Chapter One

Departments

Issue 0: Department Demographics

Key Indicator 0.0: Characteristics of instructional staff and student body
Sub Indicators
0.1 Instructional staff by tenure status and gender
0.2 Instructional staff by tenure status and race/ethnicity
0.3 Student characteristics by enrollments in departmental course offerings
0.4 Student admissions policies (mathematics requirements for admission)

Issue 1: Department goals and priorities

Key Indicator 1.0: Departmental emphasis on undergraduate instruction
Sub Indicators
1.1 FTE’s committed to undergraduate instruction; graduate instruction; service and research
1.2 Instructional staff by tenure status teaching lower-division courses
1.3 Instruction takes place in flexible settings
1.4 Facilities are available to enable the best possible teaching methods

Issue 2: Program maintenance and monitoring

Key Indicator 2.0: Departmental provision for review and revision of course goals and content
Sub Indicators
2.1 There is a written statement of department goals
2.2 A departmental syllabus exists for each course
2.3 Provisions are made in the department for the revision of courses
2.4 Course goals and content have changed within the past five years
2.5 Changes in course goals and content reflect recommendations of national reports
2.6 The department keeps abreast of the changing course needs of its students
2.7 The concerns of the department in choosing a text

Issue 3: Professional development and instructional staff support

Key Indicator 3.0: Departmental support of instructional staff
Sub Indicators
3.1 The department supports and encourages the professional development of its instructional staff in
the teaching and learning of mathematics
3.2 The department supports and encourages the professional development of its instructional staff in
the knowledge of and ability to do mathematics
3.3 The instructional staff is using instructional technologies in the classroom
3.4 The instructional staff is using innovative instructional approaches in the classroom
3.5 The instructional staff participates in professional associations

Issue 4: Partner Disciplines

Key Indicator 4.0: Departmental communication with partner disciplines about student needs and program
content
Sub Indicators
4.1 The goals of the department speak to the needs and desires of a wide range of users of the
mathematical sciences (that is, the ‘partner disciplines’)
Chapter One

Departments

In the mid 1990s, the Directorate for Education and Human Resources of the National Science Foundation commissioned a review of undergraduate education in Science, Mathematics, Engineering and Technology (SMET). Among the resulting recommendations were:

(College and university governing boards and administrators should)…

• provide resources to ensure that faculty, particularly new faculty, have the opportunity to both learn how to and have the time to design effective instruction, use technology appropriately, foster inquiry-based and collaborative learning and assess learning achieved. (George, Melvin D. (1996), p. 63)

(SMET departments should)…

• provide a curriculum that engages and motivates the broadest spectrum of students, enabling every student to learn… (George, Melvin D. (1996), p. 64)

Educational institutions explicitly or implicitly have goals that they try to accomplish. At colleges and universities, these goals typically reflect the relative priority given to instructional, research, and service activities. These goals also reveal to some degree the nature of the faculty and the students attending those institutions. Goals may be stable, in a state of gradual evolution, or chaotic in nature. They may be widely shared by the faculty and administration at department, college, and campus levels. The goals may be handed down from one level of administration to the next and finally to the department and faculty. They may be multi-faceted with different goals for different departmental programs. The kind of goals, the priorities, and how widely they are shared likely affect the climate of departments, how resources are allocated, and the kind and extent of effort that is put into instruction, research, and service activities.

In this chapter, we examine the nature of the goals of mathematics departments from a variety of vantage points. As we do, a number of questions are likely to arise, including: What are the department’s goals? How were they developed? What process was used to determine the priorities reflected in the goals? How are different courses, departmental programs, and students and their needs factored into the goal setting processes? What is the process for re-examining the goals from time to time and possibly altering the goals and their rank priorities? How widely held are these goals among the instructional work force? What assessment is made of departmental progress toward meeting the stated goals?
**Issue 0: Department Demographics**

**Key indicator 0.0 Characteristics of instructional staff and student body**

To begin to understand a department, one must have a feel for its composition. Thus, one of the first kinds of data that should be considered are those that give a demographic profile of the department. For example, it is important to know the make up of the instructional staff\(^1\): Its overall size as well as its composition by rank, gender, ethnicity, and interests. Such information allows one to begin to form a mental image of the people who comprise a department’s instructional staff.

**Indicator 0.1 Instructional staff by tenure and gender**

*Figure 1.0.1 [0.1] CU-In St Rank by Gender, n=17*

_Note on numbering convention:_
In ‘Figure 1.0.1 [0.1] CU’
1.0.1 Refers to: Chapter One, Issue 0, Sequence 1 (that is, first figure)
[0.1] Refers to Indicator 0.1
CU Refers to the comprehensive state university.

![Bar chart]

<table>
<thead>
<tr>
<th>Rank Type</th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ten'd</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Ten-Track</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Other FT</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PT</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>TA</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

Key:
Ten’d: tenured; Ten-track: tenure-track; Other FT: other full time; PT: part-time; TA: teaching assistant

A look at the three departments in the sample provides a variety of pictures. The department of the comprehensive state university (CU) consists of 7 tenured faculty, of which 5 are male. There are an additional 2 male faculty members who are in tenure eligible slots. The 4 part-time faculty are evenly divided along gender lines. Supporting these 13 faculty members are 4 graduate teaching assistants.

