283	142	141	75	precalculus : 39 intro to calculus: 15 AP calculus: 11 AP calc w/physics: 10	53%
B	382	274	108	156	precalculus: 60 advanced math: 66 calculus: 30	57%
C	498	477	21	317	precalculus: 93 honors precalculus: 5 honors calculus: 69 AP calculus: 12 AP calculus AB: 22 AP calculus BC: 16 stats and prob: 65 AP stats and prob I: 20 AP stats and prob II:15	66%
D	102	78	24	14	precalculus: 3 honors precalculus: 5 statistics: 2 calculus: 4	18%
Totals	**1265**	**971**	**294**	**562**		**58%**

High School Mathematics Teacher Survey

This survey was created and sent to individual teachers within the high school mathematics departments of each of the schools participating in the project. In this survey the teachers were asked to share the number of years of mathematics teaching experience they possessed, as well as the type(s) and level(s) of degrees earned. They were also instructed to list the courses they taught with the names of accompanying textbooks, authors, and copyright dates. Additionally, they were asked questions to gauge personal opinions of mathematical skills necessary for college-bound students, gaps in student mathematics skills between grades 8 and 9, and gaps in student mathematics skills between high school and college. (See Appendix C on page 67 for the High School Mathematics Teachers' Survey.)

Teacher Qualifications

Of the 61 high school mathematics teachers who responded, 51% (31 out of 61) reported having 1-10 years of mathematics teaching experience with 14 out of the 31 having only 1-3 years experience. Twenty percent (12 out of 61) reported having 10-24 years of mathematics teaching experience and 30% (18 out of 61) reported having more than 24 years of mathematics teaching experience.

Of those surveyed, 79% (48 out of 61) reported being certified in secondary mathematics, 13% (8 out of 61) reported having an alternative IV provisional certificate, and 8% (5 out of 61) did not respond to the certification question. Fifty-two percent (32 out of 61) reported earning a minimum of a Bachelor's degree in either mathematics or mathematics education, 20% (12 out of 61) reported earning a minimum of a Master's degree in either mathematics or mathematics education, and one reported earning a PhD in mathematics. Forty-eight percent (29 out of 61) reported earning a minimum of a Bachelor's degree in a related field while 38% (23 out of 61) reported earning a minimum of a Master's degree in a related field. Some of the related degrees include those in the Sciences, Engineering, Special Education, Business, and Technology.

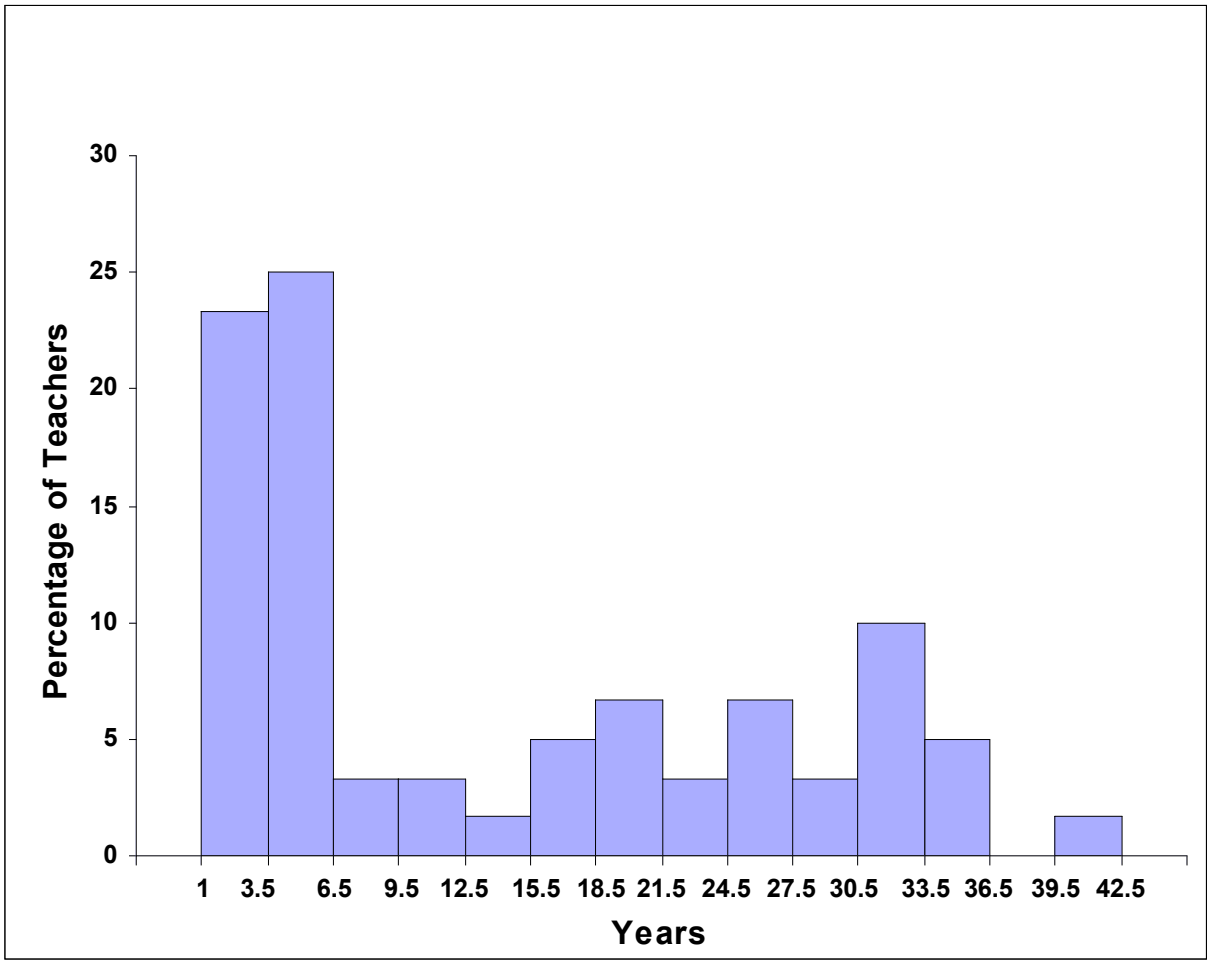
Of those teachers who reported teaching Calculus and/or PreCalculus, 78% possess a Master's degree. This group has a collective average of 25 years mathematics teaching experience and all are certified to teach secondary mathematics. Of those teachers who reported teaching Algebra II and/or Algebra I, slightly less than 60% possess a Master's degree. This group has a collective average of 14 years of mathematics teaching experience and a little over 80% are certified to teach secondary mathematics. Of the Algebra II teachers who responded, 52% hold a bachelor's degree in an area other than mathematics or mathematics education.

The group of teachers who reported teaching Geometry has a collective average of 17 years mathematics teaching experience with 90% of them being certified to teach secondary mathematics. Nearly 60% of these teachers possess a Master's degree. The average number of years of teaching experience for those reported teaching Pre-Algebra was 7.5 years with 75% of them being certified to teach secondary mathematics. None of the pre-algebra teachers possess a Master's degree in mathematics or mathematics education. The graph on page 11 gives a visual display of the respondent's number of years of mathematics teaching.

Discussion of Perceived Gaps

Many high school mathematics teachers identified problem solving skills including reasoning, critical thinking, attention to detail, and number sense as necessary for college-bound students and most reported the need for college-bound students to complete courses in Algebra I, Geometry, and Algebra II to be successful. Perceived gaps between grades 8 and 9 included the lack of student competency in the areas of basic skills, mathematical reasoning, reading comprehension, and problem solving. Perceived gaps between high school and the post secondary level included the lack of student competency in basic skills, mathematical reasoning, communication in a mathematics environment, graphing, statistics/probability, and problem solving.

Number of Years of Mathematics Teaching



High School Mathematics Topics Survey

Each mathematics teacher from the participating schools was asked to complete a topics survey. This survey consisted of a list of topics typically taught in high school courses that was constructed from the Grade Span Expectations (GSEs) issued by the New Hampshire Department of Education. Each teacher was instructed to check the topics from the list that students would be competent in at the end of each course. The survey was divided into the five categories of the GSEs: (1) Number and Operations,(2) Geometry and Measurement, (3) Algebra and Functions, (4) Data, Statistics, and Probability, and (5) Advanced Mathematical Topics. (See Appendix D on page 70 for the High School Mathematics Topics List).

To analyze data from the Mathematics Topics Survey, courses were grouped by type: (1) Calculus-type courses, (2) PreCalculus-type courses, (3) Algebra II-type courses, (4) Geometry-type courses, (5) Algebra I-type courses, and (6) Pre-Algebra-type courses. Courses within these groupings include Advanced Placement (AP), honors, college-preparatory, and foundation level courses.

The Survey Committee created the following questions to help analyze the data from individual courses within each course-type.

1. What topics were covered from the five highlighted areas of the Mathematics Topics Survey?
2. Were these topics ones that you expected to be covered within the specific course?
3. What surprised you?
4. What did you view as a gap?
5. Did you find other interesting and summarizing points?

Data were analyzed from teacher responses with each course type and learner outcomes were developed for each course. The answers to these questions were the basis for the course summaries that follow on pages 13 – 23.

The results from the GSE portion of the survey revealed that there was no consistency in expectations/skills in similarly named courses, nor was there consistency in titles of courses with similar content. In addition, there was a wide range of textbooks driving instruction and content.

Calculus - Type Courses

12 total courses
7 AP Calculus
1 Honors Calculus
4 Calculus

Within **Number and Operations,** 33% of the courses covered "percentages", and "compound percentages" was covered by 50% of the courses. Additionally, "mental calculations" was covered by 33% of the courses, "estimation" at 42%, and "reasonableness of solutions" at 50%.

Within **Geometry and Measurement,** half of the courses covered "using units of measures", "conversions", and "using product measures".

In **Algebra and Functions**, "identifying patterns" was covered in 33% of the courses, "rates of change" was covered in 50% of the courses, and "solving problems that involve how a change in one variable affects the value of another variable" was covered in 42% of the courses. "Solving problems that involve systems of linear equations in context" was covered the same amount of time as "simplifying algebraic expressions" (42%).

Very few items under **Data, Statistics, and Probability** were covered in the Calculus courses. The most frequently covered topics were "solving problems involving experimental or theoretical probability" (25%) and "making predictions" (25%).

In **Advanced Mathematical Topics**, all courses covered "limits of functions", "critical points on a graph", "derivatives of a function", and "integration". However, not all courses covered "iteration of functions" (42%), "inverse functions" (75%), "composite functions" (75%), "families of graphs" (83%), and "curve fitting" (83%). Other topics that were not typically covered include:

- "solving problems involving discrete structures" (25%),
- "linear programming to solve problems" (17%),
- "recurrence" (8%),
- "matrices and determinants" (8%),
- "chaotic behavior of functions" (8%),
- "iterations to explore fractals" (8%), and
- "combinatorics" (0%).

Perceived Gaps:

- The fact that several key topics were reported as not taught 100% of the time in the **Algebra and Functions** section does not reflect the extent to which algebra is needed in a Calculus course. It was surprising that all students were not receiving instruction in "identifying patterns", "rates of change", "solving prob-

lems that involve how a change in one variable affects the value of another variable", and "solving problems that involve systems of equations".

- The topics of "solving problems that involve systems of linear equations in context" and "simplifying algebraic equations" were covered in the same amount (42%).

- Not all courses covered "iteration of functions" (42%), "inverse functions" (75%), "composite functions" (75%), "families of graphs" (83%), and "curve fitting" (83%).

Points of Interest:

- As expected, all Calculus - type classes covered "limits of functions", "critical "points on a graph", "calculation of area under a curve", "derivatives of a function", and "integration". However, "iteration of functions" (42%), "inverse functions" (75%), "composite functions" (75%), "families of graphs" (83%), and "curve fitting" (83%) were not covered by all Calculus - type offerings surveyed.

- As expected very few items under **Data, Statistics, and Probability** were covered in the Calculus courses. The most frequently covered topics were "solving problems involving experimental or theoretical probability" and "making predictions" which were covered in 25% of the courses.

- It was surprising that 33% of the courses covered "percentages" and that "compound percentages" was covered by 50% of the courses.

- Coverage of "mental calculations" (33%), "estimation" (42%), and "reasonable-"ness of solutions" (50%) were lower than was expected.

PreCalculus - Type Courses

11 total courses 11 PreCalculus

In the **Number and Operations** section, coverage of all the basic math skills occurred in at least 20% of the courses. The topics of "irrational numbers", "rational bases with integer exponents", and "absolute value" were covered in at least two thirds of the classes.

Within **Geometry and Measurement**, the topic "lines (parallel, perpendicular, skew, midpoint on line segment)" was covered in 27% of the courses.

Every topic within **Algebra and Functions** was covered within at least 36% of the courses, including "generalizing a nonlinear relationship". "Evaluating algebraic expressions", "solving multi-step linear equations (symbolically and graphically), inequalities, and quadratic equations and providing the meaning of the graphical interpretations of the solutions", and "solving problems that involve how change in one variable affects the value of another variable" were covered in 45% of the courses.

Within the **Data, Statistics, and Probability** section, very few topics were covered. For example, "collecting and organizing data" was covered in 18% of the courses while "scatterplots/regression equations" were not covered in any of the courses.

