Diagnostic Student Computerized Evaluation of Multicomponent Courses

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Over the past few years we have devised a DIagnostic Student COmputerized Evaluation scheme (DISCOE) which we have found to be especially helpful in improving large courses involving many instructors and components. The method is quite versatile and can be used in modified form in almost any course, large or small.

The primary testing ground for our student evaluation procedure has been the non-calculus-based General Physics I and II courses, P201-2, for science (but not physics) majors, enrolling primarily pre-meds and pre-health professionals. The enrollment in these courses averages about seven hundred students per semester. As many as 250 students may be in any one section, which comprises lectures, discussions, and laboratories. The lecturer, who meets the entire section three times a week in 50-min sessions, attempts to coordinate the various phases of the course and to supervise the instructors and other faculty members who serve as discussion and laboratory teachers.

The general nature and timing of the two phases of DISCOE are explained in the "course outline" distributed to students and instructors at the beginning of the semester. The initial and primary diagnostic evaluation is normally administered during a lecture period in the fifth week of the 15 or 16 week semester. By this time the students have experienced a good sampling of most of the rigors of the course: hour examinations, discussions, homework assignments, laboratory experiments, etc. Hence by the fifth week most students have formed strong opinions which they are eager to vent on score sheets and suggestion forms, especially if they feel that their complaints and suggestions may actually result is some changes of direct benefit to them.

It is fortunate that the students are so well motivated. Our form (see Appendix) for this first stage of evaluation is five pages long and requests that the student make about 100 separate evaluation responses on the standard 160-question computer score sheet, write comments on the strengths and weaknesses of the course, and make suggestions for improvements. Many of the current questions are specific to the present course. However, the form and computer processing are such that questions can easily be revised, omitted, or added by the administrator of the evaluation.

We have found that, contrary to faculty predictions in our department, most students are adept and apparently quite thoughtful in using the form. They normally complete the evaluation well with in the allotted 25 minutes, contribute many worthwhile comments and suggestions, and rate the form, on average, at about the "B" (good) level. In addition, several students have told us that the evaluation procedure was the best they had encountered at Indiana University. We think that the

early forewarning in the course outline, the familiar computer score sheets, and the standard evaluation response format for most of the questions (A = excellent, B = good, C = fair, D = poor, E = fail) probably promote the rapid and relatively incisive student response.

The structure of the evaluation form, as well as the details of the computer processing, are very flexible and can easily be amended for different types of courses. For Physics P201-2, separate evaluations are made by each student for various aspects of the teaching performance of the lecturer, the student's discussion instructor, and the student's lab instructor. (The names of the latter two are indicated by student responses on the computer score sheet.) In addition, various facets of the laboratory and textbook are evaluated. After appraising specific qualities of each of the instructors or components of the course, the student gives an overall evaluation of that instructor or component (along with a "calibration response" to a question such as "Please indicate your overall rating of the *average* lectures in university courses that you have taken"), and a final overall rating of the entire course. The simple A-to-E response format allows the total evaluation response from all students for each question to be summarized in terms of a weighted Evaluation Point Average (EPA), the analogue of the student's Grade Point Average (GPA). For the EPA, A is weighted as 4, B as 3, C as 2, D as 1, and E as 0.

The completed score sheets are optically scanned in a standard manner by the Bureau of Evaluative Studies and Testing (BEST). The "key sheet," submitted to BEST along with the score sheets, consists merely of a score sheet with all the "A" spaces blackened. Usually within 24 hours we receive from BEST the results of the evaluation on a floppy disk, along with a computer print-out containing the test analysis data and an "item analysis" with the percentage responses to each evaluation question. A computer program prints out separate pages of percentage response tabulations for each instructor in the course, including the evaluation point averages (EPA's) for each question. Student responses to the overall-rating questions for each instructor and component of the course, in terms of the single number EPA, provide a quick summary of the gross features of the evaluation.

It is interesting that BEST's test analysis, which treats the evaluation as if it were an exam in which "A" is the correct answer for each question, always yields high Kuder-Richardson reliability coefficients KR-20 of about 0.9. This evidently means that each student tends to be consistent throughout the evaluation in the relative frequency of A's awarded.

We return to each instructor individually all the computer output sheets pertaining to his/her own evaluations, along with a listing of the EPA's for all instructors for each evaluation question. The names of the other instructors are excised from the EPA listings since the purpose of the listing is to allow each instructor to compare his/her own performance with that of others to see where improvements might be achieved. We also return to each instructor abstracted student comments, criticisms, and suggestions.