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\(^1\) ‘Mathematics instruction’, unless otherwise noted, refers to instruction at the first two years of college (lower division).

‘Instructional staff’ includes anyone who is engaged in the teaching of mathematics in the department, be they tenured faculty, adjuncts, teaching assistants, or others.
For the community college (CC) the picture is a bit different. The data show a department with 12 tenured faculty, 4 of which are female and the remaining 8 are male. In addition, another female and 6 male faculty are in tenure eligible slots. Beyond these 19 individuals, there is 1 full time female teaching along with 37 part-time faculty, 16 female and 21 male. Since CC is a community college, there are no graduate teaching assistants.

Figure 1.0.3 [0.1] RU-In St Rank by Gender, n=221

The mathematics department at the research university (RU) consists of 221 individuals in teaching roles. Of these, 66 are tenured, of whom 4 are female. An additional 7 faculty are in tenure eligible lines, 1 of which is female. Nine faculty members are full time but not tenure eligible: 4 female and 5 male. There are 2 part-time female and 1 part-time male instructors along with 38 female and 96 male graduate teaching assistants.

These data alone exhibit great diversity in the three departments. One is a developing state university campus with 17 individuals involved in its instructional mission in mathematics. Another is a public community college with 57 persons providing instruction at one level or another. The third is a major research, public university with 221 individuals involved in the university’s educational missions in the service of mathematics.
Indicator 0.2 Instructional staff by tenure status and race/ethnicity

Figure 1.0.4[0.2] CU-In St Race by Rank, n=16
Figures 1.0.4 through 1.0.6 display the composition of the instructional work face at each campus for tenure status by member of these racial/ethnic groups: Hispanic, American Indian, Asian, African-American, Hawaiian or Other Pacific Islanders, White, and other.
These data help portray the degree to which the instructional staff help serve as role models for members of their campus’ student body. In its 7 faculty members, CU had the only tenured Hispanic (1) and African American (1) faculty, as well as one Asian with tenure. CC reported one non-tenured Hispanic faculty out of 58, and RU 5 out of 221. The remaining tenured faculty members at the three campuses were white.
Student Data

Indicator 0.3 Student characteristics by enrollments in departmental course offerings

In terms of importance to a department, student data rank alongside data on the instructional staff. Tables 1.0.1 and 1.0.2 show the difference in student enrollment in selected lower division courses across the three campuses in fall, 1998.

Table 1.0.1[0.3]-Enrollments for Courses at CU

<table>
<thead>
<tr>
<th>Course</th>
<th>CU Enrolled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-algebra</td>
<td>0</td>
</tr>
<tr>
<td>College Algebra</td>
<td>104</td>
</tr>
<tr>
<td>Math for Elem Teachers</td>
<td>150</td>
</tr>
<tr>
<td>Liberal Arts Math (RU)</td>
<td>100</td>
</tr>
<tr>
<td>Technical Math</td>
<td>0</td>
</tr>
<tr>
<td>Elem Stats</td>
<td>0</td>
</tr>
<tr>
<td>Pre-calculus</td>
<td>40</td>
</tr>
<tr>
<td>Business/Soc Sci Calculus</td>
<td>120</td>
</tr>
<tr>
<td>University Calculus</td>
<td>60</td>
</tr>
<tr>
<td>Other Undergraduate</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
</tr>
</tbody>
</table>

Table 1.0.2[0.3]-Enrollment, withdraw, fail data for Courses at CC, RU

<table>
<thead>
<tr>
<th>Course</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Enrolled</td>
<td>Withdrew</td>
<td>Failed</td>
</tr>
<tr>
<td>Pre-algebra</td>
<td>283</td>
<td>65</td>
</tr>
<tr>
<td>College Algebra</td>
<td>297</td>
<td>105</td>
</tr>
<tr>
<td>Math for Elem Teachers</td>
<td>44</td>
<td>4</td>
</tr>
<tr>
<td>Liberal Arts Math (RU)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Technical Math</td>
<td>74</td>
<td>22</td>
</tr>
<tr>
<td>Elem Stats</td>
<td>203</td>
<td>35</td>
</tr>
<tr>
<td>Pre-calculus</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Business/Soc Sci Calculus</td>
<td>154</td>
<td>45</td>
</tr>
<tr>
<td>University Calculus</td>
<td>140</td>
<td>32</td>
</tr>
<tr>
<td>Other Undergraduate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Completed=Enrolled-withdrew-failed (withdrew, failed data not available for CU)

These data, along with reports on the number of students enrolling in courses and completing add to the picture of undergraduate instruction on each of the campuses. Also important in developing a portrait of a student body are data on the number of students judged ready for advanced placement upon entry, as well as those requiring remediation before they may start in credit bearing courses.
### Table 1.0.3