In the **Advanced Mathematical Topics** section "linear equations" and "systems of equations" were covered in 100% of the courses and "inverse functions" was covered in 90% of the courses.

Perceived Gaps

- There did not seem to be specific gaps overall. Most of the courses covered topics that would be expected to be taught within a PreCalculus - type course.

Points of Interest

- More topics from the **Geometry and Measurement** section were taught than was expected. It was surprising to see that one third of the courses covered "perimeter", "circumference" and "area", while one fourth of the courses covered "congruency", "similarity", "volume and surface area", and "constructions".

- "Limits" (54%) and "rates of change" (72%) were covered in more courses than expected.

Algebra II – Type Courses

22 total courses
4 Honors Algebra II
18 Algebra II

Within **Number and Operations**, the most frequently covered topics were "square roots" (91%), "absolute value" (91%), "irrational numbers" (86%), "integers" (77%), and "rational bases with integer exponents" (77%). Estimation topics were covered less frequently. For example, "methods of estimating" was covered in 14% of the courses and "evaluating the reasonableness of solutions" was covered in 50% of the courses.

Many topics within the **Geometry and Measurement** section were not covered in the Algebra II courses. Topics that were covered included "using units of measure appropriately" (32%), "conversions within or across systems" (14%), and "using measurement conversion strategies" (23%).

The following topics from the **Algebra and Functions** section were covered:

- "translating problem situations into algebraic expressions"(95%),
- "solving problems involving algebraic expressions" (95%),
- "linear relationships and linear and non-linear functions" (95%),
- "identifying and extending to specific cases a variety of patterns" (91%),
- "algebraic expressions by evaluating or simplifying expressions" (91%),
- "working flexibly between and among different representation of functions" (91%),
- "translating problem situations into equations or inequalities" (91%),
- "solving problems involving systems of linear equations in context" (86%), and
- "equality by using models or different representation of expressions" (86%).

Most of the topics in **Data, Statistics, and Probability** were not covered. It was reported that "scatterplots" (27%), "solving problems involving experimental or theoretical probability of events" (14%), and "making predictions, asking questions or making connections to real world situations" (14%) were covered.

In **Advanced Mathematical Topics**, "linear equations and systems of equations" was covered in only 86% of the courses, while "linear programming" was covered in 64% of the Algebra II - type courses.

Perceived Gaps

- Surprisingly, "methods of estimating" was only covered in 14% of the courses.

- Evaluating the "reasonableness of solutions" was only covered in 50% of the courses. This is a topic that would be expected to be covered in all Algebra II - type courses.

Points of Interest

- Although the following topics were reported as covered in more than 85% of the courses, it is disappointing that these topics were not covered in 100% of the Algebra II - type courses.
  - "translating problem situations into algebraic expressions",
  - "solving problems involving algebraic expressions",
  - "linear relationships and linear and non-linear functions",
  - "identifying and extending to specific cases a variety of patterns",
  - "algebraic expressions by evaluating or simplifying expressions",
  - "working flexibly between and among different representation of functions",
  - "translating problem situations into equations or inequalities",
  - "solving problems involving systems of linear equations in context", and
  - "equality by using models or different representation of expressions".

- There does not seem to be a core set of topics that all the Algebra II - type courses cover. Some seem to cover topics that traditionally are not covered in Algebra II - type courses.

Geometry – Type Courses

23 total courses 2 Honors Geometry 21 Geometry

Within **Number and Operations,** the most frequently taught topics were "square roots" (70%), "integers" (61%), "problems with proportions and percents" (61%), and "common irrational numbers" (57%). The topic, "reasonableness of a solution", was covered in 30% of the Geometry courses surveyed.

In **Geometry and Measurement**, most topics were covered in all the courses. "Circles" was not covered in 2 of the 23 courses, "right triangle ratios" was not covered in 1 of the 23 courses, and "applying congruency" was not covered in 7 of the 23 courses. The less frequently covered topics included "conversions within or across systems" (39%), "knowing the appropriate degree of accuracy in problem solving" (35%), "using measurement conversion strategies, such as unit/dimensional analysis" (22%), and "using product measures, such as person hours, to solve problems" (4%).

Within the **Algebra and Functions** section, very few topics were included. The most common topics were "generalizing a linear relationship" (26%) and "translating problem situations into algebraic expressions" (26%).

In **Data, Statistics, and Probability**, the most frequent topic was "making predictions or connections to real-world situations" (13%). The topics of "scatterplots" and "counting techniques" were also included in several of the Geometry courses.

Within the **Advanced Mathematical Topics** section, very few topics were covered by the Geometry courses. A few topics that were identified were primarily by teachers of honors courses. "Systems of equations" was taught in 22% of the Geometry courses, and "linear equations" was taught in 30% of the courses.

Perceived Gaps

- Only 30% of the Geometry - type courses included the topic, "reasonableness of solutions".

- Topics that students are likely to use in mathematical applications were taught a smaller percentage of the time. These topics included "conversions within or across systems" (39%), "knowing the appropriate degree of accuracy in problem solving" (35%), "using measurement conversion strategies, such as unit/dimensional analysis" (22%), and "using product measures, such as person hours, to solve problems" (4%).

Points of interest

- It was surprising to see the topics of “scatterplots” and “counting techniques” included in several of the Geometry courses.

- Two unexpected topics were “systems of equations”, which was taught in 22% of the courses, and “linear equations” which was taught in 30% of the courses.

Algebra I – Type Courses

32 total courses
6 Honors Algebra I
26 Algebra I

Most items from **Number and Operations** were covered in 65% or more of the classes. The following important topics were not covered as consistently:

- "estimating part of a number using percents" (58%),
- "mentally calculating benchmark perfect squares and related roots" (55%),
- "numbers represented in scientific notation using number lines" (52%),
- "direct and inverse variation" (52%),
- "demonstrating conceptual understanding of field properties as they apply to the set of real numbers" (45%),
- "estimation when appropriate" (42%),
- "selecting appropriate method of estimation" (39%),
- "determine level of accuracy" (39%),
- "estimating value of non-perfect square root or cube root between two whole numbers" (32%), and
- "analyze effect of estimation" (29%).

Most topics from the **Geometry and Measurement** section were not covered consistently. Several topics that were often covered included "perimeter" (68%), "Pythagorean Theorem" (48%), and "area of two-dimensional figures" (45%). "Using units of measures appropriately and consistently when solving problems across the content strands" was not covered as often (26%).

In **Algebra and Functions**, the following algebra topics were not taught in 100% of the courses:

- "algebraic expressions by evaluating or simplifying" (87%),
- "identifying and extending patterns" (84%),
- "translating problem situations into algebraic expressions" (84%),
- "generalizing a linear relationship" (74%), and
- "translating problem situations into equations or by writing equivalent forms of formulas" (71%).

In **Data, Statistics, and Probability**, all of the topics listed were taught in less than 39% of the courses, with the exception of "scatterplots or regression lines" (55%). The most frequently covered topics were: "using measures of central tendency" (39%), "interpret and analyze differences and similarities between data sets" (39%), "solve problems involving experimental or theoretical probability of an event" (39%), and "collect, organize, and display data" (39%).

Within the **Advanced Mathematical Topics** section, “linear equations” (61%), “systems of equations” (48%), and “relations” (23%) were covered in the Algebra I courses.

Perceived Gaps

- It was expected that topics of estimation would have been covered at a higher percentage in the courses. The following topics were covered in less than 50% of the courses, “estimation when appropriate” (42%), “selecting appropriate method of estimation” (39%), and “analyze effect of estimation” (29%).

- It was surprising that “reasonableness of solutions”, “word problems”, and “linear equations” were not consistently covered in all the courses.

Points of Interest

- The following topics that are traditionally considered to be Pre-Algebra topics were covered in 80% of all the Algebra I - type courses.
  - “absolute values”,
  - “integers”,
  - “relative magnitude of real numbers by ordering or comparing”,
  - “proportions and percents”,
  - “equality and inequality symbols”,
  - “algebraic expressions by evaluating or simplifying expressions”,
  - “rational bases with integer exponents”,
  - “identifying and extending to specific cases a variety of patterns”, and
  - “translating problem situations into algebraic situations”.

- The following topics that are considered to be statistical areas were covered in an Algebra I course:
  - “using measures of central tendency”,
  - “interpret and analyze difference and similarities between data sets”,
  - “solve problems involving experimental or theoretical probability of an event”
  - “collect, organize, and display data”.

Pre-Algebra - Type Courses

3 total courses
1 Topics in Mathematics
2 Pre-Algebra

Within the **Number and Operations** section**,** 66% of the courses covered 27 of the 29 topics. The two topics of "applying properties of numbers to solve problems and to simplify computations" and "demonstrating conceptual understanding of field properties as they apply to the set of real numbers" were taught in 33% of the courses.

In **Geometry and Measurement**, 15% of the topics were covered in all the courses: "lines (parallel, perpendicular, skew, midpoint on line segment)", "perimeter", "circumference", and "area of two-dimensional figures". One of the three courses covered 55% of these geometry topics.

Within the **Algebra and Functions** section, one of the courses covered 8 of the 14 topics (57%). Six of the fourteen topics were covered in two of the courses. These topics were:

- "identifying and extending to specific cases a variety of patterns (linear and nonlinear)",
- "generalizing a linear relationship",
- "generalizing a nonlinear relationship using words or symbols",
- "working flexibly between and among different representations of functions",
- "algebraic expressions by evaluating or simplifying expressions", and
- "translating problem situations into equations or inequalities, or by writing equivalent forms of formulas".

Within the **Data, Statistics, and Probability** section, there was one topic that all 3 courses covered, "solving problems involving experimental or theoretical probability of an event".

Most topics in **Advanced Mathematical Topics** were not covered. However, one course did cover "the factor and remainder theorem to factor polynomials".

Perceived Gaps

- Only one of the courses titled *Pre-Algebra* covered the "impact of scale on linear and area concepts," a topic one might have expected in all the courses.

- Overall, it was surprising that only one course expected students to "apply properties of numbers to solve problems", to "simplify computations", and to "demonstrate" an understanding of field properties such as additive and multiplicative inverses".

- It was surprising that “reasonableness of solutions” was not covered consistently in all the courses.

Points of interest

- Only one course covered “circles”, but all three said they covered “circumference”.

- The two courses titled *Pre-Algebra* covered the “Pythagorean Theorem” and “right triangle ratios”, whereas the course titled *Topics in Mathematics* did not. From the titles, one might have expected it to be the opposite.

- Only the course titled *Topics in Mathematics* covered “using units of measures appropriately and consistently when solving problems across the content strands” but it was expected that all the Pre-Algebra - type courses would be covering this topic since they all indicated that they include instruction in perimeter, circumference, and area.

- “Applying properties of numbers to solve problems and to simplify computations” and “demonstrating conceptual understanding of field properties as they apply to the set of real numbers” are topics that may be more appropriate in an Algebra I - type course.

- Surprisingly, one of the three courses covered 55% of the topics listed in the **Geometry and Measurement** section.

- It was surprising that one course covered “the factor and remainder theorem to factor polynomials”.

Learner Outcomes

To further analyze the survey data, the Survey Committee developed learner outcomes for each course-type. The purpose was to identify essential outcomes that should be covered in each course-type as well as to provide a guide for teachers to follow to create consistency among courses. Using these outcomes, the Committee was able to map corresponding topics from the Mathematics Topics Survey. The percentage of classes of each course-type that covered each of these topics was compiled. From these percentages, the Committee determined whether these outcomes were met. A discussion of each course-type follows.

In the Calculus-type courses there were five learner outcomes. These are listed on page 26. Four of the five outcomes seemed to be met. The one that was not met according to the data reported was "interpret the attributes of linear and nonlinear functions numerically, algebraically, and graphically using technology. The topics mapped to this outcome were "average and variable rates of change; including solving problems within mathematics and across disciplines and contexts using appropriate technology," and "working flexibly between and among different representations of functions." They were covered by 50% and 58% of the teachers respectively.

In the PreCalculus-type courses there were four learner outcomes. These are listed on page 30. Three of the four outcomes seemed to be met. The one that was not met according to the data reported was "symbolically represent functional transformations." The topics mapped to this outcome were "applying the concepts of congruency by solving problems on or off a coordinate plane involving reflections, translations, or rotations," "applying concepts of similarity by determining the effect of changing a scale factor on similar figures," and "the impact of scale on linear and area concepts." They were covered by 22%, 18%, and 18% of the teachers respectively. One reason for these low percentages could be explained by the location of the topics in the survey. These topics appeared in the geometry section. Perhaps the teachers teaching PreCalculus-type courses did not consider the topics in the geometry section.

In the Algebra II-type courses there were six learner outcomes. These are listed on page 34. Five of the six outcomes seemed to be met. The outcome that was not met according to the data reported was "identify arithmetic and geometric sequences (general and recursive forms)." A primary reason for this omission was that there was not a topic on the survey that specifically stated arithmetic and geometric sequences. Instead the topic that was mapped to this outcome was "recurrence" and only 5% of the teachers reported covering this topic. Perhaps this terminology was misunderstood or it was overlooked because it appeared in the advanced mathematical topics section of the survey.

