

To: Barbara Watkinson, Chair, EPC, and David Aday, Chair, Assessment Committee

From: GER1 Working Group (Robert Archibald, Harvey Langholtz,, George Rublein, and David Lutzer, Chair)

Date: November 10, 2000

Re: Report of the GER1 Working Group to questions posed by EPC

The Working Group has completed its assessment of GER1 courses and hereby submits its final report to EPC and the Assessment Office. The format of our report is to answer each of the fifteen questions posed to us by EPC. We particularly want to call EPC's attention to our responses to Question 1 and Question 9, and to the attached appendix containing a letter sent to us by the Mathematics department Undergraduate Curriculum Committee.

ANALYSIS OF COURSE PORTFOLIOS: TABLE 1

Question 1. Based on analysis of student work and other course portfolio materials, how well is each of the GER1 criteria being met?

- a) What types of courses would clearly meet each criterion?
- b) What types of courses would not meet each criterion?

Answer 1: Our portfolio analysis (including syllabi, hour examinations, final examinations, special project assignments, and samples of student work) led us to believe that all of the GER1 courses that we reviewed are fulfilling GER1 requirements.

This consensus in the Working Group is based on certain interpretive decisions that we made after our initial meeting to score a set of sample portfolios. After discussion of the portfolios and the GER1 requirements, we concluded that there are really three central questions lying at the heart of what it means to be a GER1 course, namely:

- *a) To what extent did the given course involve numerical calculations?
- *b) To what extent did the given course involve mathematical justifications that explain why the approaches and calculations used in the course actually work?
- *c) To what extent did the given course involve applications to real-world settings or to disciplines other than mathematics?

EPC will observe that we used these three questions as the basis of our surveys of students and faculty.

Portfolio analysis led us to believe that all GER1 courses reviewed meet (*a) very well. We agreed that all mathematics GER1 courses meet (*b) very well, and that all social science GER1 courses meet (*b) at least adequately, provided one takes a realistic view of what "mathematical justification" should mean in a social science course. (See also Answer 9-b, below.) Furthermore, we concluded that all social science GER1 courses satisfied (*c) very well, and that the mathematics GER1 courses satisfy (*c) at least adequately, provided one takes a reasonable attitude toward what constitutes an application. (See also

Answer 9-a, below.) Finally, so long as the required calculus labs contain the kind of applied material that we reviewed in our study, then we agree that Math 111 and Math 112 satisfy (*c) more than adequately.

Question 2. Do the student survey responses support the portfolio analyses? If not, please explain.

Answer 2: In this answer, we refer to items (*a), (*b), and (*c) that we listed in Answer 1 above.

Table 1 shows that students' responses agree with portfolio analysis findings on item (*a) (numerical calculations). Over 90% of students give a score of 4 or 5 (where 5 = very much) on this question. Students were less convinced concerning item (*b)(mathematical justification in their courses), with only 52% giving a score of 4 or 5. In some ways, this is consistent with what was found through portfolio analysis: recall that the portfolio analysis also revealed less consensus among Working Group members about the existence of mathematical justification than about the existence of numerical calculations. On item (*c)(applications), students were even less convinced that their courses met this goal. Recall that the portfolio analysis results for (*c) were also less than for (*a). This lower level of students response to (*c) could be due to students in beginning mathematics courses being confused about what constitutes an application. (See also Answer 9-a, and the attached memo from the Mathematics Undergraduate Curriculum Committee.)

While we wish that the applicability of the GER1 mathematics courses was clearer to students, even after seeing the student responses in Table 2, we reiterate our overall conclusions as reported in Answer 1.

Question 3. For the GER1 course criteria, do you find any significant differences between:

- a) Student and faculty responses (Table 3)
- b) Instructor rank (Tables 4a and 4b)
- c) Course level (Tables 5a and 5b)
- d) Class size (Table 6)
- e) Student class status (Table 7)
- f) Department (Table 8)

Answer 3: In this answer, we refer to items (*a) (numerical calculations), (*b) (mathematical justification), and (*c) (applications) that we listed in Answer 1 above.

3-a) Table 1 shows that faculty respond more positively than students to all three questions about GER1 components of their courses, with the greatest difference occurring on the applications question (3.8 for students, and 4.3 for faculty). We ascribe this to the faculty members' deeper insight into how the subject matter of their courses is actually used, and we do not see this disagreement as indicating a problem with the courses. See also Answer 9-a below, and the attached appendix from the Mathematics department about applications.

