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Teaching Statistics in Integration with Psychology

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Key Words: Student-centered learning, Research problems, Course revision.

Abstract

The aim was to revise a statistics course in order to get the students motivated to learn statistics and to integrate statistics more throughout a psychology course. Further, we wish to make students become more interested in statistics and to help them see the importance of using statistics in psychology research. To achieve this goal, several changes were made in the course. The theoretical framework to motivate teaching method changes was taken from the statistics education literature together with the ideas of student-centered learning and Kolb's learning circle. One of the changes was to give the students research problems in the beginning of the course that were used throughout the course and which they should be able to solve at the end of the course. Other changes were to create a course webpage and to use more computer-based assignments instead of assignments with calculators. The students' test results and their answers on the Survey of Attitudes Toward Statistics, SATS, (Schau, Stevens, Dauphinee, & Del Vecchio, 1995) together with course evaluations showed that by changing the course structure and the teaching, students performed better, and were more positive towards statistics even though statistics was not their major.

1. Background

Teaching statistics with statistics students can be relatively easy compared to teaching statistics with students who are not primarily interested in statistics. Teaching statistics integrated with another subject might even be more difficult. This paper focuses on how to motivate students in another subject area to study statistics. In particular, the focus is on students who learn statistics integrated with a psychology course. Hogg (1991) points out that "students frequently view statistics as the worst course taken in college". Further, Gal and Ginsburg (1994) noted that the fact that students tend to have negative feelings about statistics is recognized by many teachers in statistics. Peterson (1991) noted that most students have to take at least an introductory statistics course in college but they tend to remember the pain more than the substance. Using different teaching methods the ambition was to revise a course and change students' negative attitudes toward statistics.

The statistics course of interest is integrated in an undergraduate second semester psychology course. The course runs through the whole semester and is part of three out of four psychology modules offered during the semester. The statistics part in each module consists of a few lectures in the beginning of each module. At the end of each module, one or two exam questions in their written exam focus on statistics. The students need at least 50 percent correct on the statistics questions in order to pass the statistics taught in each particular module. The department of psychology is responsible for the course and decides the contents of the course. The structure of the statistics part and the detailed

contents of the lectures are decided by the statistics teacher. The statistics part is intended to help the students to become better psychology researchers. For details about the course outline, objectives and a thorough description see Appendix A. Note, there are no statistical prerequisites for the course although one semester of psychology is mandatory. This makes this course comparable to an elementary introductory statistical course.

During the first semester I taught the course, I noted frustration and lack of motivation among the students since they failed to see the links between psychology and statistics. The course evaluations and the students' test results showed that something was wrong with the course. This led me to rethink the course and search for possible solutions on how to motivate students to learn statistics and change the students' attitudes toward statistics.

1.1. Aim

The aim was to revise a statistics course in order to get the students motivated to learn statistics and to integrate statistics more throughout a psychology course. A further objective was to find a possible solution for how statistics should be taught to psychology students in a way which makes them become interested in statistics and to help them see the importance of using statistics in psychology research.

2. Method

2.1. Participants and procedure

The course was first given as a traditional course to 20 students and background material was collected. The revised course was taken by 24 students and the same material as when the traditional course was given was collected. The two groups are assumed to be similar since they had the same average admission points. Further, the groups had similar average ages and about 1/5 were male students and 4/5 were female students.