In the Geometry-type courses there were eleven learner outcomes. These are listed on pages 38-39. All appear to be met with the exception of "use technology to construct and/or validate properties of geometric figures" because teachers reported using technology for two-dimensional figures (83%) more than three-dimensional figures (48%).

In the Algebra I-type courses there were six learner outcomes. These are listed on page 47. None of the outcomes seemed to be met. This was perhaps due to the fact that this grouping of courses ranged from Honors Algebra I to General Algebra I.

In the Pre-Algebra-type courses there were nine learner outcomes. These are listed on page 52. Due to the fact that only three teachers reported on these courses, no conclusions could be made on whether these outcomes were met.

The data described above represents the percentage of classes that covered each topic aligned with each of the learner outcomes. The Survey Committee decided to investigate further and determine how many courses covered none, one, two, three, etc. of the topics aligned with a specific outcome. This gave the Committee further insight into exactly what topics were being covered. The analysis and alignment of these topics appears after each of the courses learner outcomes, starting on page 27.

Learner Outcomes for Calculus – Type Courses

At the completion of the course, the learner will demonstrate the ability to:

1. Interpret the attributes of linear and nonlinear functions numerically, algebraically, and graphically using technology.
   Suggested topics include:
   a. rates of change/slope
   b. continuity/discontinuity
   c. asymptotes
   d. end behavior

2. Define and calculate limits for function values.
   Suggested topics include:
   a. instantaneous rates of change
   b. informal definition of limit
   c. numerical limits to values of functions
   d. properties of limits
   e. one-sided and two-sided limits
   f. Sandwich Theorem
   g. continuity/discontinuity as related to limits

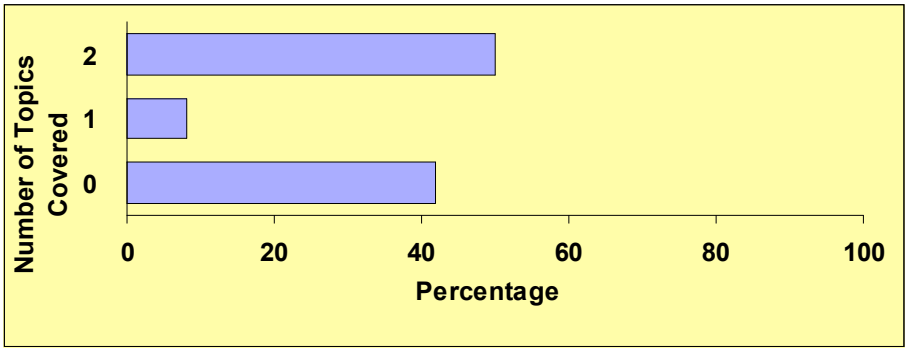
3. Find and interpret the derivative.
   Suggested topics include:
   a. the derivative as a limit
   b. instantaneous rate of change as the slope
   c. the first derivative rules, including constant, constant multiple, sum, chain, product, power, and quotient
   d. the derivative at a point

4. Use derivatives to analyze functions and to solve problems.
   Suggested topics include:
   a. maximum and minimum values
   b. increasing or decreasing functions
   c. inflection points
   d. curve sketching
   e. optimization problems from engineering or non-engineering fields
   f. related rates

5. Find and interpret the anti-derivative of a function.
   Suggested topics include:
   a. approximate, label, and interpret the area of a region
   b. the integral as a limit
   c. algebraic anti-derivatives of functions
   d. definite and indefinite integrals
   e. Fundamental Theorem of Calculus
   f. integration by substitution

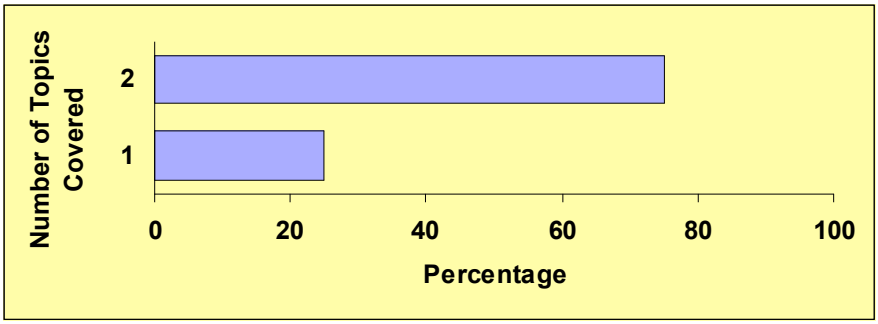
Alignment and Analysis of Topics in Calculus - Type Courses

The following table includes the topics the Survey Committee aligned with the Calculus-type learner outcomes. The data were analyzed and the graphs were created to illustrate gaps among topics teachers reported as covered.

Calculus Learner Outcome	Topic from the Mathematics Topics Survey
1. Interpret the attributes of linear and nonlinear functions numerically, algebraically, and graphically using technology.	▪ average and variable rates of change; including solving problems within mathematics and across disciplines and contexts using appropriate technology ▪ working flexibly between and among different representations of functions (graphs, tables, equations, function notation)
The graph below shows that 42% of the classes did not cover any of the topics, 8% covered one, and 50% covered both topics. 	
2. Define and calculate limits for function values.	limits of functions
All of the classes covered this topic.	

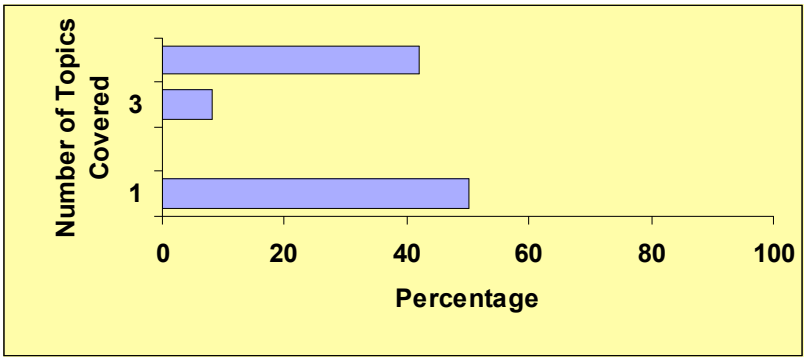
Calculus Learner Outcome	Topic from the Mathematics Topics Survey
3. Find and interpret the derivative.	▪ derivatives of a function ▪ composite functions

The graph below shows that 25% of the classes covered 1 topic and 75% of the classes covered both topics.



4. Use derivatives to analyze functions and to solve problems.	▪ linear relationships and linear and non-linear functions (including characteristics of classes of functions) through analysis of slope, intercepts, domain, range, maximum and minimum values or constant ▪ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s) ▪ solving problems that involve how a change in one variable affects the value of another variable ▪ critical points on a graph (maximum, minimum, points of inflection)

See the next page for the graph pertaining to these topics.

Calculus Learner Outcome	Topic from the Mathematics Topics Survey
The graph below shows that 50% of the classes covered only one topic, 8% covered three, and 42% covered all of the topics.  	
5. Find and interpret the anti-derivative of a function.	▪ the calculation of the area under a curve ▪ integration
All classes covered both of these topics.	

Learner Outcomes for PreCalculus - Type Courses

At the completion of the course, the learner will demonstrate the ability to:

1. Solve equations algebraically and graphically with technology.
   Suggested types of equations:
   a. linear
   b. quadratic
   c. rational
   d. polynomial
   e. radical
   f. exponential
   g. logarithmic
   h. trigonometric

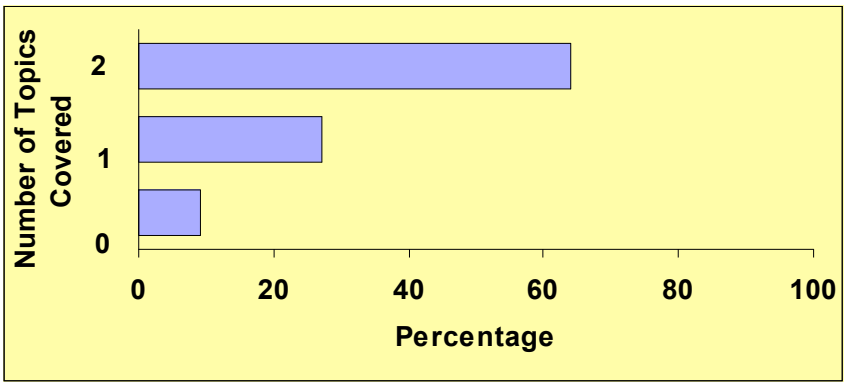
2. Describe the characteristics of functions.
   Suggested topics include:
   a. domain and range
   b. intercepts
   c. symmetry
   d. vertical and horizontal line tests
   e. one-to-one in conjunction with invertibility of a function
   f. horizontal and vertical asymptotes
   g. end behavior
   h. extrema (maximа and minima)
   i. regions of functional increase and decrease

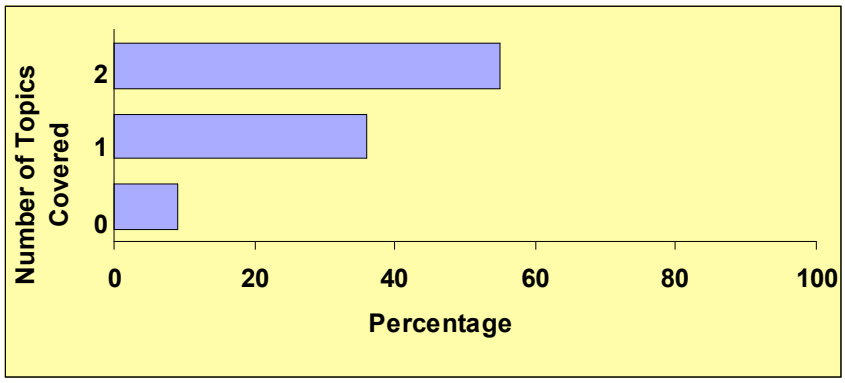
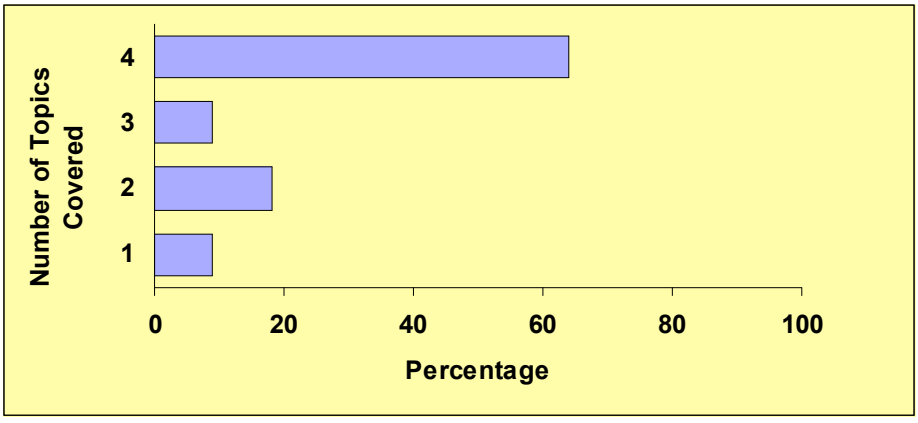
3. Represent, evaluate, graph, interpret, and relate functions.
   Suggested structures to be analyzed:
   a. sum, difference, product, and quotient
   b. composition
   c. piecewise-defined
   d. power
   e. linear
   f. quadratic
   g. rational
   h. polynomial
   i. radical
   j. exponential
   k. logarithmic
   l. trigonometric

4. Symbolically represent functional transformations.
   Suggested topics include:
   a. translations in x and y directions
   b. reflections about the x and y axes
   c. scaling (dilations and contractions)
   d. combinations of the above transformations

Alignment and Analysis of Topics in PreCalculus- Type Courses

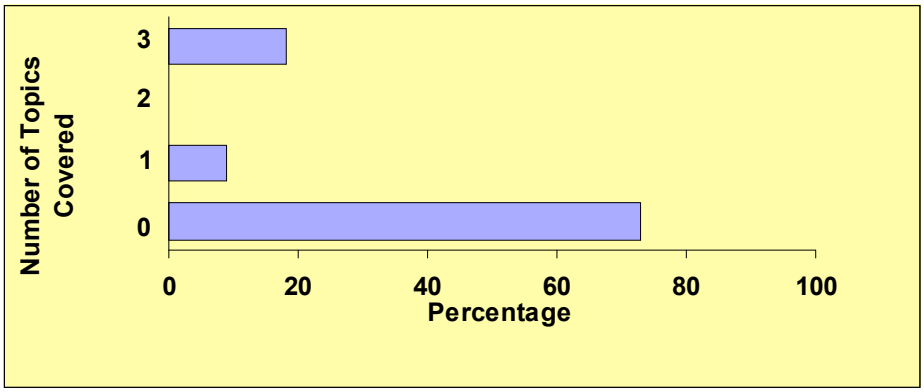
The following table includes the topics the Survey Committee aligned with the PreCalculus-type learner outcomes. The data were analyzed and the graphs were created to illustrate gaps among topics teachers reported as covered.

