Comparison of Methods of Collecting Student Time Use Data

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Abstract

This article compares various methods of collecting the total time per week and the time per task spent by students in a science class, including journalling, an in-class work sheet, and questions imbedded in other class materials. The data shows that an in-class work sheet provides an accurate estimate of total time use.

1 Importance of Time Data

Introductory physics courses always have more to teach than there is time to teach[1]. Any introductory physics student will receive a better education if they invest more time on the class. Time, particularly, student out-of-class time, is the rare resource around which a science class must be designed. One conclusion of a detailed analysis of the IUPP project data was that "Time is our most precious asset."[2] A science class that does not use its allocation of student out-of-class time should adjust homework, exams, reading, and other assignments until student time is fully used based on department and university standards. In the current environment, where science classes are being pressured to teach more, better, full student time use is the first step.

The total time spent by a student on a science class is the most fundamental background mea-

surement for any education reform. An education change that consumes greatly increased student time needs to be evaluated against a traditional offering with the same time usage characteristics. Otherwise, it is impossible to say whether the improvements seen in the educational reform are the result of the detailed educational changes or simply getting the students to work harder.

In [3], we showed that traditional science classes sub-optimally used total student time and failed to divide student time based on the instructor opinion of the relative value of different class tasks. These measurements were performed with a single survey at the end of the semester asking the students to estimate the total time spent on a list of tasks. Asking the students to average tasks over the semester based on their memory of events which are many months past is a process almost guaranteed to yield substantial inaccuracies. This paper seeks to produce an accurate measurement technique for student time use sufficiently resource-efficient that it could be applied each semester in a science class.

In this paper, we compare the results of different strategies to gather student time use information for a single class week, immediately after the week is complete. The comparison of the various techniques allows the selection of a measurement technique which is both accurate and consumes the minimum instructional resources.

2 Description of Measurement

Three different strategies were examined for the collection of student time usage data during one class week: (1) Student Journals, (2) A three page survey applied during a lab section, and (3) A single optional question asked as part of an hourly exam. 60 students were asked to participate in this measurement. 43 students performed all three experiments, returning a journal, filling out the survey, and answering the test question. Only these students are included in the results. A comparison of the results of the three measurement techniques is presented in next section.

2.1 Journal Measurement

The most accurate way to extract student time data without intrusion into the student's lives seemed to be to ask the students to produce a journal of time use. Two forms of journals were used. Each journal contained a page for each day of the week with the day and date labeled at the top of the page. Half the journals asked the student to record the starting and ending time of all time periods during the week spent working on the class University Physics II, called UPII. The other half of the journals asked the student to record the total time spent on the class each day and then to divide that time among a list of tasks. The tasks were similar to the tasks listed in Table 2. The journals were passed out to the students the first day in the journal and collected the day after the last day.

Students were observed carrying the journals during the week and through various interactions with the students about 20% of the journals were observed during the journalling period, being filled out progressively during the week. The journals divided time in a different manner than the surveys and test question, so the students could not simply remember their journal results.

2.2 Survey Measurement

The journals were collected in lab the day after the last day included in the journal. At the beginning of the lab, the students were given a survey instrument containing three separate pages: (A) A page containing the single question "How much time did you spend on UPII excluding time in lecture, lab or taking the exam for the days Wednesday 9/15/99 to Tuesday 9/21/99? Hours_____ Minutes_____ " (B) A page that asks the student for the time use by day with seven questions like "Friday 9/17/99 - How much time did you spend on UPII excluding time in lecture or lab? Hours_____ Minutes _____ " and (C) a page asking for the time spent over the last week divided by task. The first part of page (C) follows:

Divide this time among the following tasks The total of the times below should equal the total time. So if some of your time was spent doing many of the tasks at once, pick the main one you think you were doing at that time and assign the time to ONLY that task. Don't double count your time. Do not include any time spent doing these things that you did in lecture, lab, or while taking the test.

- Working Homework - Hours_____ Minutes _____
- Studying for Exam - Hours _____ Minutes _____

The order of pages (A) and (B) was reversed for half the students. Page (C) was always the last page so that the students would first constrain their task totals by the total time in the week. The students were asked to work between pages of the survey until the total time agreed. This was done to improve the accuracy of the total time.

The students were not allowed to observe their journals while filling out this survey. Once everyone was done with the survey, red pens were passed out and the students were asked to compare the journal with the survey and to correct discrepancies without obscuring the original entry. Many students made modifications to the survey, but very few changed the journals, indicating that little was missed by the journals. In the data which follows, only the uncorrected survey results are reported.