<table>
<thead>
<tr>
<th>Courses</th>
<th>CU</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>A Enrolled</td>
<td>B Completed</td>
</tr>
<tr>
<td>Pre-algebra</td>
<td>283</td>
<td>188</td>
</tr>
<tr>
<td>College Algebra</td>
<td>297</td>
<td>174</td>
</tr>
<tr>
<td>Math for Elem Teachers</td>
<td>44</td>
<td>36</td>
</tr>
<tr>
<td>Liberal Arts Math (RU)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Technical Math</td>
<td>74</td>
<td>42</td>
</tr>
<tr>
<td>Elem Stats</td>
<td>203</td>
<td>146</td>
</tr>
<tr>
<td>Pre-calculus</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Business/Soc Sci Calculus</td>
<td>154</td>
<td>105</td>
</tr>
<tr>
<td>University Calculus</td>
<td>140</td>
<td>100</td>
</tr>
<tr>
<td>Other Undergraduate</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td>1195</td>
<td>791</td>
</tr>
</tbody>
</table>

### Figure 1.0.8  CC-Retention Rates (see Table 1.0.3)

![Retention Rates](chart)
Upon looking at what numbers of these students see mathematics as their main focus, one can inspect the present year and average of the past three years in terms of number of mathematics majors. At CC, these numbers are 20 and 21 respectively. At CU the information is unavailable. At RU, the numbers are 599 and 618 respectively. (To be sure, there is a difference between a student declaring the major and actually completing it.) In 1998, 6 students at CU completed a mathematics major while 101 students completed the major at RU.
Indicator 0.4 Student admissions policies (mathematics requirements for admission)

Part of the progress made by students and their overall success in an undergraduate program may be attributed to the amount and quality of guidance that they receive from faculty, staff, and others as they move through their undergraduate programs. Three questions ask about institutional entrance requirements, how students are placed in their first mathematics course, and the degree to which this placement is binding on the student. Here, again, there are some wide differences in the three institutions.

At CC, a student can enter upon demand, as the community college has an open admissions policy. When students enter, they are given the ACT COMPASS adaptive testing battery to ascertain their current level of mathematical knowledge. Students are then advised by a mathematics staff member and required to follow that recommendation in enrolling in a mathematics course. Other information taken into account besides the COMPASS score are the results of an institutional placement examination, performance in previous high school courses, consultation with a general academic advisor, and transfer credit, if any.

At CU, a student must have at least three years of high school mathematics including at least Algebra I, Geometry, and Intermediate Algebra, plus a scale score that takes into account high school grade point average and SAT score. Students are then advised by a general advisor from their college, but are free to not follow the recommendations made by that advisor. Like CC, CU takes into consideration the student’s performance on the institutional placement examination, performance in previous high school courses, consultation with other advisement staff, and transfer credit.

RU requires 3 to 3.5 years of high school mathematics at the level of Algebra I or higher, with some programs of study requiring trigonometry. Students are advised by a member of the mathematics department staff, but like CU, are free to disregard that advice if they so choose. As at the other campuses, various kinds of information go into making the placement—institutional placement examinations, performance in previous work in mathematics or transfer credit, advanced placement scores, consultation with advisors from the student’s college and major program area, and, even, student desires.

<table>
<thead>
<tr>
<th>Course</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algebra</td>
<td>Required</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>Col Algebra</td>
<td>Required</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>Geometry</td>
<td>Required</td>
<td></td>
<td>Required</td>
</tr>
<tr>
<td>Trigonometry</td>
<td></td>
<td></td>
<td>May be required</td>
</tr>
</tbody>
</table>

These data points help fix the nature of a department’s allocation of resources to instruction, the placement of faculty in instructional positions within those programs, the number of students entering these programs and their distribution across identifiable sub-major programs of study, and the way that students come to know, and the universities’ role in helping them know, where to start their university study of mathematics.
Issue 1: Department goals and priorities

Key Indicator 1.0 Departmental Emphasis on Undergraduate Instruction

Related research:

Ewell (2001) has observed:
Numerous researchers on teaching and learning in collegiate settings have noted when an institution holds values about and orientation toward undergraduate teaching, such values are palpable and observable—and have a direct impact on the delivery and effectiveness of instruction (Astin, 1993; Gamson and Associates, 1984; Chickering, 1989) (page 22).

Indicator 1.1 FTE’s committed to undergraduate instruction; graduate instruction; service and research

Another major question of interest has to do with who carries the department’s instructional load. The following questions probe this area, asking first about generation of Full Time Equivalent (FTE) hours of credit by different groups of staff members. This allows the computation of the percentage of FTEs devoted to various levels of instruction.

Figure 1.1.1[1.1] Estimated allocation of InSt FTEs to CU departmental activities

Figure 1.1.2[1.1] Estimated allocation of InSt FTEs to CC departmental activities

Figure 1.1.3[1.1] Estimated allocation of InSt FTEs to RU departmental activities
At CC, 100% of the instructional time is devoted to undergraduate instruction. At CU, the FTE is divided 60% for undergraduate instruction, 20% for service, 20% for graduate instruction, and 0% for research. At RU, the percentages are 25% for undergraduate instruction, 5% for service, 20% for graduate instruction, and 50% for research. It is here that one begins to see differences in missions of the departments, at least as they devote their faculty time resources to differing activities. These activities, by the very nature of the particular campus, are consistent with the stated purposes of the respective institutions.