PreCalculus Learner Outcome	Topic from the Mathematics Topics Survey
1. Solve equations algebraically and graphically with technology.	▪ solving problems involving algebraic expressions (polynomial, rational, integer exponents, square roots, or absolute values) ▪ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s)
The graph below shows that 9% of the classes did not cover any of the topics, 27% covered one topic, and 64% covered both. 	
2. Describe the characteristics of functions.	▪ linear relationships and linear and non-linear functions (including characteristics of classes of functions) through analysis of slope, intercepts, domain, range, maximum and minimum values or constant ▪ critical points on a graph (maximum, minimum, points of inflection)
See the next page for the graph pertaining to these topics.	

PreCalculus Learner Outcome	Topic from the Mathematics Topics Survey
	The graph below shows that 9% of the classes did not cover any of the topics, 36% covered one of the topics, and 55% covered both topics. 
3. Represent, evaluate, graph, interpret, and relate functions.	▪ working flexibly between and among different representations of functions (graphs, tables, equations, function notation) ▪ inverse functions ▪ composite functions ▪ families of graphs
	The graph below shows that 9% of the classes covered one of the topics, 18% covered two of the topics, 9% covered three of the topics, and 64% covered all of the topics. 

PreCalculus Learner Outcome	Topic from the Mathematics Topics Survey
4. Symbolically represent functional transformations.	▪ applying the concepts of congruency by solving problems on or off a coordinate plane involving reflections, translations, or rotations ▪ applying concepts of similarity by determining the effect of changing a scale factor on similar figures ▪ the impact of scale on linear and area concepts

The graph below shows that 73% of the classes did not cover any of the topics, 9% covered one of the topics, and 18% of the classes covered all of the topics.



Learner Outcomes for Algebra II - Type Courses

At the completion of the course, the learner will demonstrate the ability to:

1. Identify arithmetic and geometric sequences (general and recursive forms).

2 Identify and extend to specific cases a variety of linear and nonlinear patterns represented in models, tables, sequences, graphs, or in problem situations.

3. Perform a variety of algebraic manipulations.
   Suggested topics include:
   a. evaluate and simplify algebraic expressions
   b. add, subtract, multiply, and divide polynomials and rationals
   c. expressions
   d. factor quadratic and some higher degree polynomials
   e. apply properties of logarithms
   f. manipulate, evaluate, and simplify expressions involving rational exponents and radicals and convert between the two
   g. simplify rational expressions and explain the effect on the domain of the related functions

4. Solve quadratic equations.
   Suggested methods include:
   a. factoring
   b. completing the square
   c. using the quadratic formula
   d. graphing

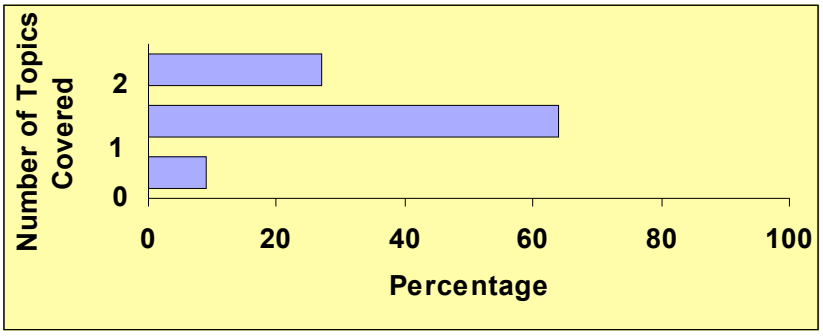
5. Solve equations involving polynomial, rational, and radical expressions.
   Suggested methods include:
   a. algebraic techniques
   b. approximate solutions by graphing

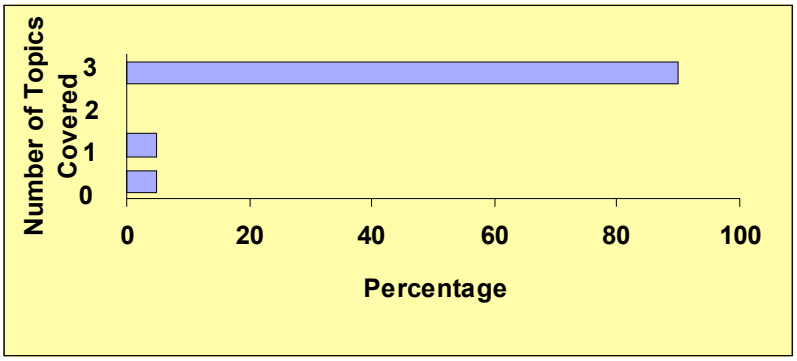
6. Solve systems of equations and inequalities.
   Suggested methods include:
   a. algebraic techniques
   b. approximate solutions by graphing
   c. matrices

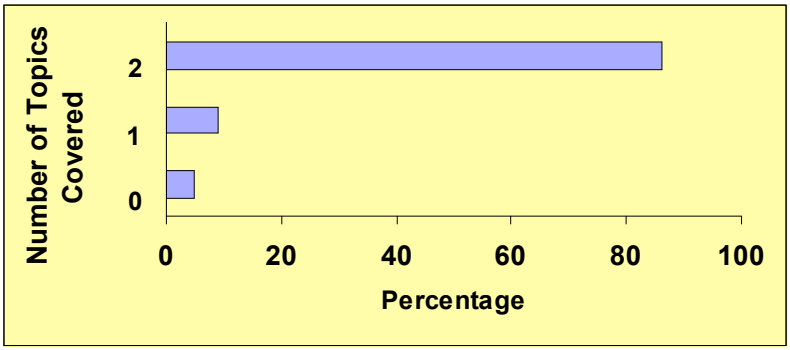
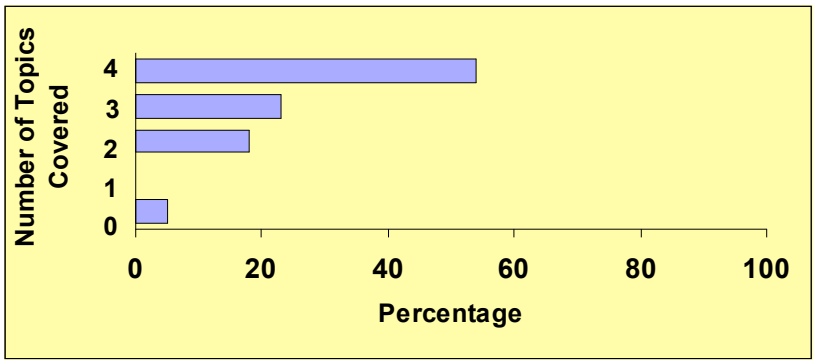
Alignment and Analysis of Topics in Algebra II - Type Courses

The following table includes the topics the Survey Committee aligned with the Algebra II-type learner outcomes. The data were analyzed and the graphs were created to illustrate gaps among topics teachers reported as covered.

Algebra II Learner Outcome	Topic from the Mathematics Topics Survey
1. Identify arithmetic and geometric sequences (general and recursive forms).	▪ recurrence
Only 4% of the classes covered this topic.	
2. Identify and extend to specific cases a variety of linear and nonlinear patterns represented in models, tables, sequences, graphs, or in problem situations.	▪ identifying and extending to specific cases a variety of patterns (linear and nonlinear) represented in models, tables, sequences, graphs, or in problem situations ▪ scatter plots or regression lines representing distributions of data by informally estimating and interpreting correlation coefficients as strong positive, strong negative or no correlation and providing explanations about the meaning of that value in context of the data
The graph below shows that 9% of the classes did not cover any of the topics, 64% covered one topic, and 27% covered both topics.	



Algebra II Learner Outcome	Topic from the Mathematics Topics Survey
3. Perform a variety of algebraic manipulations.	▪ algebraic expressions by evaluating or simplifying expressions (including expressions within an equation(s) ▪ solving problems involving algebraic expressions (polynomial, rational, integer exponents, square roots, or absolute values) ▪ translating problem situations into equations or inequalities, or by writing equivalent forms of formulas
The graph below shows that 5% of the classes did not cover any of the topics, 5% covered one topic, and 90% covered all the topics.  	
4. Solve quadratic equations.	▪ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s)
Fourteen percent of the classes did not cover this topic.	
5. Solve equations involving polynomial, rational, and radical expressions.	▪ solving problems involving algebraic expressions (polynomial, rational, integer exponents, square roots, or absolute values) ▪ linear equations
See the next page for the graph pertaining to these topics.	

Algebra II Learner Outcome	Topic from the Mathematics Topics Survey
	The graph below shows that 5% of the classes did not cover any of the topics, 9% covered one topic, and 86% of the classes covered both topics. 
6. Solve systems of equations and inequalities.	▪ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s) ▪ solving problems involving systems of linear equations in a context (using equations or graphs) ▪ systems of equations ▪ matrices and determinants
	The graph below shows that 5% of the classes did not cover any of the topics, 18% covered two topics, 23% covered three of the topics, and 54% covered all the topics. 

Learner Outcomes for Geometry – Type Courses

At the completion of the course, the learner will demonstrate the ability to:

1. Solve problems involving two-dimensional figures.
   Suggested topics include:
   a. perimeter
   b. area

2. Use two-dimensional representations of three-dimensional objects to visualize and solve problems.
   Suggested topics include:
   a. surface area
   b. volume
   c. cross sections

3. Analyze the characteristics of and distinguish among various types of polygons.
   Suggested topics include:
   a. triangles
   b. quadrilaterals
   c. n-gons

4. Define, analyze, and apply the properties of points, lines, and planes.
   Suggested topics include:
   a. collinear and noncollinear points
   b. line segments, length, and distance
   c. rays, angles, and angle measures
   d. parallel, intersecting, perpendicular, and skew lines
   e. planes

5. Define, analyze, and apply the properties of circles.
   Suggested topics include:
   a. radius, diameter, and circumference
   b. central angles, inscribed angles, and arcs
   c. chords, secants, and tangents

6. Apply geometric properties and relationships to solve problems using the coordinate plane and concepts from algebra.
   Suggested topics include:
   a. distance formula
   b. midpoint formula
   c. slope formula
   d. Triangle Inequality Theorem

7. Use transformations to move figures and/or demonstrate geometric properties.
    Suggested topics include:
        a. translations
        b. reflections
        c. rotations
        d. dilations
        e. symmetry
        f. congruence
        g. similarity
        h. orientation

8. Use technology to construct and/or validate properties of geometric figures.

9. Solve problems using right triangles.
    Suggested topics include:
        a. Pythagorean Theorem
        b. right triangle ratios (sine, cosine, tangent)

10. Formulate, test, and validate geometric conjectures and construct geometric arguments.
    Suggested topics include:
        a. inductive reasoning
        b. deductive reasoning
        c. counterexamples
        d. proofs (formal, informal, direct, and indirect)

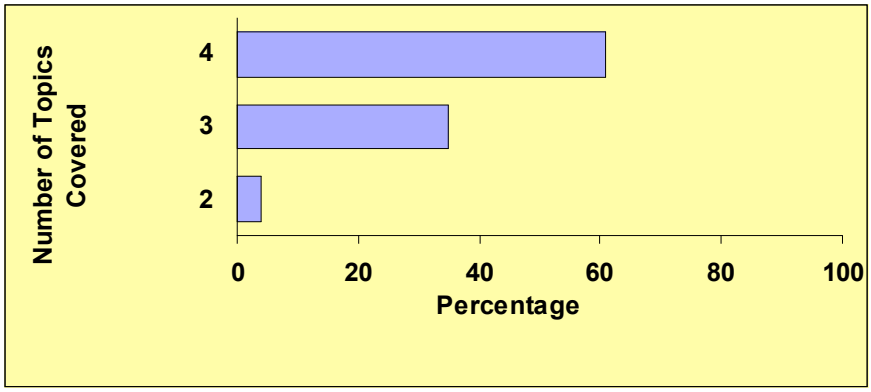
11. Apply the concept and strategies of measurement.
    Suggested topics include:
        a. unit conversion/dimensional analysis
        b. systems of measurement
        c. precision and error

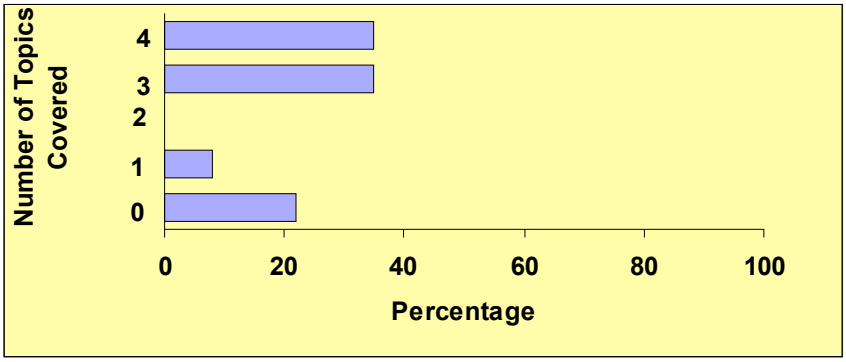
Alignment and Analysis of Topics in Geometry - Type Courses

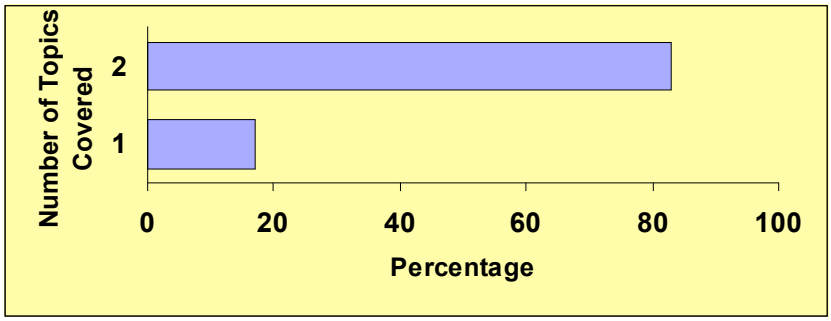
The following table includes the topics the Survey Committee aligned with the Algebra II-type learner outcomes. The data were analyzed and the graphs were created to illustrate gaps among topics teachers reported as covered.