The complete evaluations on all the instructors are made available on a confidential basis to those faculty who are in a position to recommend awards and recognition for meritorious teaching: the chair of the department and the heads of committees on Awards, Financial Aids, Associate Instructor Assignments, Lab Coordination, and Improvement of Teaching. (At the beginning of the semester we explain the evaluation scheme to the instructors and give them an opportunity to object to such dissemination of the results. Thus far, only one instructor has objected - we honored his request.) Of course, caution must be exercised in judging teaching ability or effectiveness on the basis of student evaluations. Experience with the present evaluations suggests that students tend to rate more highly those instructors who give easier exams and quizzes and higher grades.

After considering the student evaluation responses, criticisms, and suggestions, and gathering further suggestions from the instructors, we try to make at least some concrete and substantive changes in the course in hopes of achieving improvement. In the past, we have, for example, replaced one instructor whose English could not be understood by students; placed lecture notes and helpful texts on reserve in the library; instituted pre-exam review lectures; adopted a mix of one-third multiple choice, two-thirds written answer for exams; and extended the time allowed for "hour examinations" to two hours. in addition, we usually discuss with instructors some possible methods for improving teaching effectiveness, especially in those areas indicated as weak by the students and by our own observations. We think that the various changes made in response to the initial student evaluations have generally been effective in increasing the instructional value of the course.

We normally devote about ten minutes of one lecture to a discussion of the evaluation results. We discuss the responses that have been made to various key questions and the more prevalent student comments and suggestions, and enumerate the changes we are making. We also distribute the complete evaluation results (in the form received from BEST in which all instructors of the labs and all instructors of the discussions are rated together) directly to all the instructors, and, indirectly, to all students by making copies available at the local copy center. Copies of the sheets containing student comments and suggestions are made available for check-out by the instructors.

Ideally, a final evaluation is administered at the end of the semester, although this is not always feasible due to time demands. The same computer program and the same sort of evaluation form are used, except that in this final stage the form consists of only three pages with six questions. We elicit only *overall* evaluations of the lecturer, discussion instructor, laboratory instructor, laboratory, and course. We again request students to write down strengths and weaknesses of the course, and to make suggestions for improvements. This very short end-of-semester evaluation allows the course supervisor to find out whether or not students feel the course has improved and to gather ideas for innovations in future courses. The same sort of computer processing and feedback to all instructors is repeated so that they may gauge their progress and the final ratings given by the students.

We think that some of the more important advantages of the DISCOE scheme are (1) it permits supervisors of multicomponent courses to pinpoint and sometimes eliminate trouble spots early in the semester, (2) it facilitates measurement of student response to changes in a course if an end-of-semester evaluation can be administered, (3) it induces greater effort towards effective teaching by the instructors, (4) it allows the students to play a more active and productive role in making course improvements.

We wish to acknowledge helpful ideas, advice, and criticism from Professor Clinton Chase of the School of Education and Professor Robert Bent of the Physics Department.

APPENDIX - Sample DISCOE Evaluation

DIAGNOSTIC **S**TUDENT **CO**MPUTERIZED **E**VALUATION (**DISCOE**)
Spring 1995, P201, 3/29/95, R.R. Hake, R. VanKooten, L.C. Bland

INSTRUCTIONS:

   A. Except where indicated, please mark the blue computer *Score Sheet* with a heavy black pencil (#2.5 or softer):
       in accord with the following standard rating scale:
       a. A = excellent, B = good, C = fair, D = poor, E = fail.
       b. For some questions a *different meaning* than that indicated in "a" will be specified for A, B, C, D, E.
   B. In some response spaces you will be asked to indicate the *sections* (discussions and labs) which you attend.
   C. Do not place any identifying marks on these evaluation forms or on the blue computer *Score Sheet.*
   D. This evaluation is divided into seven parts.
       I. Lectures
       II. Discussions
       III. Laboratory
       IV. Text
       V. Homework Graders
       VI. Overall Evaluation
       VII. Comments
   E. Please be *very* careful to mark each evaluation response *in its proper numbered position* on the *Score Sheet*. This requires
       leaving some sections of the *Score Sheet* BLANK as indicated by the instructions:
          N - P. LEAVE BLANK! SKIP TO SCORE SHEET #(P + 1) (Here N and P are question numbers.)

