DIFFERENT VIEWS OF A BASIC STATISTICS COURSE

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This paper aims at reporting the results of a project that evaluated a basic statistics course offered by the University of São Paulo to undergraduate students of different careers. We collected, through interviews, teachers' and (under)graduate monitors' opinions and visited the classrooms to observe the dynamics and the relationships between teachers and students. Also, students answered, voluntarily and anonymously, an evaluation questionnaire about the course and, three months after the course had finished, a test to measure the statistics basic knowledge learned was applied. These different methodological tools are important for a critical comprehension of what is going on with the course and to guide future changes. The results indicated that the students have unfavorable opinion about this basic statistics course, while the majority of teachers liked the way it was organized. Furthermore, the statistical test revealed poor performance of students who had been previously approved in the course.

INTRODUCTION

The importance of statistics is widespread in most university fields and it is present in the curricula of several careers. In this paper, we report the results of a project that evaluated a basic statistics course, offered by the Statistics Department, University of Sao Paulo, Brazil, to students enrolled in non-mathematics majors. It is a 4-hour class weekly offered, during one semester to cover topics as: descriptive statistics, probability and inferential statistics aiming at promoting *statistics literacy* and *statistics reasoning* as indicated in delMas (2002). Because of the large number of students who attend this course, several classes are provided in different time schedules. The data for this study were collected in 8 classes, 4 classes in each semester of 2007. Seven of these classes were organized in a same rigid plan for the classroom activities without any modification by the instructor. We named them *group classes*. This kind of course began several years ago with the objective to improve learning and to save class faculty hours. The material of the lectures is available in advance to the students through internet website. The other class of our study was named *regular class* because it is the usual teaching context. In this class the instructor had a possibility to slow down or speed up the lecture contents as he/she felt it was necessary, according to the students' needs. It is important to say that the instructors of all these classes agreed to participate in the project but those who conducted the project are not directly involved with any of the classes of the course. The *regular* and *group* classes are not intended to be compared here as a methodological way to teach. However, they are mentioned in this paper because their lecture organization has influenced several aspects of our evaluation. In fact, it would not to be appropriated to compare one with seven classes, especially when this one class is strongly dependent on the instructor´s job. Besides this, we will point out comparisons in a few moments to highlight aspects in the discussion.

Data were collected in classes that included students from majors as: Psychology, Sociology, Biology, Geography, Physical Education, Phonology, Physiotherapy, Geology, Therapy, Pharmacy and Physics. The *regular* class only contained students from Psychology while the *group* classes had the other majors with several classes being composed of mixed majors. Around 1700 students were required to take this course and 500 of them were in the classes included in this study. Also, most of the students, as required by their careers, attended the statistics course in the first school year which, in fact, does not help to increase students' motivation and interest.

METHOD

The evaluation of the course results is a rather complex matter and not an easy one to summarize, and we do not intend to cover everything in our analysis. We might compare the objectives for the teaching and the content taught with the knowledge acquired by the students, but

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this is not easy to do in these basic statistics courses since the majority of the objectives are related to concepts to be used in future research or work activities. We intend to present the different views of all the agents that interact in the course, which by themselves constitute only a partial picture of what was going on. As far we are concerned, a complete view of the situation is not a superposition of these different views, which, in some sense, we tried to do in this paper. It would have been necessary to include the discussions and opinions of all participants, which was practically impossible to do since the course had ended. Despite this restriction, this paper aims at bringing to the discussion the course content and organization in order to get better results in students' learning.

The different views obtained are pictured in Figure 1, and they are explained in the sequence. The course had monitors which were undergraduate or graduate students. They were responsible for grading students' homework and for answering students' questions during office hours. We interviewed 11 monitors to collect their opinion on the course development, monitors' tasks and their relationship with instructors. The 8 classes included in this study had a total of 10 instructors because two of the classes had two instructors each, and they shared the semester lectures. The instructors were interviewed about their general expectation, objectives, and relationship with students. Another look to the course came from an observational visit to the class. Two members of the project observed one day class to describe the environment and the students' participation in class activities. The last two views come from the students. During the semester they answered, voluntarily and anonymously, a questionnaire addressing points as expectation to the course, participation in class, opinion about the lectures, etc. About three months after the end of the course, we contacted the students who passed and asked them to answer a test with statistical items related to the concepts discussed in class.