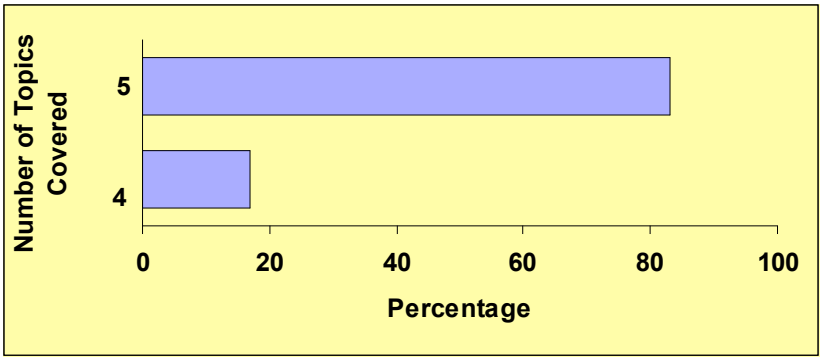
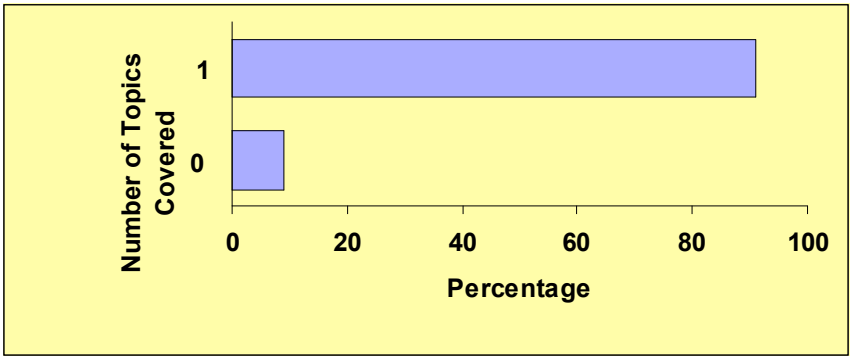
Geometry Learner Outcome	Topic from the Mathematics Topics Survey
1. Solve problems involving two-dimensional figures.	▪ the volume or surface area measures of two and three-dimensional figures when linear and area measures are multiplied by a constant ▪ perimeter ▪ circumference ▪ area of two-dimensional figures (including composite figures) in problem solving situations on or off a coordinate graph

The graph below shows that 4% of the classes covered two of the topics, 35% covered three, and 61% covered all of the topics.



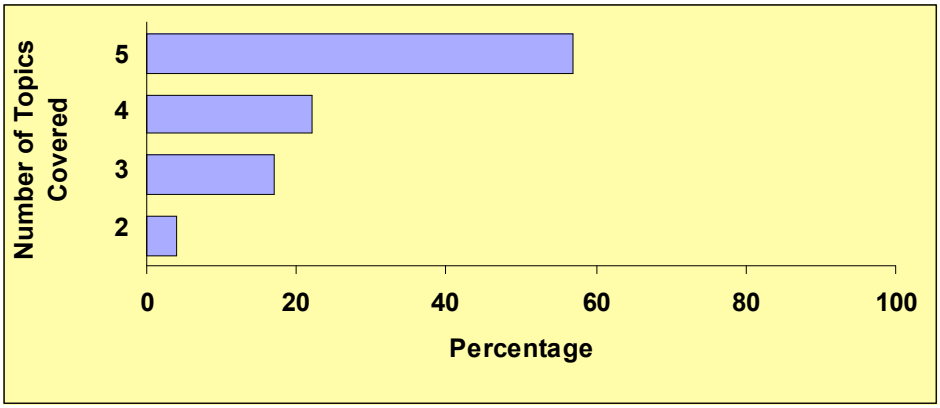
Geometry Learner Outcome	Topic from the Mathematics Topics Survey
2. . Use two-dimensional representations of three-dimensional objects to visualize and solve problems.	▪ the volume or surface area measures of two and three-dimensional figures when linear and area measures are multiplied by a constant ▪ surface area or volume of prisms, cylinders, cones, pyramids, and spheres (including composite figures) by solving problems involving and using appropriate units of measure ▪ models to generalize formulas for the perimeter and area of two-dimensional polygonal figures and circles (including composite figures) or surface area or volume of prisms, cylinders, cones, pyramids) ▪ understanding of spatial reasoning and visualization by sketching or using dynamic geometric software to generate three-dimensional objects or orthogonal views (projections and isometric views)
The graph below shows that 22% of the classes did not cover any of the topics, 8% covered one topic, 35% covered three topics, and 35% covered all of the topics. 	
3. Analyze the characteristics of and distinguish among various types of polygons.	▪ polygons ▪ the constructions or representations of angle bisectors, perpendicular lines (including bisectors, and from a point not on the line), congruent segments, parallel lines, regular polygons, isosceles triangles, inscribing and circumscribing figures using appropriate tools, coordinate geometry or dynamic geometric software and solving related problems
See the next page for the graph pertaining to these topics.	

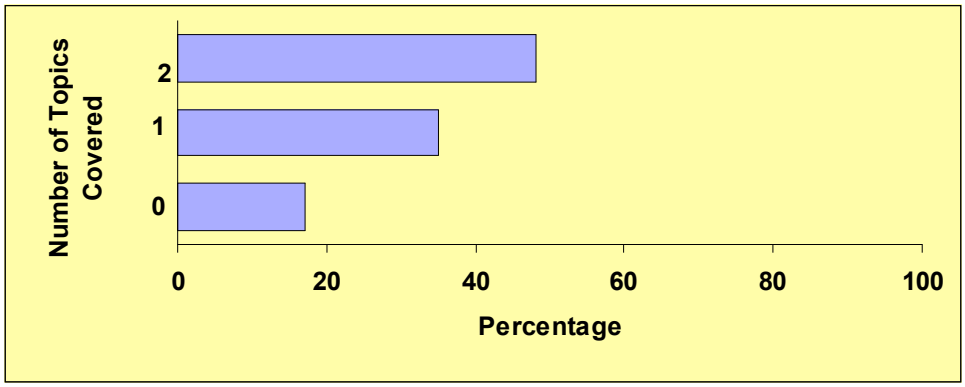
Geometry Learner Outcome	Topic from the Mathematics Topics Survey
The graph below shows that 17% of the classes covered one topic and 83% covered both topics.  	
4. Define, analyze, and apply the properties of points, lines, and planes.	▪ geometric properties, or theorems involving angles (vertical, straight, right, complementary, supplementary, linear pair, angle bisector) ▪ lines (parallel, perpendicular, skew, midpoint on line segment ▪ solving problems involving missing lengths and angles of polygons using similarity, including problems within mathematics and across disciplines and contexts using appropriate technology ▪ solving problems on and off the coordinate plane involving distance, midpoint, perpendicular and parallel lines, and slope ▪ understanding of spatial reasoning and visualization by sketching or using dynamic geometric software to generate three-dimensional objects or orthogonal views (projections and isometric views)
See the next page for the graph pertaining to these topics.	

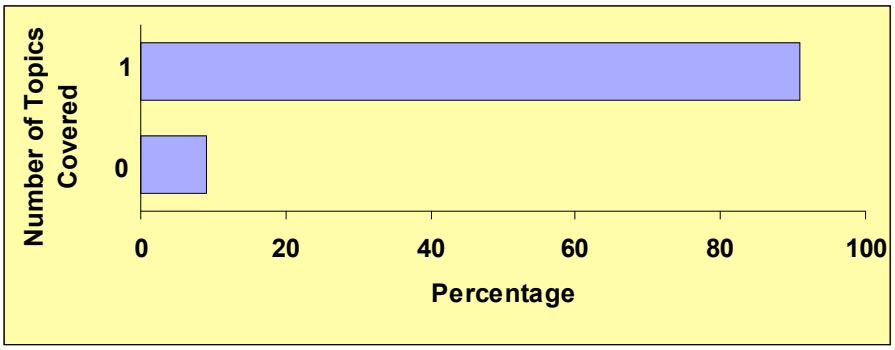
Geometry Learner Outcome	Topic from the Mathematics Topics Survey
The graph below shows that 17% of the classes covered four of the topics and 83% covered all of the topics.  	
5. Define, analyze, and apply the properties of circles.	circles (radii, arcs, diameters, central angles, segments)
The graph below shows that 9% of the classes did not cover this topic and 91% of the classes covered it.  	
6. Apply geometric properties and relationships to solve problems using the coordinate plane and concepts from algebra.	▪ the Triangle Inequality Theorem ▪ solving problems on and off the coordinate plane involving distance, midpoint, perpendicular and parallel lines, and slope
All of the classes covered these topics.	

Geometry Learner Outcome	Topic from the Mathematics Topics Survey
7. Use transformations to move figures and/or demonstrate geometric properties.	▪ applying the concepts of congruency by solving problems on or off a coordinate plane involving reflections, translations, or rotations ▪ solving problems using congruency involving problems within mathematics, across disciplines, and contexts using appropriate technology (e.g., paper, pencil, calculator, computer) ▪ applying concepts or similarity by determining the effect of changing a scale factor on similar figures ▪ the impact of scale on linear and area concepts ▪ the volume or surface area measures of two and three-dimensional figures when linear and area measures are multiplied by a constant

The graph below shows that 4% of the classes cover 2 of the topics, 17% covered three, 22% covered 4, and 57% covered all of the topics.



Geometry Learner Outcome	Topic from the Mathematics Topics Survey
8. Use technology to construct and/or validate properties of geometric figures.	▪ understanding of spatial reasoning and visualization by sketching or using dynamic geometric software to generate three-dimensional objects or orthogonal views (projections and isometric views) ▪ the constructions or representations of angle bisectors, perpendicular lines (including bisectors, and from a point not on the line), congruent segments, parallel lines, regular polygons, isosceles triangles, inscribing and circumscribing figures using appropriate tools, coordinate geometry or dynamic geometric software and solving related problems
The graph below shows that 17% of the classes did not cover any of the topics, 35% covered one topic, and 48% covered all of the topics. 	
9. Solve problems using right triangles.	▪ the Pythagorean Theorem ▪ right triangle ratios (sine, cosine, tangent) to solve problems in mathematical situations or related to other disciplines and areas of interest (e.g. arts and architecture)
All classes covered these topics.	

Geometry Learner Outcome	Topic from the Mathematics Topics Survey
10. Formulate, test, and validate geometric conjectures and construct geometric arguments.	justifying solutions to problems using geometric properties, attribute, theorems, and postulates
The graph below shows that 9% of the classes did not cover this topic and 91% of the classes covered it. 	
11. Apply the concept and strategies of measurement.	using units of measures appropriately and consistently when solving problems across the content strands
Ninety percent of the classes covered this topic.	

Learner Outcomes for Algebra I

At the completion of the course, the learner will demonstrate the ability to:

1. Identify and extend to specific cases a variety of linear and nonlinear patterns represented in models, tables, sequences, graphs, or in problem situations.

2. Describe how change in one variable relates to change in the value of a second variable.

3. Distinguish between linear relationships (constant rate of change) and nonlinear relationships (varying rates of change).

