Mechanics Texts Are for Students

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ABSTRACT

A study of student use of their Mechanics text was undertaken in three successive Statics Intersession classes. In each case the Intersession text was different from the one that had been used in the full-time program. The Intersession students, who had also been enrolled in the Full-time course, were in a unique position to compare the two texts.

They were quite definite in their preference for one of the texts and supported their choice with both quantitative assessments and descriptive comments. The students also reported the specific use they had made of the course text and their lecture notes at various stages during the course.

Introduction.

There are many good Mechanics text books available for instructors to adopt in their courses. Instructors usually choose a text that not only covers the required topics in sufficient detail for completeness but is also one that they consider to be written at an appropriate level for the students. At the end of the course, instructors might solicit student feedback on whether the text was in fact useful. They rarely, however, get the opportunity to ask their students to compare two texts. Such an opportunity existed for each of the years 1993, 1994 and 1995 at The University of Western Ontario where the students in the Intersession class used a different Mechanics text from the one they had used in the Full-time program. This paper summarises the student comments on how they used the Mechanics text at various stages in the course and also on their comparison of the two texts and why they found one of the texts more pleasing.

Background.

Most of the students in the Intersession Mechanics course at The University of Western Ontario are students who have dropped the Full-time course or who did not complete it successfully. By adopting an Intersession Mechanics text for each of the three years 1993, 1994 and 1995 that was different from the text used in the Full-time program it was possible to get comparative student opinions of the two texts. Table 1 shows how the Intersession text was different from the Full-time text for each of the three years.

The intersession course is an intensive three-week course with lectures and tutorial classes each day. The course instructors and the method of course presentation also changed from year to year. In 1993 the
instructor taught the course on the blackboard and, although problem assignments were taken from the text and the lectures paralleled the text sequence, they were not otherwise tied to the text. In 1994 partial lecture notes were prepared that linked closely to the text and used problems from the text. These notes were sold to the students and completed by the students during the lectures which were presented mainly at the overhead projector. The 1995 Intersession course was shared by two instructors who each presented blackboard lectures. Additionally in 1995, students were given handouts of the more important algorithmic routines and problem formats. At the end of each of these courses the students completed a questionnaire and the more interesting results from these surveys are presented below.

**Table 1: Comparative course data.**

<table>
<thead>
<tr>
<th></th>
<th>1993</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fall/Winter Session</strong></td>
<td>TEXT B</td>
<td>TEXT B</td>
<td>TEXT A</td>
</tr>
<tr>
<td><strong>Intersession</strong></td>
<td>TEXT A</td>
<td>TEXT A</td>
<td>TEXT B</td>
</tr>
<tr>
<td><strong>Presentation</strong></td>
<td>blackboard lecture</td>
<td>overhead semi-notes</td>
<td>blackboard lecture problem routines</td>
</tr>
<tr>
<td><strong>Instructor</strong></td>
<td>Prof. X</td>
<td>Prof. Y</td>
<td>Prof. X and Y</td>
</tr>
</tbody>
</table>

**General student use of text.**

Figure 1 shows how the students typically used their text in the three intersession courses. Mainly they used the text to study the worked sample problems and as a source of problems for themselves to solve. To a lesser extent they read the text and worked the review problems. Also to some extent in 1993 they studied problem solutions from the solutions manual but they were not given access to the solutions manual in the 1994 and 1995 intersession courses. It is noticeable that in 1994 the students made greater use of the sample problems and the review problems from the text and even read the actual text a little more. It seems that brief pre-printed lecture notes that are closely allied to the course textbook have the effect of encouraging the students in increased use of that text. It is also apparent from Figure 1 that the 1995 class made less use of each aspect of their Intersession text (Text B) than either of the other two years made of their Intersession text (Text A).

**Student use of various text components.**

The students were also asked about the importance of various learning materials such as lecture notes (text), lecture notes (sample problems), text, sample problems from text, etc. They were asked to sequence the order in which they accessed these materials

a) when studying a new topic,
b) when doing a homework assignment, and
c) when reviewing for an examination.
The students usually ranked about three such materials from the suggested list of six or seven. By weighting their responses three for first choice, two for second choice and one for third choice it was possible to generate weighted responses. These weighted responses are shown at Figure 2 for “Studying topic as new material”, at Figure 3 for “Working homework problem assignments”, and at Figure 4 for “Reviewing for examinations”.

Figure 2 shows that the students place their main emphasis on reading the text of both their lecture notes and their textbook when they study the topic for the first time. It is quite apparent however that the 1995 students only read the text of their textbook, even when studying the topic as new material, about half as much as the students in the other two years. This increased reading of the textual material in 1993 and 1994 (in which years they used Text A) is consistent with their qualitative views (expressed below) that they found Text A to be easier to read with more suitable verbal explanations. Their secondary recourse in studying a new topic is to the worked examples in both the lecture notes and the textbook. It is noticeable that the 1993 class relied more heavily on their lecture notes whereas the 1994 class (which used lecture semi-notes written to complement the textbook) placed about equal emphasis on the lecture notes and the textbook.