**Table 1.1.1[1.1]: Departmental weights for professional activities**

<table>
<thead>
<tr>
<th>Departmental mission/goals</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>0</td>
<td>70</td>
</tr>
<tr>
<td>Service</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Teaching</td>
<td>95</td>
<td>25</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Departmental tenure/review process</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>0</td>
<td>85</td>
</tr>
<tr>
<td>Service</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Teaching</td>
<td>95</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Departmental reward process</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>0</td>
<td>75</td>
</tr>
<tr>
<td>Service</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Teaching</td>
<td>90</td>
<td>20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>The average faculty member’s professional activity</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research</td>
<td>0</td>
<td>65</td>
</tr>
<tr>
<td>Service</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Teaching</td>
<td>90</td>
<td>30</td>
</tr>
</tbody>
</table>

*Note: Data for CU are missing.*

A further investigation into Table 1.1.1 gives an even more revealing look at the priorities of the departments. For CC, the emphasis across the board is teaching, as opposed to research and service, with 90% or more of the weights falling on teaching. Research is not included for consideration. We find RU on the opposite side of the spectrum, with the vast majority of the weight falling in the area of research, with teaching being a distant second consideration.

**Indicator 1.2 Instructional staff by tenure status teaching lower-division courses**

The extent to which undergraduate instruction plays a role in the department’s priorities is also shown by the weight given an instructor’s undergraduate teaching performance in considerations of a faculty member for tenure. At CC, it constitutes about 80% of the decision; at CU it is considered a necessary, but not sufficient, portion of the decision; and at RU, undergraduate instructional performance is reported to constitute about 20% of the decision weight for an individual’s tenure decision.

Another area where data are informative is in considering which undergraduate courses are taught by tenured, tenure eligible, other full-time, part-time, and graduate assistants on a particular campus.
Key:
Ten-track: tenure-track; Other FT: other full time; PT: part-time; TA: teaching assistant

Here the patterns are diverse and, for the three campuses studied, no general patterns emerge. However, in departments of other institutions, such data might provide a very telling story about faculty access to teach certain courses or neglect of certain courses by a department or department administration.
**Indicator 1.3 Instruction takes place in flexible settings**

Another block of survey items deals with the facilities available to the department for delivering instruction. CC and RU have dedicated classrooms for mathematics instruction, while CU shares its classrooms with other departments. Figures 1.1.11 to 1.1.16 contain information on the percentage of students taught in varying types of classrooms and some features of the classrooms used for mathematics instruction on the three campuses.

*Figure 1.1.11[1.3] CU-% of students taught in various instructional settings*

*Figure 1.1.12[1.3] CU-% of students taught in flexible settings*

*Figure 1.1.13[1.3] CC-% of students taught in various instructional settings*

*Figure 1.1.14[1.3] CC-% of students taught in flexible settings*

*Figure 1.1.15[1.3] RU-% of students taught in various instructional settings*

*Figure 1.1.16[1.3] RU-% of students taught in flexible settings*
Again, one sees relationships between facilities and decisions departments make. At RU one sees the fixed desks, which happen to be in lecture halls, and the lecture hall percentages. It should be kept in mind, however, that the relative newness of the CU and CC buildings may also be reflected in these data.

**Indicator 1.4 Facilities are available to enable the best possible teaching methods**

Besides the classroom setting discussed previously, the facilities which a department makes available for its instructors to use in teaching are an important indicator. Below are the responses of the three sites indicating what percent of students are taught in environments with various technologies. Of special note is the presence of both computers and calculators in CC classrooms reflecting, it would seem, recommendations of the AMATYC Crossroads Report.

*Table 1.1.17[1.4] Facilities available for instruction*

<table>
<thead>
<tr>
<th>% of students taught in classes with</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computers for instructor demonstration</td>
<td>0</td>
<td>40</td>
<td>5</td>
</tr>
<tr>
<td>Computers for student use</td>
<td>25</td>
<td>5</td>
<td>4</td>
</tr>
<tr>
<td>Graphing calculators for student use</td>
<td>10</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>Overhead projectors</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>VCR and display</td>
<td>100</td>
<td>90</td>
<td>5</td>
</tr>
<tr>
<td>Opaque or ELMO projectors</td>
<td>25</td>
<td>10</td>
<td>4</td>
</tr>
</tbody>
</table>
**Issue 2: Program maintenance and monitoring**

**Key Indicator: 2.0 Departmental provision for review and revision of course goals and content**

Once faculty are selected and students are admitted, the question of what happens in the department at an undergraduate level from an instructional standpoint becomes one of curriculum and delivery of instruction to those students. The structure of courses, the monitoring of the content of the courses, the articulation of the courses one with another, the types of instruction through which course content is delivered, the role played by technology, the forms of assessment, the expectations for student performance, and the out-of-classroom opportunities for mathematics experiences afforded by the program become signal indicators of health and vitality of the program.