2.2. Instruments

The collected materials included test score results, course evaluations, teacher reflections and students' beliefs about statistics collected using the affect subscale, i.e. students' feelings concerning statistics statements from the Survey of Attitudes Toward Statistics, SATS (Schau, Stevens, Dauphinee, & Del Vecchio, 1995). The SATS with 28 items was used which have items on a 7-point Likert-type scale which ranged from strongly disagree to strongly agree, with higher ratings indicating a more positive attitude. There are four subscales within the instrument; a 6-item Affect subscale, a 6-item Cognitive Competence subscale, a 9-item Value subscale and a 7-item Difficulty subscale. The SATS was chosen since it correlates highly with the Attitude Toward Statistics, ATS (Wise, 1985) and the Statistics Attitude Survey (Roberts & Bilderback, 1980) see e.g. Schau et al (1995) or Carmona (online). Especially the affect scale, which is suppose to measure students' feelings concerning statistics and the value subscale, which is suppose to measure students' attitudes about the usefulness, relevance, and worth of statistics in personal and professional life, were of interest. The choice of SATS was also due to the fact that the SAS and the ATS have been criticized for not measuring what they intend to measure (Gal & Ginsburg, 1994). A choice was made to only use the SATS post test, as opposed to use both SATS pre and post tests. The reason behind this choice was our main interest to examine attitude differences between groups which receive different teaching methods and there were no explicit interest in examining attitude differences within individuals.

In order to decide what and which changes should be made in the course in order to facilitate the learning of statistics for the students the statistics education and pedagogy literature were examined. The literature search included searching the databases Science Direct, Educational Resources Information Center (ERIC) and Academic Search Elite. The course changes made were motivated by the material found in articles from the statistics education literature and from the pedagogy literature.

3. Theoretical frameworks

3.1. Teaching methods in statistics education

There has been substantial research over the past years about how one should teach statistics at different levels and for different students. Cobb & Moore (1997, p. 814) states clearly that "Statistics should be taught as statistics." By that statement they emphasize that Statistics is a field on its own and should be treated as such and not as a subfield of something else. In that sense it is especially important to use the opportunity as a statistician to be allowed to teach statistics for e.g. psychologists in their own course. A statistician can contribute to a large extent although it helps to have some knowledge of the students' major area of study.

Cobb (1991) noted that most courses can be improved by emphasizing the use of empirical data and concepts linked to the data, at the expense of giving the students less theory and fewer "recipes" to follow. Cobb also emphasizes using descriptive statistics such as graphs throughout the teaching. Cobb & Moore (1997) suggested using data in the statistical course in order to introduce statistical ideas and applications. Smith (1998) stated that students learn statistics by doing statistics. This includes; collecting data, performing analyses and communicating the results. Smith's students' results on the final exam and the students' course evaluations showed that the students appreciated this method. Hogg (1991) also emphasized that students benefit in their learning if they also collect data and not just work with other people's data. Summing up, in statistics education it is a common belief that students learn by working with real data which they are involved in collecting.

Teaching statistics to non statisticians has been explored in different contexts before. Roback (2003) e.g. sketched how to develop a course for a mixed audience. Roback's first aim of the course was that students should develop a "statistical literacy", and an "…understanding of basic elements of statistics that can help in critically evaluating data-driven results…" in the students' field of interest and in their lives. This goal is in line with the ideas of data-driven learning in statistics. In this light, when teaching statistics to non statisticians it is important to focus on real problems which can appear in the industrial or business world. Romero, Ferrer, Capilla, Zunica, Balasch and Serra (1995) also emphasized that the focus should be more on the student than on the teacher.

A problem with traditional introductory statistics courses is usually the lack of motivation among the non statistician students. In the past, researchers (see e.g. Gal & Garfield, 1997; Hoerl, Hahn and Doganaksoy 1997) have emphasised the importance of enthusiasm and of interest for students together with teaching statistical literacy and thinking as desired in introductory statistical courses. Gal & Ginsburg (1994) showed that the students' motivations, expectations, attitudes and their impression of the discipline play a role in their success in statistical courses. Varhoof, Sotos, Onhena, Verschaffel, van Dooren, & Noortgate (2006) also noted a positive attitude between the students' results and their attitudes.

3.2. Suggestions from pedagogy literature

The pedagogy literature search revealed that there are a number of theories on how to increase motivation among students and how to change the student perspective and focus in a course (see e.g. Heikkilä & Lanka, 2006). Here, student-centered learning (e.g. Stuart, 1997) was chosen since it was in line with the statistics education literature together with the idea of a *learning* circle as discussed in Kolb (1984).