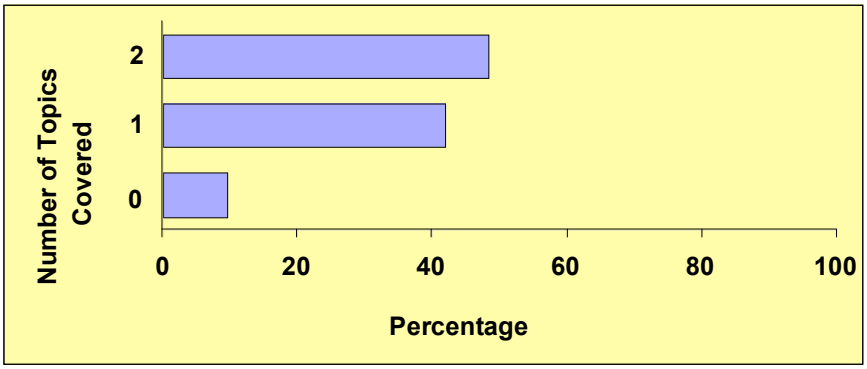
4. Perform basic algebraic manipulations.
   Suggested topics include:
   a. simplify algebraic expressions including those with square roots, whole number exponents, or rational numbers
   b. evaluate algebraic expressions
   c. evaluate an expression within an equation (e.g., determine the value of y when x=4 given $y = 7\sqrt{x} + 2x$)

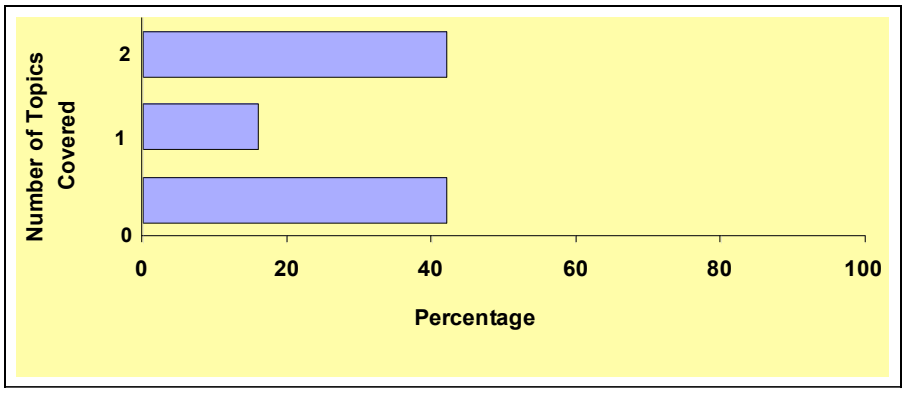
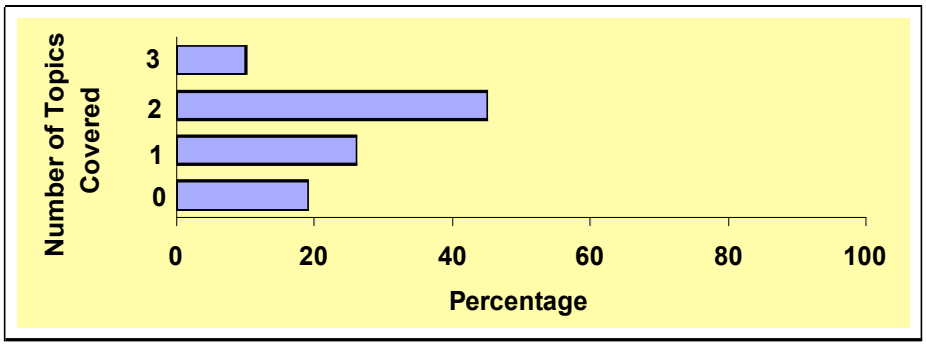
5. Solve linear equations.
   Suggested topics include:
   a. show equivalence between two expressions
   b. solve formulas for a variable requiring one transformation
   c. solve multi-step linear equations with integer coefficients
   d. solve problems involving systems of linear equations

6. Solve a quadratic equation of the form $ax^2 + b = c$.

Alignment and Analysis of Topics in Algebra I – Type Courses

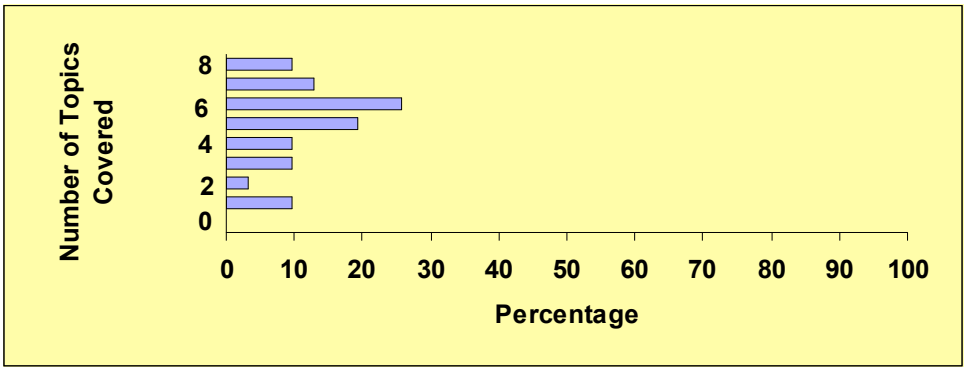
The following table includes the topics the Survey Committee aligned with the Algebra I - type learner outcomes. The data were analyzed and the graphs were created to illustrate gaps among topics teachers reported as covered.

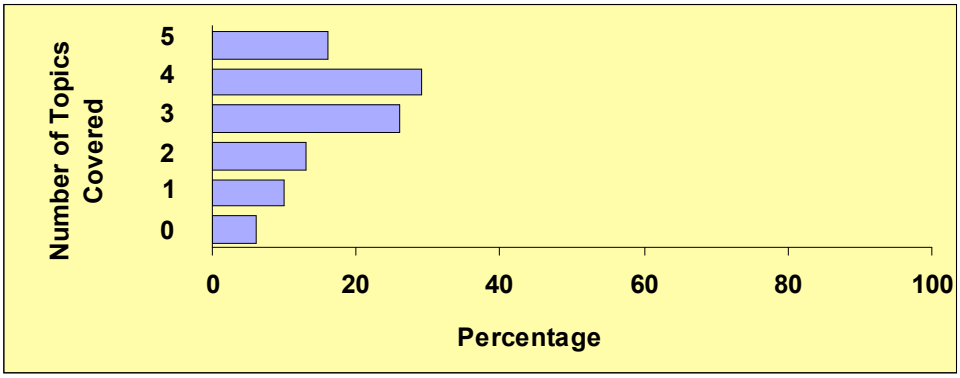
Algebra I Learner Outcome	Topic from the Mathematics Topics Survey
1. Identify and extend to specific cases a variety of linear and nonlinear patterns represented in models, tables, sequences, graphs, or in problem situations.	▪ identifying and extending to specific cases a variety of patterns (linear and nonlinear) represented in models, tables, sequences, graphs, or in problem situations ▪ scatter plots or regression lines representing distributions of data by informally estimating and interpreting correlation coefficients as strong positive, strong negative or no correlation and providing explanations about the meaning of that value in context of the data
The graph below shows that 10% of the classes didn't cover any of the topics, 42% covered one of the topics and 48% covered all of the topics.  	
2. Describe how change in one variable relates to change in the value of a second variable.	▪ direct and inverse variation ▪ solving problems that involve how a change in one variable affects the value of another variable
See the next page for the graph pertaining to these topics.	

Algebra I Learner Outcome	Topic from the Mathematics Topics Survey
	The graph below shows that 42% of the classes didn't cover any of the topics, 16% covered one topic, and 42% covered all of the topics. 
3. Distinguish between linear relationships (constant rate of change) and nonlinear relationships (varying rates of change).	▪ solving problems on and off the coordinate plane involving distance, midpoint, perpendicular and parallel lines, and slope ▪ generalizing a linear relationship (nonrecursive explicit equation) ▪ generalizing a nonlinear relationship using words or symbols
	The graph below shows that 19% of the classes didn't cover any of the topics, 26% covered one topic, 45% covered two topics, and 10% covered all three. 

Algebra I Learner Outcome	Topic from the Mathematics Topics Survey
4. Perform basic algebraic manipulations.	▪ common irrational numbers ▪ square roots ▪ mentally calculating benchmark perfect squares and related square roots ▪ estimating the value of a non-perfect square root or cube root between two whole numbers ▪ applying properties of numbers to solve problems and to simplify computations ▪ demonstrating conceptual understanding of field properties as they apply to the set of real numbers (e.g., the set of whole numbers does not have additive inverses, the set of integers does not have multiplicative inverses) ▪ algebraic expressions by evaluating or simplifying expressions (including expressions within an equation(s) ▪ solving problems involving algebraic expressions (polynomial, rational, integer exponents, square roots, or absolute values)

The graph below shows that 10% of the classes covered one topic, 3% covered two, 10% covered three, 10% covered four, 19% covered five, 25% covered six, 13% covered seven, and 10% covered all the topics.



Algebra I Learner Outcome	Topic from the Mathematics Topics Survey
5. Solve linear equations.	▪ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s) ▪ solving problems involving systems of linear equations in a context (using equations or graphs) ▪ translating problem situations into equations or inequalities, or by writing equivalent forms of formulas ▪ linear equations ▪ systems of equations
The graph below shows that 6% of the classes didn't cover any of the topics, 10% covered one, 13% covered two, 26% covered three, 29% covered four, and 16% covered all the topics. 	
6. Solve a quadratic equation of the form $ax^2 + b = c$.	equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s)
Only 16% of the classes covered this topic.	

Learner Outcomes for Pre-Algebra – Type Courses

At the completion of the course, the learner will demonstrate the ability to:

1. Perform basic operations with whole numbers, integers, fractions, and decimals.

2. Solve problems involving ratios, proportional reasoning, and percents.
   Suggested topics include:
   a. percent increase or decrease
   b. interest rates
   c. mark-ups
   d. rates

3. Select and use appropriate methods of estimation.

4. Evaluate the reasonableness of solutions.

5. Convert among different forms of representations: verbal (e.g. integers greater than five), numeric (e.g. {6,7,8,9,…}), symbolic (e.g. $x > 5$) , and graphical (e.g. number line).

6. Perform basic algebraic manipulations.
   Suggested topics include:
   a. simplify algebraic expressions
   b. evaluate algebraic expressions
   c. solve linear equations in one variable
   d. solve linear inequalities in one variable

7. Apply geometric concepts and relationships related to one-, two- and three-dimensional figures.
   Suggested topics include:
   a. perimeter, area, and volume
   b. Pythagorean Theorem
   c. Cartesian plane
   d. angles and triangles
   e. similar figures

8. Use and/or convert units of measure appropriately and consistently when solving problems.

9. Perform basic statistical measures to analyze data and make predictions.
   Suggested topics include:
   a. mean, median, mode
   b. range

Alignment and Analysis of Topics in Pre-Algebra - Type Courses

The following table includes the topics the Survey Committee aligned with the Pre-Algebra-type learner outcomes. The data were analyzed and the percentages are given to illustrate gaps among topics teachers reported as covered.

Since there were only three classes in the Pre-Algebra sample, graphs were not created because they were not meaningful.

Pre-Algebra Learner Outcome	Topic from the Mathematics Topics Survey
1. Perform basic operations with whole numbers, integers, fractions, and decimals.	▪ rational bases with integer exponents ▪ integers
All of the classes covered these topics.	
2. Solve problems involving ratios, proportional reasoning, and percents.	▪ percentages ▪ mathematical and contextual problems involving proportions and percents ▪ percent of increase and decrease ▪ interest rates ▪ markups ▪ compound percentages ▪ determining or estimating the part of a number using percents ▪ translating problem situations into algebraic expressions
All of the classes covered these topics.	

Pre-Algebra Learner Outcome	Topic from the Mathematics Topics Survey
3. Select and use appropriate methods of estimation.	▪ estimation in a given situation by identifying when estimation is appropriate ▪ selecting the appropriate method of estimation ▪ knowing the appropriate degree of accuracy in problem solving situations involving measurement
All classes covered these topics.	
4. Evaluate the reasonableness of solutions.	▪ determining the level of accuracy needed given the situation ▪ analyzing the effect of the estimation method on the accuracy of results ▪ evaluating the reasonableness of solutions appropriate across content strands ▪ knowing the appropriate degree of accuracy in problem solving situations involving measurement
Two classes covered all of these topics and one class covered one topic.	
5. Convert among different forms of representations: verbal (e.g. integers greater than five), numeric (e.g. {6, 7, 8, 9, …}, symbolic (e.g. $x > 5$), and graphical (e.g. use a number line).	▪ equality and inequality symbols ▪ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s)
One class covered both topics and two classes covered one topic.	

Pre-Algebra Learner Outcome	Topic from the Mathematics Topics Survey
6. Perform basic algebraic manipulations.	▪ applying properties of numbers to solve problems and to simplify computations ▪ demonstrating conceptual understanding of field properties as they apply to the set of real numbers (e.g., the set of whole numbers does not have additive inverses, the set of integers does not have multiplicative inverses) ▪ algebraic expressions by evaluating or simplifying expressions (including expressions within an equation(s)) ▪ linear equations
One class covered all four topics, one class covered two, and one class did not cover any of the topics.	
7. Apply geometric concepts and relationships related to one-, two-, and three-dimensional figures.	▪ the Pythagorean Theorem ▪ the volume or surface area measures of two and three-dimensional figures when linear and area measures are multiplied by a constant ▪ solving problems involving missing lengths and angles of polygons using similarity, including problems within mathematics and across disciplines and contexts using appropriate technology ▪ perimeter ▪ circumference ▪ area of two-dimensional figures (including composite figures) in problem solving situations on or off a coordinate graph ▪ surface area or volume of prisms, cylinders, cones, pyramids, and spheres (including composite figures) by solving problems involving and using appropriate units of measure ▪ the constructions of angle bisectors, perpendicular lines (including bisectors, and from a point not on the line), congruent segments, parallel lines, regular polygons, isosceles triangles, inscribing and circumscribing figures using appropriate tools, coordinate geometry or dynamic geometric software & solving related problems

Pre-Algebra Learner Outcome	Topic from the Mathematics Topics Survey
Two classes covered five of the topics and one class covered four.	
8. Use and/or convert units of measure appropriately and consistently when solving problems.	▪ using units of measure appropriately and consistently when solving problems across the content strands ▪ conversions within or across systems ▪ knowing the appropriate degree of accuracy in problem solving situations involving measurement ▪ using measurement conversion strategies, such as unit/dimensional analysis or uses quotient measures, such as speed and density
One class covered all the topics and two classes covered two of the topics.	
9. Perform basic statistical measures to analyze data and make predictions.	▪ using measures of central tendency (mean, median, or mode), dispersion (range or variation), outliers, quartile values to solve problems
Two classes covered this topic and one class did not cover it.	