When doing homework assignments it is obvious from Figure 3 that the students rely most heavily on the sample problems both from their lecture notes and from the textbook. The 1994 class accessed sample problems from their notes and the text about equally but the 1993 class emphasised their use of the lecture notes. The 1995 class again used their text very little and stressed the use of lecture materials. It is probable that they are using the custom designed handouts containing standard routines and typical problem formats.
STUDYING TOPIC AS NEW MATERIAL.
SEQUENCED USE OF LEARNING MATERIALS.

Figure 2: Use of text: studying new topic.

WORKING HOMEWORK PROBLEM ASSIGNMENTS.
SEQUENCED USE OF LEARNING MATERIALS.

Figure 3: Use of text: doing homework assignment.
In their review for the examinations, the students use four components about equally; lecture notes, both textual content and sample problems, sample problems from text and practice problems from text. These are shown in Figure 4. It is clear that the students do not read the actual text material much after the initial introduction to the topic. The 1993 class again emphasised the value of the sample problems in the lectures. It is not surprising that students prepare for a Mechanics examination, which is exclusively problems, by reviewing problems in both lecture notes and text. Again though, there is a trend for the students in the 1994 class to use their text (Text A) a little more and for the students in the 1995 class to use their text (Text B) somewhat less.

Figure 4: Use of text: reviewing for examination.

Student comparison of two texts.

Table 2 shows the average student responses to various textbook characteristics. The students were constrained to select from three choices; “Text A better”, “Text B better” or “about the same”. In the students’ opinion Text A was preferred in all characteristics except the “arrangement of problems in increasing difficulty” which was rated approximately the same for both texts. The students from all three years were overwhelmingly in favour of Text A. The strongest support for the text was in 1994 which was probably attributable to the addition of lecture semi-notes which were specifically written to complement Text A and incorporate it more within the course.

This same support for Text A which was expressed quantitatively in the above responses in Table 2 was also evident in the freely structured qualitative student comments. These praised the readability and clarity of the textual material and the attractive diagrams and overall presentation. The comments claimed that Text A was “more eye-pleasing” with bigger diagrams and “a helpful use of colour”. Text B on the
other hand was criticised as being “very condensed with diagrams and text compacted as small as possible” and that it “frequently referred back to diagrams on previous pages”. Text A however was “easier to read” and the actual text “was broken by frequent sub-headings” and “usually referred to diagrams which were on the same page”.

Table 2: Student comparison of characteristics of two texts.

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>1993</th>
<th>1994</th>
<th>1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>clear written text</td>
<td>78%</td>
<td>80%</td>
<td>58%</td>
</tr>
<tr>
<td>sample problems solutions</td>
<td>66%</td>
<td>72%</td>
<td>67%</td>
</tr>
<tr>
<td>problems for solution</td>
<td>69%</td>
<td>69%</td>
<td>75%</td>
</tr>
<tr>
<td>problem sequence</td>
<td>44%</td>
<td>54%</td>
<td>27%</td>
</tr>
<tr>
<td>clarity of diagrams</td>
<td>60%</td>
<td>85%</td>
<td>67%</td>
</tr>
<tr>
<td>textbook overall</td>
<td>72%</td>
<td>90%</td>
<td>73%</td>
</tr>
</tbody>
</table>

Text A was considered to be written more as a simplified teaching text for students rather than as a comprehensive reference text. In Text A, the explanations are briefer “stating only the important information in a short compact form that keeps my attention and interest on the topic at hand”. Some students acknowledged the teaching efforts of Text A and that it seemed to develop a sense of “coaching the student through the problem rather than spilling information onto the student”. Students mentioned that the procedure for analysis was useful “especially when tackling problems of that type for the first time”.

The students in the Mechanics Intersession courses are not the strongest students but are of average academic ability. They appreciate the simplified presentation of Text A and the fact that it does not comprehensively address extraneous material. Their views of the texts are therefore those of average students and might not be identical with the opinions of the very best students, who might be better able to appreciate more complex and comprehensive texts. Nevertheless, these students preferred Text A consistently over three consecutive years and expressed this preference quantitatively in their evaluations and qualitatively in their comments.

Conclusion.

Statics is a problem-centred course and is assessed by an examination consisting exclusively of problems. It is no surprise therefore that the general student use of the text was as a source of problems; both sample problem solutions and new problems to solve. The textual part of the textbook was only read
as an introduction to a new topic. During the course the students relied heavily on sample solutions from their lecture notes and the textbook. For examination review the students again depend on sample solutions but additionally read their lecture notes as “text” rather than the textbook. There was increased student use of the textbook (Text A) in 1994 probably due to the pre-printed lecture semi-notes specifically written to link with the textbook. The 1995 course text (Text B) was less popular with the students and resulted in a marked decrease in reported use of the text during the course.

The direct student comparison of the two texts was overwhelmingly supportive of Text A in all three Intersession classes. Students commented that Text A was more attractively presented, easier to read and written in a more helpful teaching style.

If instructors want to encourage students to actually read their textbooks, these texts must be selected with the student in mind and incorporated into the course structure by the instructor.

PETER ROSATI is a Professor in the Department of Civil Engineering at The University of Western Ontario. He has engineering degrees from Oxford and Western, and an education degree from West Virginia University. His research in engineering education has focused on problems associated with personalizing the large enrolment mechanics courses. He has implemented a successful Keller plan course in dynamics, designed computer problem-solving routines and is currently principal investigator in a seven-year longitudinal study relating engineering student performance and learning style to their MBTI personality type.