3.2.1. Student centered learning

The main idea with student-centered learning is to involve the students in the learning process in order to make learning more meaningful. Further, the idea is to relate the topics taught to the students to their lives, their interests and to let the students engage in the creating and the understanding of knowledge (McCombs & Whistler, 1997). One of the ideas is that if the students are involved in the learning process they want to learn more and not just memorize given facts. Student-centered learning is the first step to let students own the material that they learn. It can also be

adapted to the needs of each individual student (Stuart, 1997). Students learn more efficiently if they are involved in their learning and they share the learning process with the teacher instead of the teacher being the only source of information. Students should be treated as creators together with the teacher in the learning process (McCombs & Whistler, 1997).

3.2.2. Kolb's learning circle

In order to describe the structure in the learning process one can e.g. use Kolb's learning circle as shown in Figure 1. Kolb (1984) created a model of learning using the four elements; concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations.

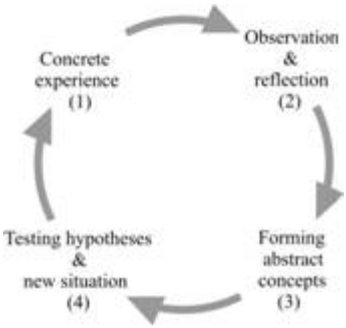


Figure 1. A model of Kolb's learning circle.

The idea is to present a concrete problem for the students, and use this problem to teach general principles and theories to the students. In the first phase, some problem is posed or action is performed. In the next phase, the students try to understand this concept in a specific setting or in similar settings. In the third phase, the students should try to generalize the problem so that in the fourth and last phase they can test hypotheses and use their knowledge in new situations. The overall idea is to make the students understand that they have to know some theories in order to solve problems. Here, the circle has been described as going from phase 1 to phase 4 but it is important to point out that Kolb & Fry (1975) argued that you can start anywhere in the learning cycle and it can be viewed as a continuous spiral. The interested reader can read more about Kolb's learning circle in Kolb (1984) or Kolb & Frye (1975).

3.3. Reflections upon the suggestions from the literature

The ideas from the statistics education literature were combined with the ideas from the pedagogy literature. In particular, when teaching statistics to non statisticians it is important to emphasize data and concepts at the expense of less theory (Cobb, 1991; Cobb & Moore, 1997) and to have hands on problems (Smith, 1998) or real-life problems (Roback, 2003) which the students have been part of collecting/creating (Hogg, 1991). To use real data and focus on the students' learning instead of the lecturing (Romero, Ferrer, Capilla, Zunica, Balasch, Serra, Alcover, 1995) will engage the students more actively and can thus be viewed as student-centered learning (Stuart, 1997; McCombs & Whistler, 1997). The same goes for the ideas of Smith & College (1998) who stated that one learns statistics by performing statistics. In other words, by letting students take responsibility over their learning process and do a lot of data analysis they will become better in statistics.

The combined ideas from the statistics education and pedagogy literature resulted in constructing and using small research problems and more extensively using the psychology labs which were already in the course. Descriptions of the changes in the course are given in more details in the next section. In order to get a structured way to work with the students in their learning process Kolb's (1984) learning circle was used.

The problems when teaching a course integrated with the students' major subject area are similar to the problems Roback (2003) encountered when teaching a course to a mixed audience. The aim is, however, the same: the students should develop an understanding of basic elements of statistics which can help them in critically evaluating data-driven results in their field of interest.

Finally, a problem with traditional statistics courses is usually the lack of motivation among the students. It is important both for the students' learning and their performance that the students are motivated, interested and feel enthusiastic about learning the subject (Gal & Garfield, 1997; Gal & Ginsburg, 1997; Hoerl, Hahn and Doganaksoy, 1997). These ideas about student motivation can be combined with the pedagogical literature on how to increase motivation among students and how to change the student perspective and focus in a course by introducing an area differently or changing teaching methods, the assessments or focus in a course (see e.g. Heikkilä & Lanka, 2006). The research problems mentioned and the use of real life examples, were therefore important when motivating students to learn statistics.

