Notes on Attitudes to Statistics among Swedish Psychology and Education Science Students: The Effects of Self-perception and Anxiety

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Abstract: A number of studies have pointed out the resistance to statistics courses and the anxiety it induces among social science students. The attitudes to statistics among psychology and education science students in a new university in Sweden were studied. Seven students were from a higher level course eight were from a course at a second year level. The students were asked voluntarily to respond to a questionnaire. The higher level students were given the questionnaire both before and after the course and they were also interviewed for about one hour each. Although all students experienced anxiety about statistics, some of them had become more positive to statistics after the course. This shows that feelings of interest and anxiety can exist at the same time. The anxiety might often be a result of low self perception of one's own mathematical abilities. This self-perception must be made more positive. Teaching statistics at the same time to both distance and campus students is not to be recommended. The students expressed a wish for a more continuous teaching of statistics, repetitions, more practical examples and practice in using statistical packages.

Key words: Psychology, statistics, anxiety, self-perception, teaching

1. Introduction

A large part of psychology uses statistics as well as other mathematical methods. At the same time many students in the social sciences as well as in psychology have a fear and anxiety for statistics. They try to get away from these courses as soon as possible or they take as few such courses as possible. Mathematics and statistics are often seen as the most important subjects in a university curriculum, while the methods for teaching these are not very effective (e.g. Prabakar, 2008). Many psychology students may even choose to study psychology in order not to study mathematics, and they are therefore negatively surprised and, at times, frustrated that the courses contain as much formal methods as they do. There have been a number of suggestions on how to deal with what Dillon (1982) has termed "statisticophobia" by e.g. Firmin and Proemmel (2008). They propose that one cause for the anxieties that many social science students have is that they think intuitively, maybe like artists, rather than "scientifically". However, whereas the social scientists might rely more on methods often called qualitative, both categories may have a scientific approach.

Part of the anxiety may be caused by the teachers themselves. One particular feature of statistics courses in non-statistical departments is that they are often given by teachers who are not statisticians themselves, e.g. a psychologist who uses statistics in his research also teaches statistics to the students. The advantage of this is that the teacher comes from the same theoretical background as the students and is more familiar with how formal methods are used in this area. The disadvantage might be that some teachers may lack a theoretical background to parts of the material. For these teachers there are now many on-line resources that may be helpful (Green, McDaniel and Rowell, 2005). There are also some general trends,

e.g. students who show less interest in studying mathematics (Smith, 2004) at the same time rely on computers to which mathematics is an essential ingredient.

There have been special efforts aimed specifically at particular subject matters to integrate them with statistics. One such attempt was made by Wiberg (2009) in the subject of psychology. She compared a traditional statistics course with a revised course using a student centred approach involving psychology in a more direct way. It showed that the students in the revised course were more satisfied and positive to statistics, but had the same difficulties as the more traditionally taught students.

With distance education, in particular by the use of the Internet and electronic communications, new difficulties but also possibilities have come into existence. For example, if the students are located in a different location, much of the personal interaction may get lost; an interaction which is crucial in a subject like statistics. One also wonders how the laboratory exercises are to be conducted. Some of the statistical programs that distance students use may not be as user friendly as those on campus. The technical difficulties may thus aggravate the anxieties of some students, regardless of how they might feel about statistics per se.

Hsu, Wang and Chiu (2009) investigated how the use of computers influences MBA students in using statistical soft wares. They found that both computer attitude and software self-efficacy had positive effects on the perceived usefulness of statistics. Perceived ease of use also had positive effects. However, statistics anxiety had negative effects on perceived usefulness, perceived level of difficulty, and behavioural intentions, i.e. if they were going to use statistical software or statistics in the future. It should be noted that there is a demand for business students who are skilled in statistics, e.g. for data mining, as a consequence of the growing information provided by the Internet. However, employers have difficulties in finding suitable candidates (Economist, 2010). There is also an interest in the education community in developing research strategies for education of adults (Larsson, 2006).