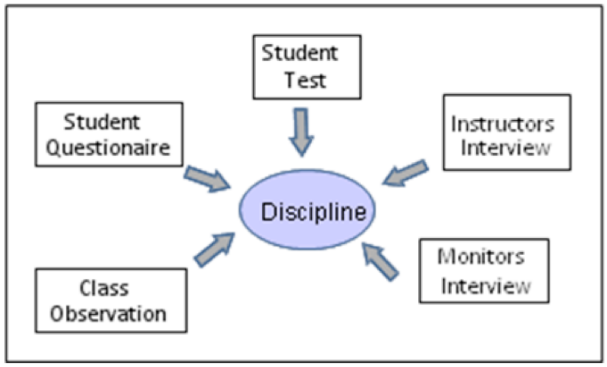

Figure 1. Different views

RESULTS

All the instructors of the course have PhD degrees in Statistics with strong background in mathematics and experience in teaching basic courses. Based on the instructors' interview answers, students did not ask many questions during the lectures, only a small group, usually the same, who tried to obtain more information from the teachers at the end of class. Also, the students did not show up at the office hours to ask further questions. Some instructors were critical as to the structure of the *group classes* because they do not have flexibility to conduct the class dynamics. However, the majority thinks that it is a convenient way to teach, because planning everything ahead makes it easy to teach.

In the interview the monitors mentioned that their principal job was to grade homework and to attend to students during office hours. They felt that students' interest in looking for the monitors' help was to obtain hints to complete the homework rather than to ask conceptual questions. Also, the monitors said they did not interact with the teachers relating to the following up of the course. For the *group classes*, it was part of graduate monitors' job to give an extra lecture to review the topics covered as a preparation for students' exams. The monitors for the *group classes* were critical of the way the course was taught but they did not seem really integrated

in the course organization. They only followed orders and did not reveal any enthusiasm with their job.

The 8 classes were observed once by the project participants in a normal day class according to a schedule previously agreed with the instructors. In the *group classes*, the instructors followed the slides projection with few extra comments. Apparently, the students showed little motivation. Differently, in the *regular class*, the instructor did not use slides on the day we observed and we saw a context in which students asked questions during the class conduction.

The questionnaire was answered by 258 students, approximately half of the students' enrolled, 217 from the *group classes* and 41 from the *regular class*. The students' answers revealed their expectation and opinions about the course and the way it was taught. Their expectations were not good and most of them thought the course would not contribute to their undergraduate major. We observed that *regular* and *group* classes had different opinions except in the neutral and middle columns as summarized in Tables 1 and 2.

Table 1. Expectation about the course

Class	Favorable	Neutral	Unfavorable	No response
Regular	51%	22%	25%	2%
Group	25%	33%	40%	2%
All	29%	31%	38%	2%

Table 2. Contribution to the career

Class	High	Middle	Low	No response
Regular	12%	42%	46%	0%
Group	30%	42%	27%	1%
All	27%	42%	30%	1%

Other results from the questionnaire showed that 40% of the students declared looking for the instructors in or outside the classroom to ask questions, which differs from the instructors' opinions. Some students indicated that they did not feel comfortable to do that, or they preferred other forms such as asking their colleagues and the monitors. As for their effort to learn the content of the course, 3% mentioned that they studied everyday, 60% studied once a week and the remainder did not study or studied only near the exams. Concerning their opinion about classroom activities, around 46% did not like the lectures, 44% liked them, and 10% did not answer. Applicability of the statistic topics to their career was the main reason for the answers above. The questionnaire allowed a free comment that was used by 34% of the students. From these, only 25% of the comments were positive and the most frequent negative comment was related to the way the course was taught in the *group classes*.

The test was answered by 178 students. From these, 151 came from the *group classes* and 27 from the *regular class*. It was prepared based on the concepts discussed in class and it had 30 items of multiple choices, which included 24 items with 2 alternatives, and 6 items with 3 alternatives. The 30 items were classified according to statistic topics: 13 items on Descriptive Statistics, 9 on Probability and 10 items related to Inference Statistics. For each student the score in the test was the percentage of the correct answers. Figure 2 presents a box plot with the scores according each career. We omitted the results of Geography and Physics because they had just one student answering the test.

The careers had quite similar results, except for Phonology which was lower than the others. Most of the students, in any career, stay below the 70% level of score and this was a poor result since these students had previously been approved in the course. The average score was 61%, which was not too high if compared to that obtained from a random answer that would be 47%.