4. Implemented changes in the course

The implemented changes in the courses were on two levels; course administrative changes and teaching method changes. From a teacher's perspective, the course administrative changes were necessary and needed in order to make the teaching method changes. Note that the course objectives were stated by the department of psychology and hence could not be changed, however the teaching methods, assignments, course materials and assessments were possible to change.

4.1. Course administrative changes

In the planning phase, some changes were made in the course schedule so that statistics would be more evenly spread out during each module in order to give the students time to reflect on their learning. The book *Statistical Methods for Psychology* by Howell (2006), which was already used in a higher level course, was added. This might seem like a small change but since the students only had handouts before, it was a huge difference for them to have a course book that dealt with statistical methods in the area of psychology. This was especially important for students who wanted to learn more and wanted to see the usefulness of statistics in psychology. By having a course book that discusses research problems in their own field they could more easily accept and understand why they had to learn statistics.

Another administrative change was to create a webpage for the course where figures and overheads shown in the lectures could be displayed together with handouts, computer assignments and extra assignments. One of the great advantages with the webpage was that students could choose whether to do the computer assignments at the scheduled hours or on their own on their home computers. The last administrative change was to add computer assignments to each module. The first time I taught the course, many lectures and assessment questions were focused on statistics with calculators and there was only one computer assignment in the last module. To mainly use calculators when teaching statistics instead of computers is something that was common a few years ago. Today, many statistical problems that were previously solved using a calculator are now solved with the help of computers and using computer software reflects the actual practice of researchers in many different fields.

To change the assessment, or part of the assessment, is a way to achieve changed student behaviour (Biggs, 1999). Therefore, the assignments were somewhat changed in the course. Today's psychology researchers have access to user-friendly statistical software and might need sophisticated statistical methods to evaluate their results. So, the focus in the course shifted from teaching students to merely doing problems using calculators to also teaching them how to use computers as a tool. If a computer is used to solve a statistical problem, it is important for the students to know what questions should be answered before using a statistical method. It is also important to know how the data material from the research question can best be structured in order to be analysed. Most importantly, are the assumptions in a model satisfied? What do we do if the assumptions in the model are not satisfied? Many computer programs will give an analysis regardless of whether the assumptions are satisfied; hence the researcher needs to know which method and what assumptions should be satisfied in order to obtain a meaningful analysis.

4.2. Revision of teaching methods

The most important change involved the more data driven and concepts based teaching found in the statistics education literature as well as models from the pedagogy literature: Kolb's learning circle and the idea of student-centered

learning including changing the structure of the lectures. Instead of teaching statistical methods and then applying them to psychological problems and research questions, the order was swapped. The students were presented a psychology research article containing statistics which they would encounter during the course. The new order included giving the students small research problems in psychology. One example is given below and five more examples are given in Appendix B. Note that the level of information and structure of the research problems differ.

A researcher is interested in determining if the decoration of a café affects people's abilities to relax, in terms of staying longer and drinking more coffee with their friends. The researcher has access to 8 test subjects. Design a suitable experiment.

Depending on the design of experiment the students chose, different data were given to the students and they could perform a different analysis, or the students were asked to perform a similar experiment. After completing the course the students should be able to solve similar problems. The problems were also used to demonstrate and motivate the importance of learning statistics for psychologists. To give the students a small psychology research problem was both an idea of trying to give the students a concrete experience as pointed out in the statistics education literature (Cobb, 1991; Cobb & Moore, 1997; Smith, 1998), and phase 1 in Kolb's learning circle and to let the students own the material.