**Indicator 2.1 There is a written statement of department goals.**

When considering the program as a whole, an indicator of a healthy program is whether or not the department has a list of goals that it is attempting to fulfill in the education of its students. Both CC and RU responded that they do have a written statement of goals that they are attempting to achieve, while CU responded that they do not, but they did include a mission statement which includes a list of goals. Below are the responses of the various sites with regards to what are concerns within their department. CU responded that they are prevalent concerns but they are not included in a goals-statement.

*Table 1.2.1[2.1] Goals of each site as reflected in their mission statements*

<table>
<thead>
<tr>
<th></th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>To prepare students for advanced study in mathematics</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>To prepare students for advanced study in mathematics-related fields</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>To prepare students to teach K-12 mathematics</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To serve the mathematical needs of diverse populations</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>To teach mathematics for its intrinsic value</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>To integrate technology into the curriculum</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>To provide opportunities for all students to learn mathematics</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>To encourage InSt in effective teaching</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>To create learning communities for IWF and students</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>To collaborate with other departments in setting goals for education</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>To encourage and promote interdisciplinary educ.</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>
Indicator 2.2 A departmental syllabus exists for each course

Table 1.2[2, 2] Provision by each site of a departmental syllabus by course.

<table>
<thead>
<tr>
<th>Course</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Algebra</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Coll. Algebra</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Math for Elementary Teachers</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Liberal Arts Math</td>
<td>No</td>
<td>Not Applicable</td>
<td>Yes</td>
</tr>
<tr>
<td>Math for Tech. Prep.</td>
<td>No</td>
<td>Yes</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Elementary Statistics</td>
<td>No</td>
<td>Yes</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Pre-Calculus</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Calculus for Business/Social Sci.</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Calculus</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Other</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Central to the extent of a program’s impact is the health of its curriculum. For example, how well is the curriculum developed, monitored, restyled, and communicated to all involved? One of the first questions in the area of a department’s academic program is whether or not the department had a written departmental syllabus for a number of courses ranging from pre-algebra through liberal arts offerings to the university calculus. Two of the three institutions reported that they had syllabi for the courses which they offered and were relevant to the study. CC did not have a liberal arts mathematics course, CU did not have a technical mathematics course, and RU did not have either a technical mathematics or elementary statistics course. RU reported having a liberal arts mathematics course, but did not have a departmental syllabus for it, leaving its content up to the discretion of the individual instructor. RU reported not having an elementary statistics course because it has a statistics department that offers such courses, and other departments (economics, psychology) offer relevant introductory statistics courses as well.

Indicator 2.3 Provisions are made in the department for the revision of courses

In answer to the question, all three sites responded that they do provide opportunity for both the department and members of the INSTRUCTIONAL STAFF to offer suggestion for course and curriculum revision.

Indicator 2.4 Course goals and content have changed within the past five years

The recency of a course syllabus is also an indicator of the care that a department affords its curriculum. Data from CU and RU indicate the recency that several of the core courses have relative to review and oversight by the department. In the cells of Table 1.28, the dates reflect the information from two of the campuses (CU and RU).
Table 1.2.3 [2.4] Changes of course goals and content (CU)

<table>
<thead>
<tr>
<th>Course</th>
<th>Revision of Course Goals</th>
<th>Revision of Course Content</th>
<th>Change of Course Text</th>
<th>Revision of Course Syllabus</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Algebra</td>
<td>Fall 98</td>
<td>Fall 98</td>
<td>Fall 98</td>
<td>Fall 98</td>
</tr>
<tr>
<td>Math for Elem. Teach.</td>
<td>Fall 94</td>
<td>Fall 94</td>
<td>Fall 94</td>
<td>Fall 94</td>
</tr>
<tr>
<td>Liberal Arts Math</td>
<td>Fall 95</td>
<td>Fall 95</td>
<td>Fall 95</td>
<td>Fall 95</td>
</tr>
<tr>
<td>Calculus for Business</td>
<td>Spring 98</td>
<td>Spring 98</td>
<td>Fall 98</td>
<td>Spring 98</td>
</tr>
<tr>
<td>University Calculus</td>
<td>Fall 99</td>
<td>Spring 99</td>
<td>Fall 2000</td>
<td>Fall 2000</td>
</tr>
</tbody>
</table>

Table 1.2.4 [2.4] Changes of course goals and content (CC)

<table>
<thead>
<tr>
<th>Course</th>
<th>Revision of Course Goals</th>
<th>Revision of Course Content</th>
<th>Change of Course Text</th>
<th>Revision of Course Syllabus</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Algebra</td>
<td>Not present</td>
<td>Not present</td>
<td>1996</td>
<td>1996</td>
</tr>
<tr>
<td>Liberal Arts Math</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Calculus for Business</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>1995</td>
<td>1995</td>
</tr>
<tr>
<td>University Calculus</td>
<td>Not present</td>
<td>Not present</td>
<td>1992</td>
<td>1992</td>
</tr>
</tbody>
</table>