Mathematics Center Directors' Survey for the USNH and NHCTCS

Another task of the Survey Committee was to learn how students progressed once they entered institutions of higher education throughout New Hampshire. This task required the creation of a survey for the Mathematics Center Directors of three institutions of the University System of New Hampshire (USNH) namely, Keene State College, Plymouth State University, and the University of New Hampshire along with the seven campuses of the New Hampshire Community Technical Colleges System (NHCTCS) which includes NHCTC–Berlin, NHCTC–Claremont, NHTI–Concord, NHCTC–Laconia, NHCTC–Manchester, NHCTC-Nashua, and NHCTC–Stratham.

This survey asked questions pertaining to such topics as mathematics placement examinations, the number and percentages of prospective students who had been placed into the developmental and non-college credit mathematics courses, specific mathematics courses taught, mathematics requirements for graduation, and perceived gaps in the high school courses taken by students as they relate to their future success in institutions of higher education.

The numerous differences among the procedures of the various Mathematics Centers of the University System of New Hampshire did not enable the Survey Committee to find many similarities among them. However, two similarities were that all three institutions require at least Algebra II or its equivalent as an admission requirement. The directors of the various centers also regarded the areas of basic algebra and number skills as perceived gaps.

The survey responses from the directors of the mathematics learning centers of the New Hampshire Community Technical College System indicated many differences in placement testing procedures, courses offered, and percentages of students enrolled in developmental level courses at each of its seven campuses. For more information on the New Hampshire Community Technical College System, refer to the report prepared by the NHCTCS Committee. (See Appendix E on page 78 for the Mathematics Center Directors' Survey for the USNH and Appendix F on page 82 for the Mathematics Center Directors' Survey for the NHCTCS).

APPENDICES

Appendix A: High School Mathematics Department Chairperson Survey (Year 1)

Appendix B: High School Mathematics Department Chairperson Survey (Year 2)

Appendix C: High School Mathematics Teacher Survey

Appendix D: Mathematics Topics Survey

Appendix E: Mathematics Center Director (University System of New Hampshire)

Appendix F: Mathematics Center Director (NH Community Technical College System)

Appendix A: High School Mathematics Department Chairperson (Year 1)

Making the Transition from High School to College (MaTHSC)

Department Chairperson Survey (Year 1)

MaTHSC is a project involving three of the institutions of the University System of New Hampshire (Keene State College, Plymouth State University, the University of New Hampshire), the New Hampshire Community and Technical College System, the New Hampshire State Department of Education, and several New Hampshire school districts. To assure that the goal is met, we need to collect information about the current status of mathematics courses commonly taken by all high school students throughout the State of New Hampshire. We also need to know how students make decisions regarding courses taken at the high school level and why those courses are taken. Since your high school is part of this project, more in-depth information regarding your program is needed.

A self addressed stamped envelope is enclosed for your convenience. Please note that there is complete anonymity with the responses. No school identifications will be made regarding the project.

1. How many mathematics teachers teach in grades 9-12?
_____

2. How many students are enrolled in your school?
_____

3. How many students are enrolled in your mathematics classes?
_____

4. How many students are taking at least one mathematics class in each of these grades?

   Grade 9 _____

   Grade 10 _____

   Grade 11 _____

   Grade 12 _____

5. How many years of mathematics study are required in your district?
_____

6. What standardized tests in mathematics are administered in grades 9-12 in your district? List the name and the grade level in which it is administered.

7. What are the primary purposes for administering the standardized test?

8. Please enclose any standardized test data that would be helpful for this study.

9. Is there an exit test that is required for graduation? If so, what type of test is it (e.g. standardized, district-made, etc.)? Please explain.

10. What summer mathematics courses are offered in your district?

11. What is the lowest numerical grade that a student can receive to pass a course?

12a. In the next section, you will be asked to list the courses taught in your department. Please enclose course descriptions for these courses or if they are available on the web provide the URL.

12b. Please complete the chart pertaining to the types of courses taught in your department. Make extra copies of the chart if needed. Individual sections of types of courses should be considered together. For example, the following chart considers all students who are enrolled in Algebra I and Applied Math II for the entire school.

Name and Purpose of Course	Total Number of Students Enrolled	Number Who Passed Completed the Course
Name: Algebra I Purpose: College Prep	Grade 9 = 112 Grade 10 = 82 Grade 11 = 17 Grade 12 = 3 Repeating students = 10	Grade 9 = 100 Grade 10 = 80 Grade 11 = 17 Grade 12 = 3 Repeating students = 9
Name: Applied Math II Purpose: Skills Review	Grade 9 = 0 Grade 10 = 43 Grade 11 = 18 Grade 12 = 15 Repeating students = 14	Grade 9 = 0 Grade 10 = 40 Grade 11 = 16 Grade 12 = 14 Repeating students = 14

Name and Purpose of Course	Total Number of Students Enrolled	Number Who Passed Completed the Course
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =

Thank you for your help!

Appendix B: High School Mathematics Department Chairperson (Year 2)

Making the Transition from High School to College (MaTHSC)

Department Chairperson Survey (Year 2)

MaTHSC is a project involving three of the institutions of the University System of New Hampshire (Keene State College, Plymouth State University, the University of New Hampshire), the New Hampshire Community and Technical College System, the New Hampshire State Department of Education, and several New Hampshire school districts. The primary goal of the MaTHSC project is to help students make a successful transition from high school to institutions of higher education in New Hampshire. To assure that the goal is met, we need to collect information about the current status of mathematics courses commonly taken by all high school students throughout the State of New Hampshire. Since your high school is part of this project, more in-depth information regarding data from the second year of the program is needed.

Although data were collected from your school last June for the academic year 2004-2005. We still need additional data. We would now like to perform some comparative analyses and would appreciate it if you would send data to help compare the academic years of 2004-2005 and 2005-2006.

A self addressed stamped envelope is enclosed for your convenience. Please note that there is complete anonymity with the responses. No school identifications will be made regarding the project.

Mathematics Credits

How many mathematics credits are required for graduation from the regular high school program in your school district? _____

Data for Academic Year Ending 2005

1. How many students graduated from your school in **2005**? _____

2. How many graduates of the class of **2005** successfully completed:

   Pre-Algebra _____

   Algebra I _____

   Geometry _____

   Algebra II _____

   A fourth year beyond Algebra II. Please list the course name and number of students who have successfully completed the course.

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

Data for Academic Year Ending 2006

1. How many students graduated from your school in **2006**? _____

2. How many graduates of the class of **2006** successfully completed:

   Pre-Algebra _____

   Algebra I _____

   Geometry _____

   Algebra II _____

   A fourth year beyond Algebra II. Please list the course name and number of students who have successfully completed the course.

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

   _____ _____

Please complete the chart below and on the next page pertaining to the types of courses taught in your department for the academic year 2005-2006. Make extra copies of the chart if needed. Individual sections of types of courses should be considered together. For example, the following chart considers all students who are enrolled in Algebra I and Applied Math II for the entire school.

Name and Purpose of Course	Total Number of Students Enrolled	Number Who Passed Completed the Course
Name: Algebra I Purpose: College Prep	Grade 9 = 112 Grade 10 = 82 Grade 11 = 17 Grade 12 = 3 Repeating students = 10	Grade 9 = 100 Grade 10 = 80 Grade 11 = 17 Grade 12 = 3 Repeating students = 9
Name: Applied Math II Purpose: Skills Review	Grade 9 = 0 Grade 10 = 43 Grade 11 = 18 Grade 12 = 15 Repeating students = 14	Grade 9 = 0 Grade 10 = 40 Grade 11 = 16 Grade 12 = 14 Repeating students = 14

Name and Purpose of Course	Total Number of Students Enrolled	Number Who Passed Completed the Course
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =
Name: Purpose:	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =	Grade 9 = Grade 10 = Grade 11 = Grade 12 = Repeating students =

Thank you for your help!

Appendix C: High School Mathematics Teacher Survey

Making the Transition from High School to College (MaTHSC)

Mathematics Teacher Survey

MaTHSC is a project involving three of the institutions of the University System of New Hampshire (Keene State College, Plymouth State University, the University of New Hampshire), the New Hampshire Community and Technical College System, the New Hampshire State Department of Education, and several New Hampshire school districts. The primary goal of the MaTHSC project is to help students make a successful transition from high school to institutions of higher education in New Hampshire. To assure that the goal is met, we need to collect information about the current status of mathematics courses commonly taken by all high school students throughout the State of New Hampshire. We also need to know how students make decisions regarding courses taken at the high school level and why those courses are taken. Since your high school is part of this project, we appreciate you taking the time to respond to these questions.

A self addressed stamped envelope is enclosed for your convenience. Please note that there is complete anonymity with the responses. No teacher identification will be made regarding the project.

1. Please identify your school district. _____

2. Please list the following for each course that you teach:

   Course _____

   Grade Level _____

   Textbook _____

   Author(s) _____

   Copyright Year _____

   Course _____

   Grade Level _____

   Textbook _____

   Author(s) _____

   Copyright Year _____

3. How many years have you been teaching mathematics?

4. Have you received your certification to teach secondary mathematics, or do you hold an Alternative Four provisional certificate?

5. Please check all degrees that you have received.

_____ B.S. in Mathematics

_____ B.S. in Education

_____ B.S. in Mathematics Education

_____ B.A. in Mathematics

_____ B.A. in Education

_____ B.A. in Mathematics Education

_____ Other, please explain. _____

_____

* *

_____ M.Ed. in Mathematics

_____ M.A. in Mathematics

_____ M.S. in Mathematics

_____ M.Ed. in Mathematics Education

_____ Master of Arts in Teaching

_____ Master of Science in Teaching

_____ Other, please explain. _____

_____

* *

_____ PhD. in Mathematics

_____ PhD. in Mathematics Education

_____ Ed.D. in Mathematics

_____ Ed.D. in Curriculum and Instruction

_____ Other, please explain. _____

6. How do students get enrolled in your mathematics classes? Please write the course name to the right of the enrollment method.

   _____ mathematics placement test (e.g. district made test) _____

   _____ standardized test (e.g. CAT, IOWA) _____

   _____ prerequisite _____

   _____ teacher recommendation _____

   _____ guidance counselor _____

   _____ Other, please explain. _____

   _____

7. What mathematical skills do you consider a necessity for college-bound students?

8. What gaps do you perceive in students' mathematical knowledge between grades 8 and 9?

9. What gaps do you perceive in students' mathematical knowledge between high school and post secondary education?

Thank you for your help!

Appendix D: Mathematics Topics Survey

Making the Transition from High School to College **(MaTHSC)**

Mathematics Topics Survey

Course Name: _____

Intended Grade Level: _____

Please check all topics that are covered within this course.

If there are topics that you cover that are not listed here, please copy the textbook table of contents and highlight the appropriate sections.

At the completion of this course, students will demonstrate an understanding of:

Number and Operations

_____ percentages

_____ the relative magnitude of real numbers by ordering or comparing rational numbers

_____ common irrational numbers (e.g., $\sqrt{2}$, π)

_____ rational bases with integer exponents

_____ square roots

_____ absolute values

_____ integers

_____ numbers represented in scientific notation using number lines

_____ equality and inequality symbols

_____ mathematical and contextual problems involving proportions and percents

_____ percent of increase and decrease

_____ interest rates

_____ markups

_____ compound percentages

_____ direct and inverse variation

_____ mentally calculating benchmark perfect squares and related square roots

_____ determining or estimating the part of a number using percents (any whole number percent between 0% and 100%, $33\frac{1}{3}\%$, $66\frac{2}{3}\%$, multiples of 100% up to 500%)

_____ determining or estimating related fractions as appropriate to a problem situation

_____ estimation in a given situation by identifying when estimation is appropriate

_____ selecting the appropriate method of estimation

_____ determining the level of accuracy needed given the situation

_____ analyzing the effect of the estimation method on the accuracy of results

_____ evaluating the reasonableness of solutions appropriate across content strands,

_____ estimating tips

_____ discounts

_____ tax

_____ estimating the value of a non-perfect square root or cube root between two whole numbers

_____ applying properties of numbers to solve problems and to simplify computations

_____ demonstrating conceptual understanding of field properties as they apply to the set of real numbers (e.g., the set of whole numbers does not have additive inverses, the set of integers does not have multiplicative inverses).

Geometry and Measurement

_____ geometric properties, or theorems involving angles (vertical, straight, right complementary, supplementary, linear pair, angle bisector).