In order to solve the problems, the students needed to search for knowledge. In this sense, the psychology research questions helped create a learning situation that is student-centered. In the second phase in Kolb's learning circle the teacher gave the students tools to help them solve the initial problem. This was done mainly in form of lectures and computer assignments with tutoring. When the students achieve the specific knowledge they can move to the next phase in the circle, hence try to generalize the problem. In general, the students used the research problems and examples in order to figure out the generalization of the problem.

The last phase described in Kolb's learning circle was not strictly part of the statistics integrated portion in each course module but can be said to be a part of each module anyway. In each of the four modules, the students had to perform psychology experiments (see examples of psychology labs in Appendix C) and write lab reports. These experiments were also part of the traditional course. The last phase states that the students should test hypotheses and use their knowledge in new situations. This is exactly what the students do in the experiments and when writing the lab reports. For example, if the students have learnt inference theory and testing of hypotheses in the statistics parts of the course module, the psychology experiment could include writing a lab report where they draw conclusions about statistical hypotheses in the psychology experiment they have performed. By letting students work with real problems they feel that they have to understand some basic concepts in order to solve the overall problem. The changes made in the course were mainly motivated from the literature but the main idea was to involve the students more so they would feel they were part of the learning process.

5. Evaluation of changes

In order to evaluate the revised course four sources of information were used; student course evaluations test score results from the written exams, the SATS questionnaire and the teacher's reflections. The results from the revised course were compared with the results from the when the course was taught traditionally.

5.1. Student perspective: course evaluations

At the end of the semester students filled out a course evaluation for the whole statistics course, i.e. including all the three modules which involved statistics. A copy of this form is given in Appendix D.

5.1.1. Traditional course

Fourteen students out of the 20 students who participated in the traditional course expressed some kind of negative general impression about the course or were sceptical of statistics in general. Eight out of these fourteen students reported that they had learned psychology and statistics separately during the semester, in other words they failed to

see the links between psychology and statistics. Hence, the students did not see the connection between the disciplines. The most confusing part was why they needed to learn statistics at all and how they would use their statistics knowledge in the psychology field. Six students expressed dissatisfaction with the statistics part of their education. Three students claimed that they wanted to learn psychology and were forced to learn statistics at the same time but they did not see why they should learn it.

Fifteen students wanted to change the structure of the course, either to spread the statistics part over each module or compress all statistics into four weeks. Nine students mentioned that the course material was not enough and the connection to psychology was lacking. All students left blank the questions on what they did not want to change in the course.

Only three students answered the question about what was the most interesting part of the course. They thought the most interesting part was when psychology examples were used or when the applicability to psychology of the statistics tools was evident. The least interesting part was learning to calculate statistics as mentioned by four students. Finally, the structure of the course, i.e. the students got two or three days of statistics in the beginning of each module and were supposed to study by themselves for the final exam for that module four weeks later, was disliked by 15 students.

5.1.2. Revised course

In the revised course, the general impressions of the students were much more positive than the students who took the traditional course. Nineteen of the 24 students had in general a positive impression about the course. Four students wrote that they had started the semester with a dislike of statistics but now wanted to learn more statistics. Seven students especially expressed that statistics was interesting. No students had a negative general impression although three students were neutral about this question.

Five students wanted to change the textbook since they thought it was somewhat advanced. The rest of the students left this question blank. Fourteen students did not want to change the fact that there was an extensive course webpage, which included all materials taught in class, assignments and handouts. Eleven students mentioned that they had used the webpage extensively and it had helped them in their learning process.

Twelve students thought that the most interesting part was to analyze psychology materials. These students felt that they could actually use statistics in their psychology assignments and psychology experimental lab reports. Fourteen students were satisfied with the textbook, especially students who planned on taking the advanced psychology course. Five students wrote that they hoped they would have more statistics when they were going to take psychology in advanced levels. The least interesting part was when purely statistics was taught as mentioned by three students. Four students suggested that the psychology labs should be used even more in the statistics part, maybe as a way to assess part of the statistics taught in the course.