Table 1.2.5 [2.4] Changes of course goals and content (RU)

<table>
<thead>
<tr>
<th>Course</th>
<th>Revision of Course Goals</th>
<th>Revision of Course Content</th>
<th>Change of Course Text</th>
<th>Revision of Course Syllabus</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Algebra</td>
<td>Spring 92</td>
<td>Spring 92</td>
<td>Spring 92</td>
<td>Spring 92</td>
</tr>
<tr>
<td>Math for Elem. Teach.</td>
<td>Fall 98</td>
<td>Fall 98</td>
<td>Fall 96</td>
<td>Fall 98</td>
</tr>
<tr>
<td>Liberal Arts Math</td>
<td>Fall 96</td>
<td>Fall 96</td>
<td>Fall 96</td>
<td>Fall 96</td>
</tr>
<tr>
<td>Calculus for Business</td>
<td>Fall 94</td>
<td>Fall 94</td>
<td>Spring 97</td>
<td>Spring 97</td>
</tr>
<tr>
<td>University Calculus</td>
<td>Fall 90</td>
<td>Fall 90</td>
<td>Fall 97</td>
<td>Fall 97</td>
</tr>
</tbody>
</table>

Indicator 2.5 Changes in course goals and content have changed within the past five years

The data in Tables 1.2.6 and 1.2.7 provide evidence reported by the three departments of increased emphasis on aspects of mathematics teaching and learning that are recommended by such reports as the George Report (NSF, 1996). All three sites report more emphasis at the department level on calculator usage, cooperative learning strategies and collaboration with the partner disciplines. The fact, already noted (Indicator 1.4) that classroom facilities were not yet equipped with calculators and computers for instruction, will doubtless have to be addressed if these departmental emphases are to become a classroom (instructional) reality.
Table 1.2.6 [2.5] Educational Issue and/or practice receiving SAME emphasis

<table>
<thead>
<tr>
<th>Issue</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using ‘reform’ textbook (such as Harvard Project calculus)</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using calculators for instruction</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using software (such as Geometer’s Sketchpad, etc) for instruction</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Using cooperative learning strategies</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using writing as a key component of student assignments</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Collaborating with ‘partner disciplines’ to revise and develop courses</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1.2.7 [2.5] Educational Issue and/or practice receiving MORE emphasis

<table>
<thead>
<tr>
<th>Issue</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using ‘reform’ textbook (such as Harvard Project calculus)</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Using calculators for instruction</td>
<td>x</td>
<td></td>
<td>x</td>
</tr>
<tr>
<td>Using software (such as Geometer’s Sketchpad, etc) for instruction</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using cooperative learning strategies</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using writing as a key component of student assignments</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Collaborating with ‘partner disciplines’ to revise and develop courses</td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Indicator 2.6 The department keeps abreast of the changing course needs of its students

Another indicator of curriculum vigilance is the degree to which a department adds and subtracts courses from its catalog. The three institutions answered this with the following responses 35/22, 4/1 and 8/0 for additions/subtractions for CU, CC and the RU respectively. See Figure 1.2.6. It is noted that since CU is a new campus, there is an unusually large number of additions and removals of courses in the given time period.

Figure 1.2.6[2.6] Courses added and removed from course offerings in the past five years
**Indicator 2.7 The concerns of the department in choosing a text**

When asked what the top concerns were in the selection of texts, different issues arose on the three campus sites. Table 1.2.7 shows the different views expressed by the departments.

*Table 1.2.7[2.7] Three most important factors in choosing a mathematics text*

<table>
<thead>
<tr>
<th>Factors</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Readability</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depth of concept coverage</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Coverage of concepts</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Sequence of concepts</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>In-text examples</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Difficulty of problem sets</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Variety of problem types</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Use of technology</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Presence of projects</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Presence of alternative assessments</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Indicator 3.0 Departmental support of instructional staff

Indicator 3.1 The department supports and encourages the professional development of its instructional staff in the teaching and learning of mathematics

An important aspect of maintaining a strong instructional work force is that of providing support and professional development opportunities for instructors at all levels of experience and academic rank. All three campuses indicated that they have, in the last 3 years, had faculty participating in short courses and workshops on either mathematics content or instructional issues, orientation sessions for new faculty, observations of classroom teaching by peers or outside specialists, periodic discussion groups on current trends and issues in the teaching and learning of mathematics, and physical office space and material support for TAs and part-time staff. Similarly, all three campuses reported providing instructors with graphing calculators, computer software for instruction, and textbooks and other print material for instruction. CU and RU also provided instructors with calculators, computer hardware, and software for research, as well as textbooks and other materials related to faculty research activities.

Table 1.3.1 [3.2] Availability of support for teaching

<table>
<thead>
<tr>
<th>Types of professional support available in the past 3 years</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Meetings etc. on mathematical content</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Meetings etc. on curricular/instructional issues</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Orientation/training on effective teaching for new staff</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Mentoring program for instructional staff</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Observation of classroom by peers/outside specialists</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Periodic discussion groups on trends in teaching mathematics</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Physical support provided to part time faculty/TAs</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>

Indicator 3.2 The department supports and encourages the professional development of its instructors to grow in the knowledge and ability to do mathematics.