I. LECTURES (The Lecturer - Rick Van Kooten)
   1. Enthusiasm for subject.
   2. Concern for student's understanding.
   3. Willingness to talk to students outside of class.
   4. Ability to organize course.
   5. Explanation of factors determining the final grade.
   6. Statement and explanation of the objectives of the course.
   7. Auditory quality of lectures (speech distinct and loud enough)
   8. Interest level of the lectures.
   9. Encouragement of questions and discussion.
   10. Quality of demonstrations.
   11. Please rate *demonstrations* in lecture insofar as they enhanced your understanding of physics.
   12. Please rate *derivations* in lecture insofar as they enhanced your understanding of physics.
   13. Please rate *problem solving* in lecture insofar as it enhanced your understanding of physics.
   14. Please rate *Concept Quizzes* in lecture insofar as they enhanced your understanding of physics.
   15. Please rate the *explanations of physics principles* in lecture insofar as they enhanced your understanding of
        physics.
   16. Please rate the *posting and distribution of practice exams* insofar as they enhanced your understanding of
        physics.
   17. Please rate *the homework assignments* insofar as they enhanced your understanding of physics.
   18. Please rate *Minute Papers* as a means for enhancing student - lecturer communication.
   19. Please rate *Minute Papers* as a means for enhancing your attention to and benefit from the lecture.
   20. Please rate the idea of giving course-grade benefits for lecture attendance as monitored by Minute Papers.
   21. Please respond *only* if you have attended *at least one* of the lecturer's office hour/help sessions!!
            Please rate the sessions insofar as they enhanced your understanding of physics.
   22. Please respond *only* if you have participated in electronic communication using *First Class*!!
            Please rate *First Class* communication insofar as it enhanced your understanding of physics.
   23. Please respond *only* if you have used *Interactive Physics* at least once!!
            Please rate *Interactive Physics* insofar as it enhanced your understanding of physics,
   24. On average, the scientific/mathematical level of the lectures is: A - about right, B - too high, C- too low.
   25. Please rate *lectures generally* insofar as they enhanced your understanding of physics.
   26. The level of difficulty of the *standard* part of Exam #1 was A - about right, B - too difficult, C - too easy.
   27. Please rate the fairness of the *standard* exam questions.
   28. Please rate the clarity of the *standard* exam questions.

29. Please rate the *standard* part of Exam #1 (taking it, reviewing it, studying distributed solutions) insofar as it enhanced your understanding of physics.
30. Please indicate your overall evaluation of the *average* lectures in the university classes that you have taken.
31. Please indicate your overall evaluation of the *average* lecturer in the university classes that you have taken.
32. **Considering your responses to the above Section I evaluation, please indicate your** OVERALL EVALUATION OF THE LECTURES.
33. **Considering your responses to the above Section I evaluation, please indicate your** OVERALL EVALUATION OF THE LECTURER (Rick Van Kooten).

34 - 50. LEAVE BLANK! SKIP TO SCORE SHEET #51.

II. DISCUSSIONS
51. My discussion instructor is (**Please encircle either A or B**)
    A. Professor Les Bland (all sections other than the 5:45 pm section)
    B. Tom McCaughey (only the 5:45 pm section).
52. Enthusiasm for subject.
53. Concern for student's understanding.
54. Willingness to talk to students outside of class.
55. Auditory quality of instructor's speech (distinct and loud enough).
56. Encouragement of questions and discussion.
57. Please rate the *explanations of physics principles* in discussion insofar as they enhanced your understanding of physics.
58. Please rate the posting of homework solutions insofar as the posting enhanced your understanding of physics.
59. Please rate the collaborative small-group discussion method insofar as it enhanced your understanding of physics.
60. Please rate *Minute Papers* as a means for enhancing student - discussion instructor communication.
61. Please rate *Minute Papers* as a means for enhancing your attention to and benefit from the discussion.
62. Please rate the idea of giving course-grade benefits for lecture attendance as monitored by *Minute Papers*.
63. On average. the scientific/mathematical level of the discussions is: A - about right, B - too high, C- too low.
64. Please rate *discussions generally* insofar as they enhanced your understanding of physics.
65. If given a choice as to discussion formats, I would prefer:
    A. the present small group "collaborative learning" method.
    B. a more traditional method in which the instructor solves problems and attempts to induce discussion.
    C. no preference or undecided.
66. If given a choice as to the class size in discussions, I would prefer about A. 5,   B. 10,   C. 20,   D. 30,   E. 40 students.
67. Please respond *only* if you have attended at least one of the discussion instructor's office hour/help sessions!!
     Please rate the sessions insofar as they enhanced your understanding of physics.
68. Please indicate your overall evaluation of the *average* discussions in the university classes that you have taken.
69. Please indicate your overall evaluation of the *average* discussion instructor in the university classes that you have taken.
70. **Considering your responses to the above Section II evaluation, please indicate your** OVERALL EVALUATION OF THE DISCUSSIONS .
71. **Considering your responses to the above Section II evaluation, please indicate your** OVERALL EVALUATION OF YOUR DISCUSSION INSTRUCTOR (indicated above in question 51).