The structure/schedule question revealed that twenty students were satisfied with the structured although four students would have preferred just a statistics course instead of an integrated course. The students who were positive said that it gave them time to reflect when the statistics part was spread over the semester.

In addition to the course evaluations a short group discussion was held at the end of the course which aimed on discussing the students' feelings and impressions about how it has been to be part of a problem-driven and student-centered course. Many students said that they felt challenged in the course and the fact that the problems were connected to their area of interest made them more engaged in the course than they had thought they would be before they started the course. Some students said that they gradually started to like Statistics as they were working with interesting problems. Several students also said that they had come to value Statistics once they realised how it could be used in their field of study. The only negative aspect which was raised was that some students felt there was much more work in this kind of course.

5.2. SATS questionnaire

In order to examine the students' attitudes towards statistics the student were given the SATS questionnaire (Schau, Stevens, Dauphinee, & Del Vecchio, 1995). The students answered the items on a scale where 1 indicates strongly disagree, 4 indicates neither disagree nor agree and 7 indicates strongly agree. The instrument was distributed at the end of the semester to both the students who were taught the traditional course and the students in the revised course. In Table 1 the results from SATS are shown for the traditional and the revised course. High values indicate a more positive attitude.

The Affect component which is intended to measure students' positive and negative feelings concerning statistics showed a substantial large difference between the two student groups. In the traditional course the median value was 3.33, which should be compared with a median value of 4.08 in the revised course. Further, the Cognitive competence component, which measures the attitudes about intellectual knowledge and skills when applied to statistics, also showed a statistically significant higher median value for the students who took the revised course as compared with the traditional course. The Value component, which measures the attitudes about usefulness, relevance, and worth of statistics in personal and professional life, also had statistically significant higher values for students in the revised course. Note the Difficulty component, which measure attitudes about the difficulty of statistics as a subject, had similar values in both groups. The internal consistency estimated with coefficient alpha revealed that most components in the SATS scale had reasonable high internal consistency in both courses.

Table 1. Median (MD), mean (M), standard deviation (SD) and coefficient alpha (a) of the attitude components from the SATS scale.

	Traditional course				Revised course			
Component	MD	M	SD	a	MD	M	SD	a
Affect	3.33	3.23	1.04	0.85	4.08	4.15	1.20	0.83
Cognitive competence	4.00	3.94	0.89	0.79	4.67	4.72	0.87	0.74
Value	4.11	4.13	0.70	0.63	4.94	4.85	0.83	0.71
Difficulty	3.43	3.41	0.55	0.51	3.43	3.41	0.64	0.65

5.3. Exam results

After each completed module written exam was given to the students. For each module the students needed to have at least 50 percent of the statistical questions correctly answered. Summing the maximum score on the items in each module yielded a maximum total score of 20 for the whole semester. In order to compare the students' exam results before and after the change the average score among the students in each group was calculated. The exams are assumed to be of equal difficulty. The result showed that the 20 students who were given the traditional course earned an average score of 12.98 (SD = 2.20). This result is in line with results obtained from previous years when the course was given by other lecturers. In the revised course the 24 students had an average score of 15.63 (SD = 2.57), hence a large (and a statistically significant) improvement. This course has been given again since these changes were made and the reported results are in line with other times the revised course has been given.

5.4. Teacher perspective: reflections

The administrative changes in the course were necessary in order to change the rest of the course. The schedule change yielded more time for the students to reflect on what they learnt. The course book was a very good tool both for extra exercises and for discussions. The course webpage was a convenient way to give extra information or more material to the students.

The teaching method changes were stimulating, not just because it made teaching more interesting, but mainly because of the positive feedback from the students. The students performed better in the course, in terms of better

understanding of key concepts which was evident when discussing statistical problems and their answers on the exam. The data-driven statistical learning seemed to increase the motivation and hence gave positive results. In the revised course the students had to take greater responsibility for their own learning and be more active in what they needed to learn. The workload was about the same as for the students in the previous semester, but instead of calculator assignments there were more computer assignments.