2.3 Exam Measurement

The third method of measuring the student time usage included a question in the hourly examination the students took on the last day included in the jounral. The text of the question was "How many hours did you spend working on UPII last week excluding time in lecture or lab? _____ **hours:minutes**" This was asked at the very beginning of the test so it does not include the time to take the test. No extra credit was given for answering the question.

3 Measurement Results

The results of the three experiments are presented in Table 1. The results only contain information provided by the 43 students participating in all three experiments. Table 1(a) shows the time use recorded on the question in the hourly exam. Table 1(b) shows the weekly out-of-class time use resulting from analyzing the journals. Table 1(c) shows the total out-of-class time use found by adding the time reported for each day on the survey. Table 1(d) shows the total out-of-class time recorded by the students in response to the survey question asking for the time spent in a week.

The distributions show a tail of students spending enormous amounts of time on the class. This tail is not a set of spurious responses but represents a group of students in the class who interact with one another and for their reasons spend a lot of time meeting about the class and in preparing the class notes.

The average for the total out-of-class time spent based on the hourly exam questions was 10.9 hours. The average of the total out-of-class time recorded in the journals was 15.4 hours. The average of the total out-of-class time from the survey question asking for the weekly time was 15.4. The weekly total resulting from summing the time per day on the survey was also 15.4. The agreement of the time estimates from survey is expected since the students were asked to work between the pages of the survey and to reach agreement. Differences in the two numbers should be a result of student error and these errors should cancel somewhat in the average.

The agreement of the survey numbers and the journals is more surprising. The journals were constructed so the survey answers could not be simply remembered from the journal. In-class time was mixed with out-of-class time in the task journals and the total time of the intervals was never summed in time interval journal. The agreement results from the population of students making random errors in their survey estimates about the mean rather than each student producing survey answers which were consistent with their journal answers. The average absolute difference between the journal weekly time and the survey weekly time was 2.2 hours.

The third page of the survey collected time per task based on a task list developed by our knowledge of student behavior. This was included in the survey to give the students another way to remember their time use. Since the task information is constrained by the total weekly time it does not contain the double counting of activity time which is often a problem in task data. The average time per task is presented in Table 2.

4 Discussion of Results

Our hypothesis entering this experiment was that the test question would yield the same results as the survey question, since they are the same question. We expected that these answers would be related to the results of the journals by some consistent pattern of miss-estimation since human beings notoriously inflate their time estimates. Neither of the hypothesis turned out to be correct.

The averages show that the question included with the exam provided a very poor estimate of the student total time usage and unfortunately, since it was the easiest to apply, cannot be used. The in-class survey provides an excellent estimate of student time usage since the students estimation errors do not have a bias toward either too little or too much time. The students make random estimation errors around the mean of the actual time usage, taken to be the result of the journal experiment.

Using this result, in future semesters we will capture a weekly time use picture of the class by applying the survey to a different lab section each week. This will allow the time use for each week to be captured with appropriate statistics while only measuring the individual student twice a semester.

Some of the students turned in task surveys which did not constrain the total of the task times to the total weekly time. These surveys consistently produced a high estimate of total time based on the sum of the task times. Therefore, measurement of the task time should always be preceded with a measurement of total time to prevent this effect. This causes the discrepancy in total time

for the week seen in Table 2.

As an example of the usefulness of this data, our educational engineering of the class based on the measurement will be as follows. From the task data, we estimate (by eliminating of exam only activities) time spent in a non-exam week as 6.7 hours a week for a semester average time per week of 9.3 hours. The class observed is a four credit class requiring six in-class hours a week. The university does not provide a target number for out-of-class time, but we try to average two out-of-class hours for each credit hour. Therefore, our time usage is about an hour high. We will adjust the class by modifying the required class notes policy which contributes 2.8 hours to the "Working on Class Notes" task to allow students greater freedom. Other than the extra hour of time, the distribution of time among tasks looks fairly good for an exam week. Plotting the distribution of times for the "Working on Class Notes" task reveals a bimodal distribution where the majority of students spend a small amount of time on the class notes but a substantial minority of students spend a lot of time, often more than studying for the exam. This indicates a problem with the policy where some students feel improving notes, which are the only resource during the exam, is a substitute for other studying behavior. The notes policy will be adjusted to remove this problem.

5 Conclusion

A survey asking for the total out of class time spent in the last week, the time per day, and the time per task, but requiring the student to make the totals agree is an efficient and accurate means of collecting student time use data.

References

[1] "Improving the quality and effectiveness of introductory physics courses." Report of a conference sponsored by the AAPT. *Am. J. Phys.*, 25:417, 1957.

[2] R. Di Stefano. Physics teaching and time management. *Physics Teacher*, 36(6):150–154, 1998.