72 - 100. LEAVE BLANK! SKIP TO SCORE SHEET #101.

III. LABORATORY (Since you are enrolled in only ONE lab, please respond to either 101 or 102 but *not* both)
101. My lab section is:

    A. Sec. A, 10:10am, Mon. (**Richard Hake** with Richard Swartz);
    B. Sec. B,   1:25pm, Mon. (**Richard Hake** with Richard Swartz);
    C. Sec. C,   3:35pm, Mon. (**Richard Hake** with Richard Swartz);
    D. Sec. D,   5:45pm, Mon. (**Elizabeth Brillhart** with Amit Bhattacharyya);
    E. Sec. E,   8:00am, **Tues.** (**Fred Lurie** with Randall Bird);

102. My lab section is NOT among those listed above but is:
    A. Sec. F, 10:10am, **Tues.** (**Fred Lurie** with Randall Bird);
    B. Sec. G,   1:25pm, **Tues.** (**Fred Lurie** with Randall Bird);
    C. Sec. H,   3:35pm, **Tues.** (**Elizabeth Brillhart** with Marc Pelath);

        D. Sec. I,   5:45pm, **Tues.** (**Elizabeth Brillhart** with Marc Pelath and Charles Hanna);
        E. Sec. J,   7:55pm, **Tues.** (**Richard Hake** with Marc Pelath, annotating by Martin Knudsen);

A. INSTRUCTOR (Please rate only the ***lead*** lab instructor in **bold** above - if you wish to comment on an *assistant* lab instructor you may do so in the comments Section VII.

103. Enthusiasm for subject.

104. Concern for student's understanding.

105. Willingness to talk to students outside of class.

106. Auditory quality of instructor's speech (distinct and loud enough).

107. Encouragement of questions and discussion.

108. Ability to help you understand the physics of the experiment.

109. Ability to assist you in figuring things out for yourself by asking questions.

110. Helpfulness of annotations in returned manuals.

111. Please respond *only* if you have attended at least one of the lead lab instructor's office hour/help sessions!! How would you grade the sessions insofar as they enhanced your understanding of physics?

112. Please indicate your overall evaluation of the *average* instructor in the university labs that you have taken.

113. Considering your responses to questions 103 - 112, please indicate your
OVERALL EVALUATION OF THE LAB INSTRUCTOR.

B. LABS (Apart from the instructor)

114. Quality of the laboratory manual write-ups.

115. Interest level of the laboratory.

116. Please rate the Socratic-dialogue method (i.e., the instructor asks leading questions in an attempt to get you to figure things out for yourself) insofar as it enhanced your understanding of physics.

117. Please rate the collaborative learning method (i.e., students discuss the experiments with one another and collaborate to try to answer the manual questions) insofar as it enhanced your understanding of physics.

118. Please rate the computer animations *Trajectory* and *Bucket* insofar as they enhanced your understanding of physics.

119. On average. the scientific/mathematical level of the labs is: A - about right, B - too high, C- too low.

120. Please rate the labs generally insofar as they enhanced your understanding of physics.

121. If given a choice as to lab formats, I would prefer:
    A. the present small group "collaborative learning" and Socratic dialogue method.
    B. a more traditional method in which students take and analyze data so as to "verify" certain physical principles.
    C. no preference or undecided.

122. If given a choice as to the method of determining the lab grade, I would prefer:
    A. the present method in which the lab grade is determined by lab exams.
    B. the traditional method in which the lab grade is determined by an average of the lab-report grades.
    C. no preference or undecided.