CC and RU had departmental policies encouraging the participation of instructional staff in both internal and external workshops/meeting/seminars/short courses dealing with instructional issues in mathematics. RU also had the same for meetings dealing with mathematical research. However, while CC made the instructional meetings a criterion for annual review, RU alone reported using the research meetings for their annual review of performance.
Indicator 3.3: The instructional staff is using instructional technologies in the classroom

Table 1.3.2 [3.3] Use of instructional technologies at three sites

<table>
<thead>
<tr>
<th>Course</th>
<th>Instructional Technologies</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CU</td>
</tr>
<tr>
<td></td>
<td>CC</td>
</tr>
<tr>
<td></td>
<td>RU</td>
</tr>
<tr>
<td>Graphing Calculators</td>
<td></td>
</tr>
<tr>
<td>Computers</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Course</td>
<td>CU</td>
</tr>
<tr>
<td></td>
<td>CC</td>
</tr>
<tr>
<td></td>
<td>RU</td>
</tr>
<tr>
<td>College Algebra</td>
<td>Always used</td>
</tr>
<tr>
<td></td>
<td>Used rarely</td>
</tr>
<tr>
<td></td>
<td>Always used</td>
</tr>
<tr>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>Math for Elem. Teach.</td>
<td>Used rarely</td>
</tr>
<tr>
<td></td>
<td>Used often</td>
</tr>
<tr>
<td></td>
<td>Used often</td>
</tr>
<tr>
<td></td>
<td>Used rarely</td>
</tr>
<tr>
<td></td>
<td>Used often</td>
</tr>
<tr>
<td>Liberal Arts Math</td>
<td>Used rarely</td>
</tr>
<tr>
<td></td>
<td>Used rarely</td>
</tr>
<tr>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td></td>
<td>Not applicable</td>
</tr>
<tr>
<td>Calculus for Business</td>
<td>Always used</td>
</tr>
<tr>
<td></td>
<td>Used rarely</td>
</tr>
<tr>
<td></td>
<td>Used always</td>
</tr>
<tr>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td>University Calculus</td>
<td>Used often</td>
</tr>
<tr>
<td></td>
<td>Always used</td>
</tr>
<tr>
<td></td>
<td>Used always</td>
</tr>
<tr>
<td></td>
<td>Not used</td>
</tr>
<tr>
<td></td>
<td>Varies</td>
</tr>
<tr>
<td></td>
<td>Varies</td>
</tr>
</tbody>
</table>

Note: 0 = Not used; 1 = Used occasionally, but not frequently; 2 = Used frequently; 3 = Used almost always.

For discussion of Table 1.3.2, see below (included in discussion of Indicator 3.4).

Indicator 3.4: The instructional staff is using innovative instructional approaches in the classroom

Another feature of information about a department consists of the degree to which its faculty and courses make use of differing instructional approaches and technology. It is also interesting to see how a department’s responses to such questions vary across different courses—courses for preservice teachers, for students taking university study courses, and for majors. The data in 1.3 indicates the usage and degree of usage of different instructional features for common courses at the three campuses.
Here again we see considerable variation in the responses to the use of instructional approaches and technology across the three different institution types and campuses. The conduct of calculus at RU involves three different approaches: one uses Ostebee-Zorn, one is computer delivered (Calculus & Mathematica), and the third is a traditional course taught out of Stewart. Across these, one sees heavy usage of graphing calculators in the Ostebee-Zorn approach, but not in either of the other section types.

Computer usage is extensive in the Calculus and Mathematica sections and not the others. Projects receive a 3 in Calculus & Mathematica, but 0 in the other sections. All three approaches rate written assignments as a 2, while Small group work gets a 3 in Ostebee-Zorn sections, a 2 in Calculus & Mathematica sections, and a 0 in the traditional sections. Again, we see the value of an indicator in setting up comparisons for achievement studies and other analyses of student outcomes.
Other comparisons of this type can ask about the use of modeling approaches, applications, and multiple mathematical representations as major aspects of instructional delivery of undergraduate courses. Such questions help round out a picture of a department’s emphases on helping connect the mathematics studied with the real world outside the classroom in a variety of fashions.