_____ lines (parallel, perpendicular, skew, midpoint on line segment)

_____ polygons

_____ circles (radii, arcs, diameters, central angles, segments)

_____ the Pythagorean Theorem

_____ the Triangle Inequality Theorem

_____ right triangle ratios (sine, cosine, tangent) to solve problems in mathematical situations or related to other disciplines and areas of interest (e.g. arts and architecture)

_____ justifying solutions to problems using geometric properties, attributes, theorems, and postulates

_____ applying the concepts of congruency by solving problems on or off a coordinate plane involving reflections, translations, or rotations

_____ solving problems using congruency involving problems within mathematics, across disciplines, and contexts using appropriate technology (e.g., paper, pencil, calculator, computer)

_____ applying concepts of similarity by determining the effect of changing a scale factor on similar figures

_____ the impact of scale on linear and area concepts

_____ the volume or surface area measures of two and three-dimensional figures when linear and area measures are multiplied by a constant

_____ solving problems involving missing lengths and angles of polygons using similarity, including problems within mathematics and across disciplines and contexts using appropriate technology

_____ perimeter

_____ circumference

_____ area of two-dimensional figures (including composite figures) in problem solving situations on or off a coordinate graph

_____ surface area or volume of prisms, cylinders, cones, pyramids, and spheres (including composite figures) by solving problems involving and using appropriate units of measure.

_____ models to generalize formulas for the perimeter and area of two-dimensional polygonal figures and circles (including composite figures) or surface area or volume of prisms, cylinders, cones, pyramids)

_____ using units of measures appropriately and consistently when solving problems across the content strands

_____ conversions within or across systems

_____ knowing the appropriate degree of accuracy in problem solving situations involving measurement

_____ using measurement conversion strategies, such as unit/dimensional analysis or uses quotient measures, such as speed and density

_____ using product measures, such as person hours to solve problems

_____ solving problems on and off the coordinate plane involving distance, midpoint, perpendicular and parallel lines, and slope

_____ understanding of spatial reasoning and visualization by sketching or using dynamic geometric software to generate three-dimensional objects objects or orthogonal views (projections and isometric views

_____ the constructions or representations of angle bisectors, perpendicular lines (including bisectors, and from a point not on the line), congruent segments, parallel lines, regular polygons, isosceles triangles, inscribing and circum-scribing figures using appropriate tools, coordinate geometry or dynamic geometric software and solving related problems

Algebra and Functions

_____ identifying and extending to specific cases a variety of patterns (linear and nonlinear) represented in models, tables, sequences, graphs, or in problem situations

_____ generalizing a linear relationship (nonrecursive explicit equation)

_____ generalizing a nonlinear relationship using words or symbols

_____ generalizing of linear and common nonlinear relationships to find a specific case

_____ linear relationships and linear and non- linear functions (including characteristics of classes of functions) through analysis of slope, intercepts, domain, range, maximum and minimum values, or constant.

_____ average and variable rates of change; including solving problems within mathematics &across disciplines and contexts using appropriate technology

_____ working flexibly between and among different representations of functions (graphs, tables, equations, function notation)

_____ algebraic expressions by evaluating or simplifying expressions (including expressions within an equation(s))

_____ solving problems involving algebraic expressions (polynomial, rational, integer exponents, square roots, or absolute values)

_____ translating problem situations into algebraic expressions

_____ equality by using models or different representations of the expressions, by solving (symbolically and graphically) multi-step linear equations, inequalities, and quadratic equations and providing the meaning of the graphical interpretations of solution(s)

_____ solving problems that involve how a change in one variable affects the value of another variable

_____ solving problems involving systems of linear equations in a context (using equations or graphs)

_____ translating problem situations into equations or inequalities, or by writing equivalent forms of formulas

Data , Statistics and Probability

_____ **i**nterpreting (interpolates or extrapolates) and analyzes differences and similarities between data sets (parallel box and whisker plots, scatter plots pictographs, bar graphs, line graphs, circle graphs, histograms, frequency charts) to make observations, to answer questions, to analyze the data to formulate or justify conclusions, or critique conclusions to make predictions, or to solve problems within mathematics and across disciplines and contexts (e.g. media, workplace, social and environmental situations)

_____ analyzing patterns, trends, or distributions in univariate and bivariate numerical data in a variety of contexts by determining their effect on mean, median, or mode

_____ using measures of central tendency (mean, median, or mode), dispersion (range or variation), outliers, quartile values to solve problems

_____ scatter plots or regression lines representing distributions of data by informally estimating and interpreting correlation coefficients as strong positive, strong negative or no correlation and providing explanations about the meaning of that value in context of the data

_____ solving problems involving conceptual understanding of the sample from which the statistics were developed in terms of bias, random or non-random

_____ organizing and displaying one and two variable data using parallel box and whisker plots, scatter plots, histograms, or frequency distributions to analyze the data to formulate or justify conclusions, make predictions, or to solve problems

_____ identifiying representations or elements of representations that best display a given set of data or situation

_____ counting techniques to solve problems in context involving combinations or permutations (e.g., handshake problem, circular arrangements) using a variety of strategies (e.g., organized lists, tables, tree diagrams, models, Fundamental Counting Principle)

_____ solving problems involving experimental or theoretical probability of an event

_____ the probability event in which the sample space may or may not contain equally likely outcomes, predicts the theoretical probability of an event and tests the prediction through experiments and simulations;

_____ comparing and contrasting theoretical and experimental probabilities

_____ a response to a teacher or student generated question or hypothesis decides the most effective method (e.g., survey, observation, research, experimentation) and sampling techniques (random sample, stratified random sample) to collect the data necessary to answer the question

_____ collecting, organizing, and appropriately displaying data

_____ analyzing the data to draw conclusions about the questions or hypothesis being tested while considering the limitations of the data that could affect interpretations

_____ making predictions, asking new questions, or making connections to real- world situations

Advanced Mathematical Topics

_____ graph theory

_____ recurrence

_____ relations

_____ combinatorics

_____ linear equations

_____ systems of equations

_____ linear programming to solve problems

_____ solving problems involving the use of discrete structures and the application of algorithms

_____ matrices and determinants

_____ linear and angular velocities

_____ conic sections

_____ vectors

_____ decomposition of fractions

_____ parametric equations

_____ limits of functions

_____ critical points on a graph (maximum, minimum, points of reflection)

_____ the factor and remainder theorems to factor polynomials

_____ the calculation of the area under a curve

_____ derivatives of a function

_____ iteration of functions

_____ integration

_____ inverse functions

_____ composite functions

_____ families of graphs

_____ curve fitting

_____ polar coordinates

_____ chaotic behavior of functions

_____ iterations to explore fractals

Thank you for your help!

Appendix E: Math Center Director
University System of New Hampshire Version

Making the Transition from High School to College **(MaTHSC)**
Mathematics Center Director Survey

University System of New Hampshire Version

MaTHSC is a project involving three of the institutions of the University System of New Hampshire (Keene State College, Plymouth State University, the University of New Hampshire), the New Hampshire Community and Technical College System, the New Hampshire State Department of Education, and several New Hampshire school districts. The primary goal of the MaTHSC project is to help students make a successful transition from high school to institutions of higher education in New Hampshire. To assure that the goal is met, we need to collect information about the current status of mathematics courses commonly taken by all high school students throughout the State of New Hampshire. We also need to know how students progress once they enter institutions of higher education throughout New Hampshire. Since your institution is one in which many New Hampshire students attend, more in-depth information regarding your program is needed.

Placement Examination

1. Do you administer a placement examination?

   If so, when is it administered?

   To whom is it administered?

2. Is the placement examination a standardized test, written by the institution, or other? Explain.

3. What is the delivery method of the placement examination (e.g. paper and pencil, electronic, oral, etc.)?

4. What is the format of the placement examination (e.g. essay, multiple choice, short answer, etc.)?

5. What is the average percentage of students who take the placement examination and move into a college-credited mathematics course?

6. What topics are included on the placement examination? Attach another sheet if needed.

7. How are the results of the placement examination used?

8. What are the specific courses in which students are placed after taking the placement examination? Please list:

Course Name	Circle appropriate type:
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit

9. Is there a mechanism on the placement examination that asks students questions based on their responses to prior questions? If so, what is it?

10. Is there a mechanism for the student to challenge the suggested class based on the results of the placement examination? If so, what is it?

11. Does your institution administer any mathematics challenge examinations? If so, what are they?

12. Does your institution allow credit by examination? If so, for what courses?

13. If your institution does not have a mathematics placement test, is there another test that is administered to incoming students for mathematics? If so, what is it?

    If so, what percentage of the students taking this test pass it?

Mathematics Requirements

14. Are there any minimum mathematics admissions requirements for incoming students? If so, what are they? Attach another sheet if necessary.

15. Is there a mathematics requirement for graduation? If so, what is it?

Mathematics Courses

16. What percentage of entering freshman is required to take developmental (non-credit) mathematics classes?

17. What topics are covered in the developmental (non-credit) mathematics class(es)? If you wish you may also attach the course syllabus and/or your institution's course catalog.

18. What percentage of freshmen attend the Mathematics Tutoring Center for extra help?

19. What percentage of full-time students take at least one mathematics course during their first year?

20. Of these students, please list the courses they may be enrolled in. Please include the percentage of these students that are enrolled in each class.

Course Name	Percentage of full-time first-year students
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

21. What percentage of full-time students complete and pass their freshmen and/or sophomore year mathematics (college-credited) courses?

_____freshmen courses

_____sophomore courses

22. What percentage of these students who passed the courses also passed their developmental mathematics courses?

23. What mathematics courses, topics, or skills do you feel that students should be proficient in prior to attending college?

24. What other non-mathematical skills should students be proficient in to be successful in your mathematics classes?

25. What gaps do you perceive in the courses students are taught in high school as it pertains to their future success in institutions of higher education?

26. If there are perceived gaps, do you feel that they are filled before the student graduates from your institution? Please elaborate.

Thank you for your time!

Appendix F: Math Center Director
New Hampshire Community Technical College Version

Making the Transition from High School to College **(MaTHSC)**
Mathematics Center Director Survey

New Hampshire Community Technical College System Version

MaTHSC is a project involving three of the institutions of the University System of New Hampshire (Plymouth State University, Keene State College, the University of New Hampshire), the New Hampshire Community and Technical College System, the New Hampshire State Department of Education, and several New Hampshire school districts. The primary goal of the MaTHSC project is to help students make a successful transition from high school to institutions of higher education in New Hampshire. To assure that the goal is met, we need to collect information about the current status of mathematics courses commonly taken by all high school students throughout the State of New Hampshire. We also need to know how students progress once they enter institutions of higher education throughout New Hampshire. Since your institution is one in which many New Hampshire students attend, more in-depth information regarding your program is needed.

Note: Please presume, unless otherwise stated, that the data being requested are for the **Fall 2005** semester.

Name of Institution:_____

Person(s) Completing the Survey: _____

_____

_____

Mathematics Placement Examination

1. Do you administer a mathematics placement examination?

   If so, when is it administered?

   To whom is it administered?

2. Is the placement examination a standardized test, written by the institution, or other? Explain.

3. What is the delivery method of the placement examination (e.g. paper and pencil, electronic, oral, etc.)?

4. What is the format of the placement examination (e.g. essay, multiple choice,

short answer, etc.)?

5. What is the average percentage of students who take the placement examination and move into a college-credited (non-developmental, counts towards graduation) mathematics course? If readily available, please provide data for the past three fall semesters, beginning with 2005. Otherwise, provide data for fall of 2005 only.

6. What topics are included on the placement examination? Attach another sheet if needed.

7. How are the results of the placement examination used?

8. What are the specific courses in which students are placed after taking the placement examination? Please list:

Course Name	Circle appropriate type:
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit
_____	developmental (no credit) or college credit

9. Is there a mechanism on the placement examination that asks students questions based on their responses to prior questions? If so, what is it?

10. Is there a mechanism for the student to challenge the suggested class based on the results of the placement examination? If so, what is it?

11. Does your institution administer any mathematics challenge examinations? If so, what are they?

12. Does your institution allow credit by examination? If so, for what courses?

13. If your institution does not have a mathematics placement test, is there another test that is administered to incoming students for mathematics? If so, what is it?

    If so, what percentage of the students taking this test pass it?

Mathematics Requirements

14. Are there any minimum mathematics admissions requirements for incoming students? If so, what are they? Attach another sheet if necessary.

15. Is there a mathematics requirement for graduation? If so, what is it?

Mathematics Courses

16. What percentage of entering freshman is required to take developmental (non-credit) mathematics classes? Please provide data for the past three fall semesters beginning with 2005. (These data are very important to the research for the NHCTCS.)

17. What topics are covered in the developmental (non-credit) mathematics class(es)? If you wish you may also attach the course syllabus and/or your institution's course catalog.

18. What percentage of freshmen attend the Mathematics Tutoring Center for extra help?

19. What percentage of full-time students take at least one mathematics course during their first year?

20. Of these students, please list the courses they may be enrolled in. Please include the percentage of these students that are enrolled in each class.

Course Name	Percentage of full-time first-year students
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

21. What percentage of full-time students complete and pass their freshmen and/or sophomore year mathematics (college-credited) courses?

    _____freshmen courses

    _____sophomore courses

22. What percentage of these students who passed the courses also passed their developmental mathematics courses?

23. What mathematics courses, topics, or skills do you feel that students should be proficient in prior to attending college?

24. What other non-mathematical skills should students be proficient in to be successful in your mathematics classes?

25. What gaps do you perceive in the courses students are taught in high school as it pertains to their future success in institutions of higher education?

26. If there are perceived gaps, do you feel that they are filled before the student graduates from your institution? Please elaborate.

Thank you for your time!