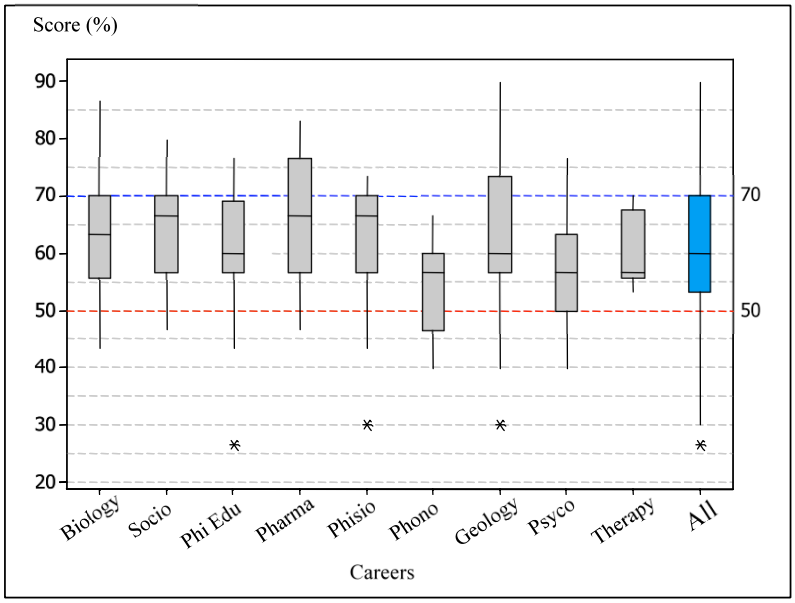

Figure 2. Performance by career

To identify learning problems and conceptual misunderstanding we computed for each item the percentage of the correct answers. The result is showed in Figure 3 and we recall that all items had two choices except items 1, 7, 12, 23, 27 and 28 that had three.

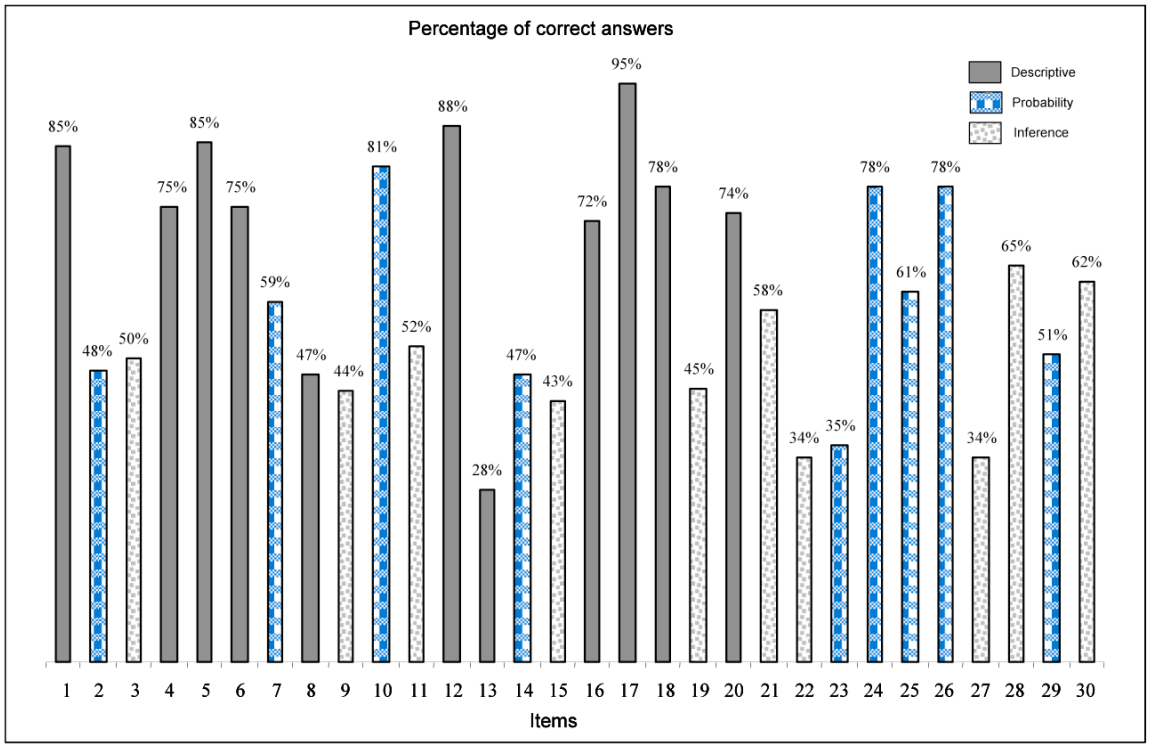

Figure 3. Answers by items

We also observe from Figure 3 that there are 11 items whose correct answer percentage was less than 50%, and 10 items with 75% or more of correctness. Looking at the topics, Descriptive Statistics had better performance and Inference Statistics the worst, as we can see in more detail in Figure 4 through box plots divided by topic.