In the future, the student-centered learning should be even more stressed, maybe in terms of letting the students come up with some research problems that they wish to solve. Further, it could also be effective to have the statistics assessment as part of the students' lab reports. In that way the students get an even closer connection to real psychology research problems and it is easy to assess whether the students can use the statistics they learned in their psychology research. Finally, changing a course takes a lot of time in planning and finding new materials. Since this course was given every year for some years some of the materials could be reused.

6. Discussion

The aim was to revise a statistics course in order to get the students motivated to learn statistics and to integrate statistics more throughout a psychology course. Further, we wished to make students more interested in statistics and to help them see the importance of using statistics in psychology research. The rationale for revising the course was that students felt they were forced to learn statistics. The evaluation of the changes included students' course evaluations, average test score results, the SATS questionnaire and teacher reflections. As a teacher I observed that the students came to the course with low expectations and they had very limited pre-knowledge. A possible solution to the problem was to use the idea of data-driven problems suggested from the statistics education literature (Cobb, 1991; Cobb & Moore, 1997; Smith, 1998), together with student-centered learning and Kolb's learning circle in order to increase motivation. These ideas were realised through introducing a psychology related research problem in the beginning of the course and letting the students find the necessary tools to solve the problem. The idea was to give the students tools to understand the statistical concept in specific situations and help them generalise them in order to apply them in similar settings. Later, when the students had completed the statistics part they would be able to generalize the statistics concepts taught in order to use them when solving research problems in their psychology experiments.

What was evident in the revised course was that most of the students had a more positive attitude towards statistics than in previous courses although they perceived the same level of difficulty of statistics as a subject. The students were much more satisfied in the revised course as seen in the course evaluations. This is important to notice, since students whose primary study area is something other than statistics tend to give the lowest ratings in course evaluations compared with students taking courses in line with their majors (i.e. pure statistical students). However, I have not investigated whether the same result is obtained in a regular statistics course if the same teaching methods are used.

So what has been learned? To integrate and develop a new course is time consuming but doing it by using great pedagogic and statistics education ideas makes it easier when one can see that it works in practice. It is a learning experience for both students and teachers which do becomes smoother over time, which also Rinaman (1998) noted. The involvement by students (Smith, 1998; Cobb & Moore, 1997) is important both from a student learning perspective and a teacher perspective.

By putting in a real effort I believe that we can change the common students' view summarised by Hogg (1991) "students frequently view statistics as the worst course taken in college" into thinking that it could be the most useful course they ever taken in college. At least that is my vision.

Appendix A

COURSE DESCRIPTION AND LECTURE OUTLINES

Course description: Integrated within three out of the four modules in the full semester psychology course, with emphasis on quantitative methods, corresponding to four credits, is an orientation about research methods and statistical procedures. This orientation includes descriptive Statistics, hypothesis testing, statistical inference, methods to estimate reliability and validity. Integrated with the three modules are also experimental design, t-tests (module 1), nonparametric tests (module 2) correlation and linear regression analysis (module 3). Details are given below.

Goals of the course: To obtain an introduction to research methods and statistical procedures. An overall aim is after finishing the course to be able to use basic statistical theory in psychology research.

Tools: Calculators and the software SPSS are used to analyze data.

Webpage: General information is given about the course. Especially, presentations from class, study materials, old exams, assignments and test results can be found on the webpage. Students are encouraged to visit the webpage regularly.

Text: Howell, D. C. (2006). *Statistical methods in Psychology*, 6th edition. New York: Thomson Learning.

Student activity and achieving the goals of the course: Students need to be active and benefit from working through the assignments. Emphasis is on understanding statistical concept, knowing when to use them, how to use them and when not to use them. Reading the text is important. Computer assignments, laboratory work and tests during each module are used to evaluate student learning.