**Table 1.3.6[3.4] Instructional Innovations**

<table>
<thead>
<tr>
<th>Course</th>
<th>CU</th>
<th>CC</th>
<th>RU</th>
</tr>
</thead>
<tbody>
<tr>
<td>College Algebra</td>
<td>Not used</td>
<td>Used often</td>
<td>Not used</td>
</tr>
<tr>
<td>Math for Elem. Teach.</td>
<td>Not used</td>
<td>Used often</td>
<td>Used often</td>
</tr>
<tr>
<td>Liberal Arts Math</td>
<td>Used rarely</td>
<td>Used often</td>
<td>Used rarely</td>
</tr>
<tr>
<td>Calculus for Business</td>
<td>Used rarely</td>
<td>Used often</td>
<td>Used rarely</td>
</tr>
<tr>
<td>University Calculus</td>
<td>Used always</td>
<td>Used often</td>
<td>Data missing</td>
</tr>
</tbody>
</table>

*Note: Proj. Lab: Project/Lab Assignments; Writing: Written Assignments; Sm Group: Small Group Work in Class*

**Figure 1.3.7[3.4] CU Instructional Innovations**
Figure 1.3.8[3.4] CC Instructional Innovations

Figure 1.3.9[3.4] RU Instructional Innovations
Indicator 3.5: The instructional staff participates in professional associations

Table 1.3.7[3.5] Percentage of instructional staff belonging to professional organizations (responses are to as many categories as apply)

<table>
<thead>
<tr>
<th>Organization</th>
<th>CU (N=7)</th>
<th>CC (N=15)</th>
<th>RU (N=68)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mathematical Assoc. of America (MAA)</td>
<td>57</td>
<td>20</td>
<td>22</td>
</tr>
<tr>
<td>American Statistical Assoc. (ASA)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>American Mathematical Society (AMS)</td>
<td>57</td>
<td>7</td>
<td>78</td>
</tr>
<tr>
<td>American Educational Research Assoc.(AERA)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Society for Industrial and Applied Mathematics (SIAM)</td>
<td>29</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>American Mathematical Assoc. for Two Year Colleges (AMATYC)</td>
<td>0</td>
<td>80</td>
<td>1</td>
</tr>
<tr>
<td>National Council of Teachers of Mathematics (NCTM)</td>
<td>29</td>
<td>20</td>
<td>1</td>
</tr>
<tr>
<td>Assoc. for Women in Mathematics (AWM)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Assoc. for Research in Undergraduate Mathematics Education (ARUME)</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

Table 1.3.7, which displays, instructional staff membership in professional organizations, reflects the nature of the campus to which the respondents belong. For CC, membership in AMATYC is most frequent. For CU, MAA and AMS attract equal numbers, with somewhat lower participation in SIAM and NCTM. The research orientation of RU is reflected in the predominance of AMS members.
Issue 4: Partner Disciplines

Indicator 4.0 Departmental communication with partner disciplines about student needs and program content

Indicator 4.1: The goals of the department speak to the needs and desires of a wide range of users of the mathematical sciences (that is, the ‘partner disciplines’)

Another area of potential input into the curriculum is faculty from partner disciplines or individuals from career related areas. CC reported consulting with both sources of input at least once in every five years. CU met with partner departments at least once a year. RU met with both sources more than once a year. Table 8 reflects the various levels of interaction for the curricular sources at the three campuses.

Table 1.4.1 [4.1] Curricular input from partner disciplines or career areas

<table>
<thead>
<tr>
<th></th>
<th>Engineering</th>
<th>Life/Physical Sciences</th>
<th>Social Sciences</th>
<th>Business</th>
<th>Education</th>
</tr>
</thead>
<tbody>
<tr>
<td>Formal mechanism to discuss curricular change</td>
<td>CC,CU,RU</td>
<td>CC,CU,RU</td>
<td>CC,CU,RU</td>
<td>CC,CU,RU</td>
<td></td>
</tr>
<tr>
<td>Interdisciplinary coursework in place</td>
<td>RU</td>
<td>RU</td>
<td></td>
<td></td>
<td>RU</td>
</tr>
<tr>
<td>Joint proposals for curricular change</td>
<td>CC,RU</td>
<td>CC,RU</td>
<td></td>
<td>CU</td>
<td>CC,CU,RU</td>
</tr>
<tr>
<td>Partner discipline helps in the setting of goals</td>
<td>CC,RU</td>
<td>CC,RU</td>
<td>RU</td>
<td>CU,RU</td>
<td>CU,RU</td>
</tr>
<tr>
<td>Partner discipline helps set and monitor student performance in courses</td>
<td>RU</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Partner discipline helps in the selection of technology for course</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CU</td>
</tr>
</tbody>
</table>

CC reported that major curricular changes initiated from within their department. CU responses suggest that the initiation of change was more of a shared responsibility when issues lapsed over department lines. They indicated that with life/physical sciences, business, and education the initiation could originate in either the partner department or the mathematics department, but was generally a joint effort. RU, on the other hand, reported that engineering and the life/physical sciences generally took the leadership for courses affecting their majors, while joint efforts were usually the case for activities involving business or education departments.

Summary

In this chapter, it has been demonstrated with data from three differing campuses the nature of questions that are contained in the indicators for undergraduate mathematics education that deal with departmental and institutional factors. The chapter helps illustrate how data so collected might be used in addressing issues of importance to administrators, faculty, state officials, or the lay public, concerning policy matters as well as overall governance and progress of a mathematics department. The data assist in painting a portrait of the department—its goals, its actions, and its accomplishments. Ways of documenting change over time are also exhibited. Finally, it is noted that such data offer a way of helping a department monitor its activities—its progress, or non-progress—in informative ways.