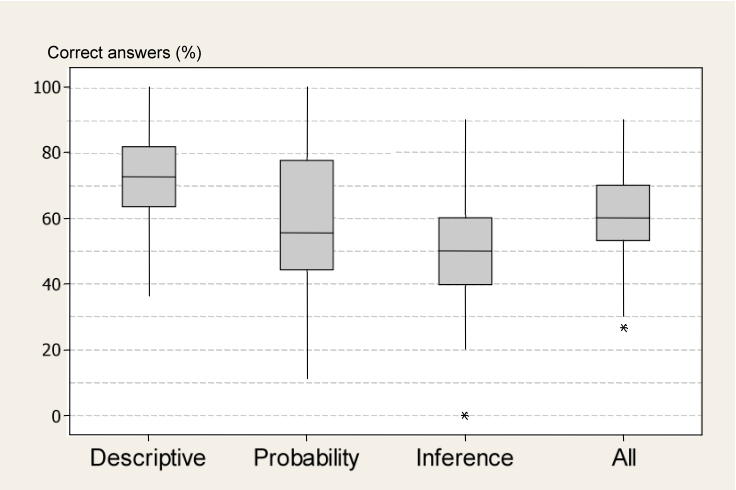

Figure 4. Performance by topics

The three items with lower percentage of correct answers were the followings:

- Item 13 (28%):

  For a Normal random variable, mean, mode and median are equal.

  ( ) True ( ) False
- Item 22 (34%):

  In a hypothesis testing problem, it is possible to conclude by the rejection of the observed sample proportion.

  ( ) True ( ) False
- Item 27 (34%):

  From a sample drawn from a city, we obtain [0.10; 0.16] as a 90% confidence interval for the proportion of a disease. Mark the correct statement:

  ( ) The disease's proportion is 0.13.

  ( ) With probability 0.9, the proportion of the disease is in [0.10; 0.16].

  ( ) The proportion of the disease can or can not be in the above interval, but the confidence is 90%.

Item 13 was classified as Probability topic, which included Normal distribution. Its properties were discussed in class and it was quite surprising that the students failed to answer this item correctly. Maybe the students forgot about median or mode, but the percentage of error was unexpectedly high. Item 22 checked the comprehension of hypothesis test and the relationship between sample and population proportions. One difficulty for the students was to distinguish parameter and estimator, consequently, they became confused with the objectives of hypothesis test and they did not realize that any decisions about sample proportion did not make sense. The interpretation of confidence interval was the subject of item 27, which was also classified as an Inference item. Note that, the correct interpretation of interval estimation is an important part of the basic understanding of statistical inference.

CONCLUSION

A basic statistics course was evaluated from different points of view. In general, the students' opinion was negatively related to several aspects of the course. They did not have good expectation with the course, neither saw utility of the course contents to their careers. The students attending *group classes* did not like the way the course was taught. In particular, they were upset with the excessive use of slides in the lectures. All these factors built a scene that could explain the low interaction instructor-students, as observed in classroom activities. In the *regular class* we had better interaction but it is not relevant.

The monitors also interacted poorly with the instructors and the students. They did not feel integrated to the course, that is, they did not feel that they were part of a team looking for better results concerning the objectives of the course.

During the interviews some instructors indicated negative opinion about the *group classes*, however the majority of them liked the structure of the course because it simplified their task. They also mentioned the low participation in class but they did not seem to consider this to be a big problem. Apart from being well prepared to teach the contents of the course, the instructors did not reveal reflections about the learning processes related to it.

The statistical test demonstrated that the objectives of the course were not reached. The students failed understanding important statistical concepts that would be necessary in future courses or even in their careers. The overall average of 61% of correct answers revealed low performance since only students approved in the course took the test. There was a reasonable effort of the Statistics Department to offer this course to several careers but, in both types of classes, the main interest seems to be in contents and in simplifying the job of instructors. At the end, the results were in some sense frustrating.

There is a lot of material in the literature with suggestions to basic statistic courses for mathematics and non-mathematics majors, for instance Bradstreet (1996), delMas, Garfield, Ooms and Chance (2007), Gaise Report-ASA (2005), Gal and Garfield (1997) and Martin (2003). Also, Magalhães (2007) discussed student's learning in basic statistics classes for mathematics majors at University of Sao Paulo. However, traditionally, there is not too much room to focus on this discussion. Note that most of the instructors of the course evaluated here are under continuous pressure by the university administration and financial agencies to produce statistical research papers. This context creates a challenging situation to introduce changes in the course organization and conduction. The Statistics Department received a copy of the conclusions of the project, whose main results were reported here. We hope, this paper might contribute to increase discussion among the faculty members to obtain better performance in the future.

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