The literature on the influence of classroom and school environments on the motivation and learning of elementary and secondary students in US schools was reviewed by Meece, Anderman and Anderman (2006) in the framework of achievement goal theory. School settings emphasizing mastery, understanding, improving skills and knowledge had the most positive motivation and learning patterns for the students. On the other hand, school environments that focused on demonstrating high ability and competing for high grades could increase the academic performance for some students, although many young people seemed to experience diminished motivation at such conditions. It is likely, the author says, that similar conclusions would also be reached for university students. One may also ask if some academic subjects, e.g. mathematics and statistics, are more sensitive to the demands of having a good classroom environment.

Some of the students in universities today may be taking a course on campus and some as distance students. Should these two groups be taught in different ways and times or should one try to combine both? Students have different amounts of mathematical knowledge and one Roback (2003)found that teaching statistics to a class with varying mathematical basis had positive effects. In some courses with few students it is only feasible to have one course. How should one examine these students? A related question is if the anxieties of the statisticophobic students will decrease or increase if they are studying by electronic means?

These issues were addressed by questionnaires distributed to psychology and education science students taking courses in statistics and by interviewing the higher level students.

The following research questions were asked: (1) Are Swedish students affected by anxiety for statistics? (2) Were attitudes changed after a course? (3) How do the new media affect the learning of statistics? (4) What can be proposed for future courses?

2. Method

During the spring term of 2010 I taught a course in quantitative methods to seven Master's students in psychology and education science at Blekinge Institute of Technology. All students were expected to gain the same competence. Using Adobe Connect for the distance students, I taught both groups at the same time..

The laboratory exercises were conducted by the campus students in special laboratory rooms, while the distance students were conducting the same exercises with their own computers, using net based software identical to the one used on campus. The statistical software package used was SPSS.

Before and after the course the higher level students were given questionnaires which contained questions about different aspects of statistics. The students' attitudes to statistics before and after the course could thus be compared to each other.

The first questionnaire that was given to the students included some demographic questions as well as the questions below (translated from Swedish). The students had to mark their opinion on a horizontal line.

A. My knowledge in statistics needed for psychology/education science is (The end marks were 'Very good' and 'Very bad').

B. Compared to other subjects study I feel (The end marks were 'Much more worried' and 'Not worried at all') when studying statistics

C. I will need statistics for my future studies in psychology/education science. (The end marks were 'Totally agrees' and 'Does not agree at all'.)

D. I need statistics for my future work in psychology/ education science. (The end marks were 'Totally agrees' and 'Does not agree at all'.)

E. I like to be engaged by numbers. (The end marks were 'Totally agrees' and 'Does not agree at all'.)

F. Before I began to study psychology/ education science at the university, I worried about statistics. (The end marks were 'Totally agrees' and 'Does not agree at all'.)

The second questionnaire was basically identical but had one additional question: "For statistics I now feel (indicate all that you agree with)", and then giving the following alternatives: "Calm, Neutral, Worried, Interested, Indifferent, Negative, Expectant".

There were seven students, one man and six women, in ages ranging from 23 to 49 years of age, with a median age of 41. The distribution was bimodal three students being aged 23-27 years and four students being aged 41-49 years. Three of the students took the course on campus while four took it as a distance course.

Another group of students, consisting of ,one man and seven women, who took a basic statistics course, were also given the same questionnaires. These students were aged 20-37 years with a median age of 23.5 years of age. B-level corresponds to courses at the second year in English speaking countries. All these students took a campus course that included lectures and statistical exercises. Their questionnaire was equal to the second one given to the Master's level students.

Since it was necessary to link eventual follow up questionnaires with previous ones, the questionnaires were not anonymous.. The students were informed that whether or not they handed in the questionnaires and regardless of they answered the questions it would not affect their grades. Rather, it was stressed that their participation was important for the quality of future courses

In addition to the questionnaires, interviews were held with all except one of the Master level students after both questionnaires had been responded to. The interviews were primarily conducted by the use of telephone, and in one case (person no 6) by a personal interview. The interviews afforded possibilities of gaining a wider and deeper view on some of the issues addressed in the questionnaires.

3. Results

3.1 Questionnaire results

The results of both groups of students on the questionnaires are summarized here.

Before the course five out of the seven master's students said that they did not consider themselves to have a low knowledge of statistics After taking the course, however, this number had risen to six, i.e. a slight improvement.