123. The level of difficulty of the *lab* part of Exam #1 was A - about right, B - too difficult, C - too easy.

124. Please rate the fairness of the *lab* exam questions.

125. Please rate the clarity of the *lab* exam questions.

126. How would you grade the *lab* part of Exam #1 (taking it, reviewing it, studying distributed solutions) insofar as it enhanced your understanding of physics?

127. Please respond only if you attended at least one of the extra "Sign Up" or "Open" Labs!! Please rate the extra lab sessions insofar as they enhanced your understanding of physics.

128. Please indicate your overall evaluation of the *average* labs in the university classes that you have taken.

129. Considering your responses to questions 114 - 128, please indicate your
OVERALL EVALUATION OF THE LABORATORY.

130 - 150. LEAVE BLANK! SKIP TO SCORE SHEET #151.

IV. TEXT - *COLLEGE PHYSICS*, 4th ED. BY SERWAY AND FAUGHN

151. Organization.

152. Clarity.

153. Interest level.

154. Quality of explanations.

155. Helpfulness of worked-out example problems.

156. Quality of end-of-chapter problems.
157. Helpfulness of the use of a consistent color code for vectors.
158. On average. the scientific/mathematical level of the text is: A - about right, B - too high, C- too low.
159. Please rate the text *generally* insofar as it enhanced your understanding of physics.
160. Please rate the *average* text used by you in university courses insofar as it enhanced your understanding of the subject.
161. Considering your responses to questions 151 - 160, please indicate you
    OVERALL EVALUATION OF THE TEXT.

162 - 170. LEAVE BLANK! SKIP TO SCORE SHEET #171.

V. HOMEWORK GRADERS (M. Bei and Z. Huang)
171. Promptness of return of graded homework.
172. Helpfulness of comments on graded homework.
173. Fairness of the homework grading.
174. Please respond only if you have attended at least one of the office hour sessions of a grader!
    Please rate the sessions insofar as they satisfied your grading concern and/or enhanced your understanding of physics.
175. Considering your responses to questions 171 - 174, please indicate your
    OVERALL EVALAUTION OF THE HOMEWORK GRADERS
176 - 180. LEAVE BLANK! SKIP TO SCORE SHEET #181.

VI. OVERALL EVALUATION
181. The pace at which material is covered in this course is A - about right, B - too high, C- too low.
182. The overall average scientific/mathematical level of this course is A - about right, B - too high, C- too low.
183. If a one-semester 2 or 3-credit hour pre-physics course had been offered to enhance your scientific/mathematical preparation for P201, what is the probability that you would have taken it?
    A. 100% - 81%,   B. 80% - 61%,   C. 60% - 41%,   D. 40% - 21%,   E. 20% - 0%.
184. Please rate this course *generally* insofar as it has enhanced your understanding of physics.
185. Please rate the *average* university course taken by you insofar as it enhanced your understanding of the subject.
186. Please rate the relevance of physics (aside from its being required by your major) to your anticipated professional activities.
187. Please rate the relevance of physics to your everyday life.
188. What is the probability that you will enroll in the course P300, General Physics III (3 cr.), specially designed for P201-2 graduates? (Special relativity, quantum physics; atomic, condensed matter, nuclear, and particle physics; applications of modern physics to related scientific disciplines including the life sciences; satisfies COAS intensive writing requirement.)
    A. 100% - 81%,   B. 80% - 61%,   C. 60% - 41%,   D. 40% - 21%,   E. 20% - 0%
189. Please indicate your overall evaluation of the *average* student evaluation form you have used in university classes.
190. Please indicate your overall evaluation of the *average* university course that you have taken.
191. Please indicate your OVERALL EVALUATION OF THIS EVALUATION FORM.
192. Considering your responses to ALL the above questions in Sec. I - VI, please indicate your
    OVERALL EVALUATION OF THIS COURSE.

PLEASE GIVE US YOUR COMMENTS ON THE NEXT PAGE SO THAT WE CAN BE MORE EFFECTIVE IN IMPROVING THE REMAINDER OF THIS COURSE AND IN IMPROVING FUTURE P201 COURSES

VII. COMMENTS

A. The major strengths of this course are:

B. The major weaknesses of this course are:

C. My suggestions for improving this course are:
    (Concrete and practical suggestions for improving the remainder of the present semester would be especially valuable.)

(Please use the back of this page if you need more room.)