3-b) We see no significant response differences based upon instructor rank.

3-c) Table 5a reveals a noticeable difference in students' responses to the applications question based upon level of the course (3.6 v. 4.3). This is easy to explain. Readers need to understand that the lower-division

GER1 courses are in the Mathematics department, while the upper-division GER1 courses are all in the social sciences. As a result, the upper-division GER1 courses were able to focus much more tightly on specific kinds of applications in their discipline, and with the result that the students were much better prepared to recognize an application when they saw one. The GER1 Working Group does not see this difference as reflecting any problem in the lower division GER1 courses.

Table 5b reveals a marked difference between lower- and upper-division GER1 courses in portfolio analysis scores (2.9 v. 2.0 on a 3 point scale) on the “mathematical theory” question. The Working Group is not surprised, because the lower division GER1 courses are in the mathematics department, while upper-division GER1 courses are not. The Working Group does not believe that Table 5b reveals any problem.

3-d) Table 6 reveals little or no variation in student responses to item (*a) (numerical calculations) based on class size. However, Table 6 reveals considerable variations in responses to items (*b) (mathematical justification) and (*c) (applications) based on class size. As in question 3-c above, we suspect that this is a departmental issue rather than a class size issue. Of the courses surveyed, only Math 106 was taught in size > 75 , and only Math 104 and Econ 307 were taught in size 41 – 75. All Calculus courses were in the 20 – 40 range, and only Psy 301 classes were taught in size < 20 . Therefore, the most of the variation in Table 6 is probably explained by our comments in 3-c, above. The one exception is in the size > 75 category, which consists of Math 106. The Mathematics department is surprised by the relatively low scores in Math 106 on both items (*b)(mathematical justification) and (*c) (applications). However, the department has pointed out to us that since the surveys in our GER1 assessment were completed, Math 106 has undergone a substantial curricular revision under the guidance of a recently hired statistician, and the department believes that future GER1 assessments will show that student reactions to the course will improve.

3-e) Table 7 shows little variation by class status to item (*a)(numerical calculations). The variation in responses to item (*b)(mathematical justification) varies only a little across classes. We do not have any explanation for why juniors see less mathematical justification than any other class in their GER1 classes, but we do not find the difference (3.8 v. 4.0) to be a cause for concern. Only in terms of item(*c) (applications) is there any marked variation based on class size, and we believe that on this question, class size is a proxy for department (because freshman-level GER1 classes are all taught in mathematics while upper division GER1 courses are all social science methods courses).

3-f) See response 3-c) above. The departmental distinction is the same as the distinction between lower-division and upper-division GER1 courses. However, we were somewhat surprised to see the difference in student responses to item (*b) (mathematical justification) between the Economics and Psychology departments. Based on our portfolio review, we would have expected students to find more mathematical justification in Econ 307 (which includes more emphasis on the probabilistic bases for statistical tests and includes some proofs of mathematical assertions) than in the Psychology courses that we reviewed. However, see also our response 9-b below about what “ mathematical justification” means in a social science course.

GER1: OVERALL ASSESSMENT

Question 4. To what extent are GER1 courses meeting the overall goals of GER1?

Answer 4: We reviewed almost all of the courses that offer GER1 credit, and we believe that these courses are meeting the overall goals of GER1.

Question 5. Based on portfolio and/or survey analysis, do you have any additional comments about GER1 courses?

Answer 5: Yes. For details, please see Answers 9-a and 9-b below.

Question 6. Did you have any difficulty interpreting the Definition and Elaboration of Criteria for GER1?

Answer 6: Yes. The Elaboration of Criteria includes three introductory sentences (“Courses offered by ... tools for their analysis”) and then lists two requirements that must be satisfied by any GER1 course. The question is: do the three introductory sentences list anything different from what is included in the specific requirements called A) and B)? Or are they introductory comments intended to explain the intent of GER1 as encapsulated in A) and B)?

After discussion among Working Group members, we decided that the first three sentences were explanatory rhetoric, whose essence was boiled down in requirements A and B. Others, as evidenced by the portfolio scoring sheets prepared by the Assessment Office, saw each of the introductory sentences as separate GER1 criteria that required a separate assessment question.