Module 1: Descriptive statistics, experimental design and hypothesis tests

- Introduction to Statistics
- Descriptive Statistics (Graphs, measuring center, measuring spread)
- Elementary probability theory
- Random variables
- Normal distribution (properties, z-scores, model)
- Sampling distributions
- Hypothesis test of mean(s)
- t distribution
- One sample t-tests
- Two samples t-tests
- Paired samples t-tests

Module 2: Nonparametric tests

- Goodness of fit - chi square tests
- Test of independence
- Kruskal-Wallis test, Mann-Whitney Wilcoxon test

Module 3: Observational design, correlation & regression

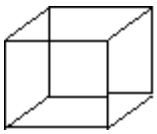
- Reliability and validity
- Correlation (linearity, graphs)
- Linear regression (including model assumptions, dummy variables, residual plots, outliers, least squares regression line)

Appendix B

EXAMPLES OF RESEARCH PROBLEMS

1. Is it possible to train the memory in order to remember spontaneous observable events? The researcher has eight volunteers and wants to compare two programs. The researcher randomly divides them into two groups; one with training and one without training. A week later the researcher shows the eight volunteers a movie with a bank robbery. The volunteers are questioned about the robbery. Those who have trained their memory had the following correctly answered items: 20, 25, 24, and 23. The other four had: 14, 22, and18, 19. Isthe program effective?

2. Examine the number of reversals for 30 students when they examine the Necker (1832) cube. In other words, the number of times a person shifts between seeing one kind of cube to see the other kind of cube. Design an experiment and examine if there is a difference between men and women.



3. Use the data obtained from your experiment in problem 2 and compare it to the historic mean result of 16 reversals per minute (Orbach, Ehrlich, & Heath, 1963).

4. Assume that we want to examine if coffee helps students to be more alert during a lecture. Design and perform such an experiment!

5. Use two different psychology tests, which are intended to measure the same or similar concept. Distribute them among volunteers. Examine them using regression. What can we learn?

Appendix C

EXAMPLES OF PSYCHOLOGY LABS

1. Neisser (1964) conducted an experiment about recognizing the letter Z. Neisser showed that the letter Z was detected much faster when displayed in a context of rounded letters (O,S,Q) as compared with a context of angular letters (K,E,L). Neisser showed when using a similar background to the letter Z it took twice the time to find it compared to when a dissimilar background was used. Neisser concluded that searching a visual array is primarily concerned with distinctive features. Design a replicate of this experiment using at least 30 persons. Use valid statistical tools to evaluate your experiment.

2. Risk perception: Estimate the intensity of the smell of iso-amylacetat and butanol. The smells are recorded using the Borg CR 10 scale developed by Borg (1982; 1998). To learn about odor perception read e.g. Dalton (1996). Perform the experiment and draw valid conclusions.

3. Noise: Develop a noise experiment and try it on several individuals. The experimental design can be a between group design with one control and one experimental group or a comparison of different levels of noise etc… Give the different groups some kind of psychological test (e.g. memory test, perception test etc.). Design and conduct an experiment and make relevant analysis.

4. Environmental stress: Conduct an experiment in a stressful environment and perform several tasks at the same time (e.g. listen to someone reading a text at the same time as they count backwards and perform Raven's (1938) test). Afterwards the individuals should fill in a survey about perceived stress. Perform this experiment, analyze the obtained data and draw valid conclusions.

5. Survey construction: Construct a survey about psychological environment, e.g. environmental behavior. Choose a sample of individuals and have them fill in your survey. Analyze your survey and discuss reliability and validity concepts.

Appendix D

COURSE VALUATION

1. General impressions about the course:

2. Things I would like to change in the course:

3. Things I would not change about the course:

4. What material have you found the most interesting?

5. What material have you found the least interesting (or most confusing)?

6. Comment the structure of the course (schedule etc.):

Other comments:

Addendum

Volume 17, Number 2, of the Journal of Statistics Education contains a Letter to the Editor concerning this article.

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