On the question of the anxiety for learning statistics, the anxiety was either as before or had decreased for the students.

The students seemed to realise the importance of statistics for their studies, although maybe not for their future work. The anxiety had declined somewhat for the Master-students.

Out of the seven Master students, six were willing to participate in an interview, while only one was unwilling. Out of the eight B-students, only one was willing to be interviewed, while six were unwilling and two were unclear. This may be interpreted as a difference in the commitment of the students to the discipline psychology.

Some of the Master's students appear to have become more positive after the course. Three of them said they were interested, while two of them stated they were both anxious and interested. This shows that a student can be both anxious of and interested in statistics at the same time.

In their open comments to the questionnaire, a few of the Master's students asked for more statistics education in the curriculum. There were also comments which suggested that it was not beneficial to have long time spans between the different statistics courses.

3.2 Interview results

The interviews were conducted in an open form. The students were first asked to speak in general terms of how they felt about statistics and how it related to their present studies. They were then asked more specific questions on their experiences from the particular course that they had recently been enrolled in. Finally they were asked for suggestions on how statistics courses in psychology or education science could be improved. Each interview lasted between 40 minutes and one hour.

The interviews were only conducted with the Master-level students. All except one (no 3) participated. The results of most interest are presented below:

Person No 1, a campus student, said that the simultaneous teaching of distance and campus students was not positive. This was a general opinion for all courses, and not specifically for statistics. The anxiety that some students have for statistics was believed to originate in a belief that the student does not have sufficient basic knowledge. The interviewee recommended having diagnostic tests before the course, which could point the students in the right direction in how to prepare. More statistical exercises were also suggested, e.g. in using the SPSS package. The students also expressed an interest in using statistics in other courses and in having the statistics courses more spread out in time.

Person No 2, a campus student, preferred campus education before distance education for all courses. She thought that there was too few statistics courses and that more repetition was needed since every time a statistics course was offered she learnt a little bit more She felt less anxiety for statistics now than in the beginning of her studies. The student also thought that there is not a great need to know much mathematics. Rather, the teacher must point out why it is good to know statistics. More practice with using SPSS was also a wish.

Person No 4 was a distance student who thought that better use could be made of available technology. The student was positive to statistics and realised the benefits. It was recommended to use some kind of problem based learning where the projects should involve statistics. IA collection of concepts and symbols was sought after. The student thought that the teacher should make sure that all students can follow the teaching. A general view or vision of statistics was also asked for.

Person No 5, another distance student, expressed a "love" for distance education, but at the same time she thought that she had been at a disadvantage in this course. No literature had been purchased by the student, who instead had used other sources for learning. A basic course in SPSS was asked for. No special anxiety was alleged to be caused by statistics: Such an anxiety would rather be related to age (the student was 48 years of age). A course more spread out in time was recommended.

Person No 6 was a campus student who preferred both psychology and statistics in this form. The student did not think that it was positive that both groups were taught at the same time since one group was always at a disadvantage. The student claimed that many students, presumably in the social sciences, see statistics as old fashioned; "Psychology is about people". Moreover, the student did not think that it was good that I quantitative and qualitative methods are presented as excluding alternatives. As one of the few interviewees, the student was positive to taking a supervised written exam. The other persons in the enquiry were either negative or neutral to this type of examination. The student said that many students erroneously believe that statistics is the same as mathematics. Increasing mathematics requirements would thus not be a solution. The Internet was said to be a one reason why many student just tried to get through the studies with minimal efforts. This also makes the learning of statistics more difficult since it demands a more active effort. In teaching statistics, many examples were recommended to be used.

Person No 7 was a distance student who had avoided mathematics in high school due of low self esteem in the subject. In this course, the student had tried hard to understand the subject matter which had resulting in her no longer being afraid of statistics. The students were of the opinion, however, that there were too long interruptions between the different statics courses. In order to increase the motivation for statistics, she thought that the teachers could emphasize the fact that many employers ask for statistics savvy in their employees. Moreover, the student thought that presenting authentic examples is a good way to teach and that it would be preferable to have statistics taught continuously in the courses instead of as now as specific blocks in time. She also thought that repetition of mathematics could be an option for students who are older, and finished school a long time ago. The student was very proud of her accomplishments.