[3] Gay B. Stewart and John C. Stewart. Optimally engineering traditional introductory physics classes. *Journal of Science Education and Technology*, 6(4), December 1997.

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Table 1: **Total Student Time for One Class Week** Each histogram shows the count (vertical axis) of the number of students reporting a given number of hours of total time use (horizontal axis).

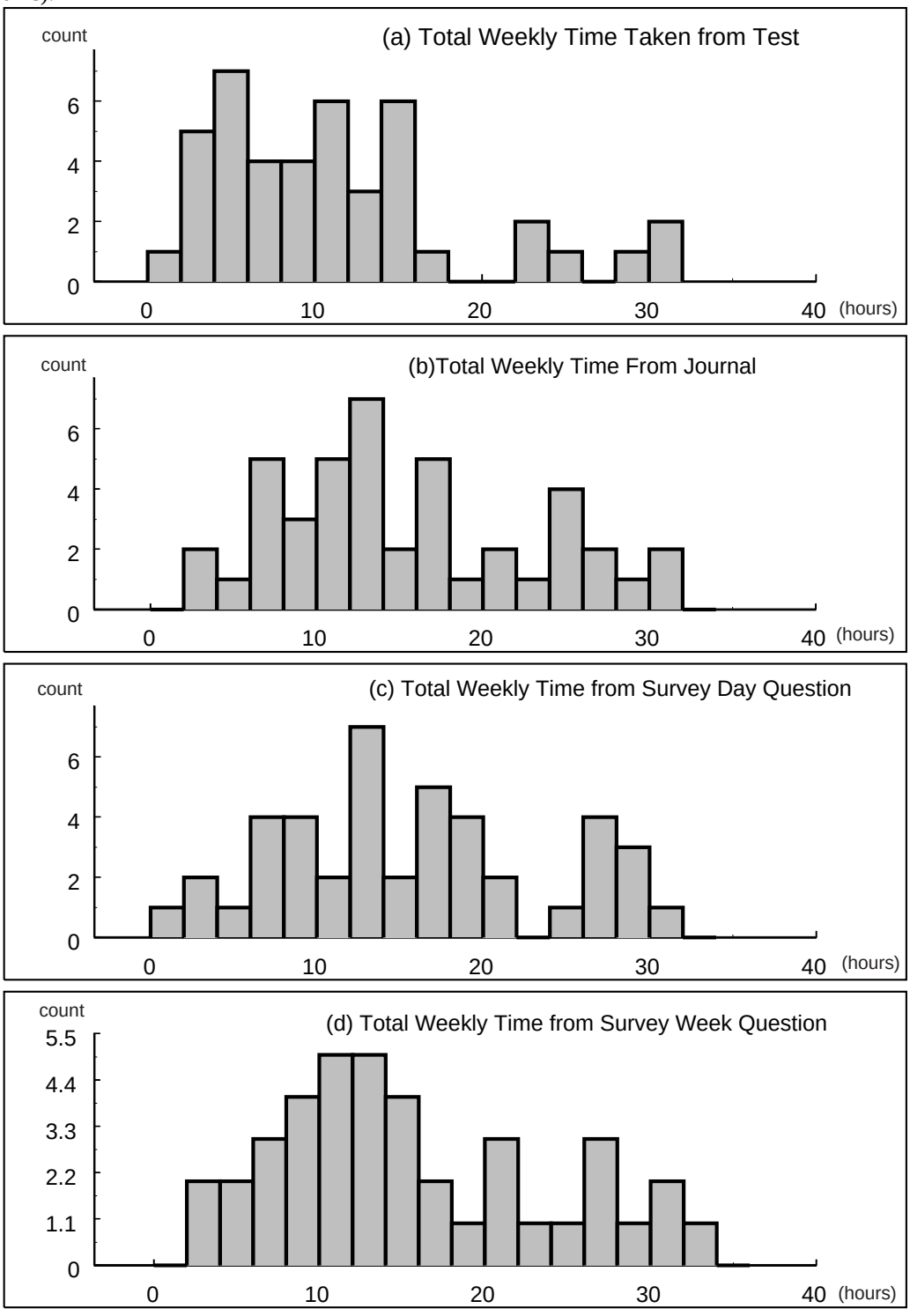

Table 2: **Student Weekly Out of Class Time Use by Task**

Tasks	Average Time Spent (Hours)
Working Homework	4.5
Studying For Exam	4.1
Reading Textbook	0.7
Reading Internet Materials	1.1
Attending Office Hours	0.24
Talking with Other Students	1.1
Working on Class Notes	2.8
Reading Class Notes	1.0
Other	0.3
Total	15.8