In addition, there was some confusion in our Working Group about the meaning of “quantitative reasoning” in the title of this requirement until we noticed that A) defines “quantitative reasoning” as being synonymous with the use of numerical procedures.

Finally, we observed that different departments interpret the phrase “mathematical theory as justification” (appearing in requirement B) quite differently. Does this phrase, for example, require social science departments to explain the probabilistic justification that underlies statistical methods, as would Math 402 (a course in mathematical statistics)? Our Working Group decided that such an interpretation was not reasonable. See also Answer 9-b), below.

Question 7. Is the EPC’s GER designation request clear?

Answer 7: Before answering Question 7, we want to report that Question 7 as sent to us by EPC is itself not clear. What is EPC’s “designation request”? The answer, as we eventually learned from Susan Bosworth, is that EPC means to ask about the form used by departments to request GER1 certification for a given course. Please make that clearer in the list of EPC questions sent to future GER assessment projects. In addition, please give a url where the relevant “designation request form” can be found. While we eventually found the designation request form, it was only through a circuitous route.

In addition to a change in Question 7 itself, we strongly suggest that the web page on which the designation request form resides should be re-titled. The very top lines on the form should say “REQUEST FOR GER1 CLASSIFICATION.” As currently configured, the on-line form begins as if it were an archival statement of what it takes to be a GER1 course. The first 14 lines say nothing about being a request form. Why is that important? It is important because typical Netscape browsers display only the top 14 lines of the form. If one is searching for a designation request form and discovers the current form, one’s natural impulse is to assume, given the first 14 lines of the current web page, that one has reached the wrong page.

With those two paragraphs out of the way, we can report that EPC’s designation request form is clear.

Question 8. Does the EPC’s GER designation request address the GER1 criteria?

Answer 8: The three questions at the bottom of the GER1 designation request forms are exactly right.

Question 9. Based on GER1 assessment results, do you have any suggestions for EPC?

Answer 9: Yes. See 9-a and 9-b below for some curricular comments and suggestions, and see 9-c for suggestions about a curricular practice that our Working Group discovered.

9-a. What is an application of mathematics? This question is not as simple as it seems. We quote from a mathematics department memo in the Appendix concerning the question “What makes a course adequately applied?”

Planets, as Galileo and Newton taught us, follow elliptical orbits. Does this make the study of the analytic geometry of the ellipse an applied topic? What if the course mentions that planetary motion follows elliptical orbits? What if ellipse problems are rephrased using planets (e.g. “A planet follows the curve $3x^2 + 5y^2 = 6$. Find the foci of that elliptical orbit.”)? What if the course presents Newton’s reasoning to show that the inverse-square law for gravitational attraction forces planets into elliptical orbits? At some level between the analytic geometry of the ellipse and Newton’s derivation, one certainly has an applications oriented topic. It is very difficult to judge where the cut off occurs, and we believe that the department is best qualified to judge that curricular issue, in the light of the faculty’s GER1 guidelines.

This is a delicate issue and the College needs to understand that reasonable people can disagree about whether a given topic is an application of mathematics.

We found a mixture of application-oriented problems in Math 111 and Math 112. In our view, some of the allegedly applied problems posed on examinations in Math 111 and Math 112 are artificial constructs that have no real applied value (although some had, and were intended to have, considerable amusement value). At the same time, we found other problems in the calculus laboratories to be really applications-oriented. Indeed, the thing that convinced us that Math 111 and Math 112 really meet the GER1 applications guideline was the material in their calculus laboratories. Our view is that, as long as these laboratories contain the kind of applications material that we reviewed, then the rest of the courses and the in-class examinations can be held to a looser standard of applicability. We suggest that EPC endorse this decision and communicate it to the Mathematics department.

We attach a memo from the mathematics department Undergraduate Curriculum Committee as an appendix to this report. In addition to the paragraph quoted above, it argues that there are broad mathematical methods (modeling and optimization) that are corner stones of the practice of applied mathematics, and that the process of “model building” ought to be mentioned in the GER1 interpretive guidelines as a desirable feature of any GER1 course. Our Working Group endorses that view.

