

**Post-Secondary Math Survey Results
Executive Summary**

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Post-Secondary Education Survey Math Results

Background

Participation by the state of Hawai'i in the American Diploma Project involves a joint commitment from the Hawai'i Department of Education, the University of Hawaii and the Hawai'i Business Roundtable. Together, these three partners seek to address ways of plugging the "leaking educational pipeline" in our state.

The American Diploma Project has four cornerstones:

- More closely aligning HS exit expectations with college/work entry expectations;
- Encouraging all students to pursue a more rigorous curriculum in high school;
- Aligning assessments between secondary and post-secondary in order to make more efficient use of results; and
- Tracking students longitudinally from high school through their post-secondary experience.

This report deals with the results of surveys of post-secondary faculty, intended to address the first of the four cornerstones -- alignment of secondary and post-secondary expectations.

Survey Method

These surveys were conducted on-line in October 2007 using a survey instrument developed by Achieve, Inc., the "parent company" of the American Diploma Project. The survey included five skill areas: number sense and numerical operations, algebra, geometry, data/statistics/probability, and mathematical reasoning.

A total of 160 usable responses were received: 134 from faculty at the ten campuses of the University of Hawai'i and another twenty-six from faculty members of three private universities in the state (Brigham Young University -- Hawai'i, Chaminade University, and Hawai'i Pacific University). (See Attachment A for more detail about survey participants.)

Subject Areas

Faculty were asked to identify specific **entry-level** courses in **any subject area**, and to then evaluate the significance of various mathematics skills for student success in the identified courses. Courses identified by respondents fell into seven broad categories:

- Arts, Humanities, Language and Literature
- Communication (written and oral)
- Career and Technical Education
- Math
- Natural Sciences
- Professional Schools
- Social Sciences

(Refer to Attachment B for course specifics)

Respondents used a scale of 1--10 to indicate the relative necessity of a given skill for success in their entry-level course (1= not essential; 10= most essential).

Subject Matter Areas with Low Response Rates

Because the number of responses in the math survey was so low from three groups (n = 12 from AHLLL, 4 from Communications and 12 from CTE), those responses were not included in the analysis as individual categories. AHLLL and Communications were combined as one group and the responses from Career and Technical Education were combined with responses from professional school programs. (There is a shared emphasis on application of mathematical principles.)

Results

Skills Identified as Key

Unlike the results of the English skills survey, **no** single skill received a rating of 9-10 from at least 50% of the total respondents. Below is a summary of the skills which were rated high (9-10) by 50% or more of the survey respondents in specific subject area groups. (Refer to Attachment C for complete list)

- Skills rated 9-10 by 50% or more of the respondents from at least three of the six subject areas included:
 - Q 11 -- basic algebra operations (algebra)
 - Q 22 -- Solve word problems (algebra)

- Additional skills rated 9-10 by 50% or more of the respondents from two of the six subject areas included:
 - Q 18 -- solve algebraic equations (algebra)
 - Q 39 -- linear equations (geometry)
 - Q 52 -- inductive and deductive reasoning (mathematical reasoning)

This is a total of five skills -- three in algebra, one in geometry and one in mathematical reasoning -- which clearly have importance across multiple subject areas.

Differing Perceptions of Importance

The data cited above (and listed fully in Attachment C) represent the perception of the importance of various mathematics skills to each unique discipline across multiple subject-area disciplines: math, natural sciences, social sciences, etc. The Table C data begin from the subject matter perspective, and reveal what percent of respondents from that subject area rated a given skill as very important (9-10) or not very important (1-2) for success in introductory courses for the stated subject matter.

Another way to consider the responses is to focus on the various skills themselves. Of all the respondents who rated a specific skill as very important for success, what percent of them came from the social sciences? The natural sciences? Attachment D presents the data in this fashion for all sixty skill items.

Looking specifically at the top five skill items, we can get a sense of the perceived importance of a skill in various subject areas by examining the high (9-10) scores it was

given. The key is to note the relationship between the overall percentage of respondents from a given subject area and to compare that to the percentage scoring a skill as 9 or 10. Items of interest include those where a difference of 30% or more exists between the participation rate and the rate ranking the skill as important.

Algebra

Q 11 Basic algebra operations

	% of item respondents	% scoring 9-10
Math	35%	45.5%
Natural Science	19.4%	20.8%
Prof Schs & CTE	19.5%	19.5%

Q18 Solve algebra equations

	% of item respondents	% scoring 9-10
Math	35%	47.3%
Natural Science	19.4%	20.3%
Prof Schs & CTE	20%	18.9%

Q22 Solve word problems

	% of item respondents	% scoring 9-10
Math	35.7%	43.8%
Prof Schs & CTE	20.4%	24.7%
Natural Science	18.5%	20.5%

Geometry

Q39 Linear equations

	% of item respondents	% scoring 9-10
Math	35%	50.9%
Natural Science	19.1%	26.3%
Social Science	15.3%	15.8%

Mathematical Reasoning

Q52 Inductive and deductive reasoning

	% of item respondents	% scoring 9-10
Natural Science	19.5%	27.4%
AHLL & Comm	10.1%	9.5%
Social Science	15.8%	33.3%

The highlighted items reflect a difference of 30% or more between the participation rate and the rate ranking the skill as important.