3.3 General patterns of the results of the interviews

Most of the interviewees had previously been involved in a programme that combined education science and psychology. It seemed that the students who had emphasized psychology in this programme had a more positive view of using statistics in the future and of the need to learn it. One student had a pure basic psychology education and clearly expressed a large need for learning statistics.

As has been reported by other researchers, many of the students had chosen psychology or education science. in order not to need to study what they see as mathematics.

3.4 Proposals

The most frequent items that the students proposed for future statistics courses included more continuous teaching of statistics during the education, having a diagnostic test at the start of each course solely for the benefit of the student's own self-assessment, more practice in using statistical packages and repetition of contents from earlier courses. It was important that the teacher assures that each student has understood. The IT-equipment should function without fault and be used more for the distance students. It was not considered wise to teach both distance and campus students at the same time, since one group would be at a disadvantage. Moreover, one should try to teach the students good studying habits, since some students may have bad habits, e.g. using Wikipedia indiscriminately.

4. Discussion

The answers to the questionnaires indicate that both groups of students experienced anxiety for learning statistics. They thus follow the pattern for most social science students, as found in other studies. One might have expected that the more mature students in the Master-level group would feel less anxious. However, the sample is rather small for drawing strong conclusions.

There was a general consensus among the Master-level students in the interviews that it was not advisable to teach statistics to both distance and campus students at the same time. Many asked for more examples from ordinary life and to have more practice with statistical packages such as SPSS. Preferably the statistics education should be spread out in time and not be concentrated in an intensive block of one or two weeks.

It is to be noted that out of the eight B-students five or six came to the first two lectures, while , only three or four of them attended the last three or four lectures. Only one student came to the last lecture. There were three SPSS laboratory exercises, to become familiar with the package itself, but they were also to see how easy it is today to make statistical calculations. All the B-students came to the first one but to the subsequent two exercises only three of them showed up. There were also SPSS exercises for the Master's students in which all participated. This difference is perhaps an expression of the interest and commitment of the students to psychology or to a realisation of the need to master statistics for their future work.

Previous experience of mathematics and statistics are important predictors of statistics at undergraduate levels (Dempster, 2009). The perception of their own mathematics ability influences how they see their own ability and attitudes to statistics. This is also congruent with a number of the interviews in the present study. Dempster says that we thus need to enhance students´ perceptions of their own mathematics abilities. One way is to give remedial teaching in mathematics before the actual course begins and to put more emphasis on the intuition of the students. Possibly it would also be useful to provide a short refresher course in mathematics or statistics before each actual course. A major obstacle to students learning statistics is that they see themselves as having a low level of proficiency in mathematics. As a teacher, one could stress that although statistics uses mathematics it is not mathematics. This could be a way to change the self-perception of the students that they have of their own capabilities in statistics.

One may here note that Treisman (1992) found that key elements for learning calculus in classes with students of different origins were group study and support, student's awareness

of their teacher's high expectations, and shared experience in solving problems of a progressively more challenging nature and building of self-confidence (see also Seymour and Hewitt, 1997). Similar elements are probably also true for social science students learning statistics.

The sample in this study was limited in size, and all of the students were from the same educational institution which is a fairly young and small one. . However, the students in this study do follow fthe same pattern as other psychology and social science students that have been studied. It is thus likely that the outcome would be the same if it had been carried out with a larger student group, including students from older and bigger universities. The recommendations would, I believe, be similar, i.e. that the focus should be on changing the self perception that the students have of their own mathematical and statistical ability.

One methodological difficulty of this study is that the same person was teacher of the course, the tester of the questionnaires and the author of this text. Although I have attempted to separate these roles, but they might still have affected the responses of the interviewees despite the fact that they were assured that their responses would not affect their grades in their courses. If possible, it would still be preferable in a future study that the investigator is not the teacher to the persons he/she studies. However, sometimes this is not feasible.

As a personal note at the end of this proceeding I would like to emphasize that I believe that statistics is an essential tool for research in psychology and related fields. At the same time, one should also try to get students to become more educated in mathematics, since this is essential for formalising equations and functional expressions. Changing the self-perception of the students would begin with statistics and then continue with how they see their relation to mathematics.

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