9-b) What does it mean to say that a given topic is “accompanied by mathematical theory as justification”? This question is also not as simple as it seems. Does it mean that social science departments must justify the techniques discussed in their statistical methods courses by explaining the probabilistic bases for statistical tests as in a mathematical statistics course such as Math 402? Or is it sufficiently theoretical to include a careful discussion of why a certain kind of problem calls for using this statistical test and not that one? The Working Group’s view was that, while we applaud asking why this or that statistical method works, it is the second option that is the most reasonable to expect in a social science GER1 course.

9-c) We believe that we encountered a practice in one section of a Psychology course that needs to be reviewed by EPC. Psy 301 is approved for GER1 credit. There is a second semester follow up of this course

(Psy 302), dealing with different material. Certain sections of Psy 301-302 are taught in an integrated way, with the material from the two courses intertwined. In those sections of Psy 301, students are told at the outset that they will not receive GER1 credit until they successfully complete both Psy 301 and Psy 302, because it is not until the end of the sequence that students will have had all of the material for which GER1 credit is given. This practice raises questions in our minds. Even after consulting the Psychology department, our committee had trouble understanding how GER1 credit approved for Psy 301 could be postponed in this way.

Please understand that we are not arguing against the pedagogical decision to intermix the course topics of Psy 301 and 302. That is not our business. However, after an exchange of correspondence with our Working Group, the Psychology department seems ready to propose that a new course number be created for the intertwined version of Psy 301-302 and that GER1 credit be associated with the second course in the new sequence. We recommend that EPC encourage the Psychology department to submit such a proposal and approve it when it arrives.

In addition, at least three of the four of us agree that EPC should make it clear to all that no department may unilaterally tell students that a course approved for GER 1 credit does not actually grant that credit.

Question 10. Were the expectations for this assessment clear?

Answer 10: Yes.

Question 11. Was the assessment process clear?

Answer 11: Yes.

Question 12. Did you have difficulty developing the portfolio scoring sheets and surveys?

Answer 12: We did not develop the portfolio scoring sheets; that was done by the Assessment Office (see Answers 13 and 15, below). We had little of no difficulty in developing the student and faculty survey questions.

Question 13. Did you have difficulty scoring the portfolios?

Answer 13: Yes, we had some difficulty for two reasons. First, many of the syllabi from the Mathematics department described course content by referring to specific sections of specific textbooks (e.g. “We will cover chapters 2 through 5.5 of the text, omitting sections 3.5, 4.7.”). This is an entirely appropriate syllabus format for students, but it made it difficult to determine from the syllabus what the content of the course was supposed to be. As a result, we tended to determine the content of a given course by looking at the midterm and final examinations, and at the laboratory material associated with the courses. We believe this approach is actually superior to relying on syllabi to find out what a given course is really about. Second, two separate items on the portfolio scoring form designed by the Assessment Office (see Answer 15 below) were synonymous, and that caused some confusion for us until the four of us discussed and agreed to interpret the items as synonyms.

Question 14. Did you have any difficulty interpreting the results of the surveys (e.g., understanding tables/charts, determining appropriate standards)?

Answer 14: No.

Question 15. Do you have any suggestions about the assessment procedure?

Answer 15: First, do not interpret the following comment as a criticism of the Assessment Office: we want to record that at all stages of the process, the Assessment Office was a great help to us. Second, we want to suggest a change for the future.

For the GER1 assessment, the Assessment Office drew up the portfolio scoring sheet by breaking the stated GER1 criteria into component phrases and asking about each phrase. This was helpful in our first meeting (to practice scoring some of the portfolios). During that initial meeting, we discovered that the GER1 criteria contained some synonymous items that were probably included to make the meaning of GER1 clearer, rather than to stand as separate GER1 criteria. During our initial meeting, the four of us agreed that two of the items listed on the Assessment Office's portfolio scoring sheet were really synonyms. We wish that we would have been able to revise the portfolio scoring sheets at that point and our first suggestion is that in future GER assessments, the Working Groups should be invited to revise the portfolio scoring sheets designed by the Assessment Office after their initial meeting.

Readers of this report and its accompanying tables will note that in the GER1 assessment, different scales were used in portfolio analysis and in the student/faculty surveys. In addition, the questions posed in the portfolio review and the surveys were somewhat different. Our second suggestion is that there should be more parallelism between the portfolio scoring sheets and the student/faculty questionnaires than there was in the GER1 process. The questions posed should be the same on both instruments (portfolio scoring sheet and student/faculty surveys) and the same numerical scales should be used if at all possible.