Q 11 and Q 18 – These skills are especially important in math

Q 39 – This skill is important in natural science as well as in math

Q 52 – This skill is particularly important to social science (at double the proportion of their overall participation) and is also important to natural sciences, but is not important to math faculty.

Survey Results in Context of Other Efforts

Survey results were compared to two other efforts undertaken in the state which also addressed the issue of more closely aligning high school exit expectations with college/work entry expectations.

- The first effort was an analysis by the Achieve organization of the content and performance standards of the Hawai'i Department of Education, known as Hawai'i Content and Performance Standards III (HCPS III). The state standards were compared to benchmark standards which Achieve had defined based upon best practices in other ADP states. The analysis by Achieve was reviewed by joint secondary-postsecondary Hawai'i teams who participated in two Alignment Institutes. These teams, in turn, made recommendations to the Hawai'i DOE and the DOE submitted a Quality Review Analysis in which they identified potential changes to the HCPS III.
- The second effort was a "Hawai'i Career Ready" study of local employers undertaken by Three Point Consulting. In this study, both front-line supervisors and higher level managers were asked, in focus groups, to identify skills essential to success in "career ladder" positions which might be filled by individuals who have only a high school education.

Post-Secondary Survey Results Compared to Achieve Analyses of HCPS Standards

Achieve's analysis of HCPS III standards noted a need to strengthen standards related to mathematical reasoning. (Refer to Attachment E to see Achieve's comments about standards ranked 0 or 1, as well as to see subsequent responses from Hawai'i DOE.) In addition, within a national context, Achieve has raised concerns about students' mastery of algebra and of data/statistics.

Post-secondary survey results for math are not as clear-cut as they are for English. No single skill received a rating of 9 or 10 from at least 50% of the total respondents. Of the five skills which surfaced as important from the survey, three are from algebra. The two other skills include geometry and mathematical reasoning.

Post-Secondary Survey Results Compared to Focus Group Sessions with Employers

The focus group sessions conducted with employers identified the following as ten essential mathematics skills:

- Understand coefficients of a linear equation, slope, and intercepts
- Solve problems using a linear equation in one variable

- Solve problems using an exponential function, e.g., compound interest*
- Identify and apply definitions related to lines and angles to solve problems
- Know properties of a circle and use them to solve problems
- Apply the Pythagorean theorem to solve problems*
- Use algebra to solve geometric problems
- Use basic right-triangle trigonometry to solve problems*
- Compute statistics including mean, median, standard deviation
- Evaluate data considering source, study design, sampling, etc.

There is significant discrepancy between these results and the results of the post-secondary surveys. Only one of the above ten skills -- using linear equations -- appears in the “top five” of the post-secondary survey. Furthermore, at least three of these ten skills (those marked with *) appear on the list of twenty skills consistently rated only 1 or 2 (on a scale of 1--10) in the post-secondary surveys.

Conclusions

Unlike a comparable survey regarding English language skills, the results of this survey do not reflect a high degree of consistency across the three areas of: 1) Achieve review of HCPS III, 2) opinions of local employers and 3) opinions of post-secondary faculty. It would appear that the definition of “college and career ready” -- in terms of math skills -- varies depending upon college major/ career field.

Additional research is needed in order to define “college and career readiness” in math. A good place to begin is with these five skills:

Algebra

- Q 11 -- basic algebra operations
- Q 18 -- solve algebraic equations
- Q 22 -- Solve word problems

Geometry

- Q 39 -- linear equations

Mathematical Reasoning

- Q 52 -- inductive and deductive reasoning

Additional comments from open-ended questions which may be relevant to “next step” discussions include:

Table 6. Frequency Distribution of Categorized Comments Made by Respondents

Category	Overall Total		University of Hawai'i		Private Institutions	
	Freq	%	Freq	%	Freq	%
Reading comprehension, writing skills	13	22.0	11	21.2	2	28.6
Study skills, time management skills	14	23.7	13	25.0	1	14.3
Basic math skills	21	35.6	21	40.4	0	0.0
Complete a pre-requisite course	2	3.4	2	3.8	0	0.0
Practical application of math skills	5	8.5	2	3.8	3	42.9
Other	4	6.8	3	5.8	1	14.3
TOTAL	59	100.0	52	100.0	7	100.0

This version has no attachments. The missing attachments include the following and are available by contacting Kathy Jaycox at Jaycox@hawaii.edu or 956-7678.

- Attachment A Campus Participation Data (1 page)
- Attachment B Course Specifics (2 pages)
- Attachment C Item-by-item data about low and high scores by subject area
(25 pages)
- Attachment D Frequency Distribution of Responses (14 pages)
- Attachment E Achieve side-by-side analysis of HCPS III with commentary
(22 pages)

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