TAKING STATISTICS OUTSIDE THE CLASSROOM: RESEARCHING THE COMMUNITY

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ABSTRACT

Oftentimes, students who take (mandatory) Introductory Statistics fail to see the value of statistics for society, or for their future careers. In order to make statistics more valuable to students and show them how statistical results are put into use in the immediate region, community based group projects were introduced to students in the Netherlands. This paper reports the outcome of an evaluation of these projects. The results show that students who took part in these projects report higher self confidence and math skills and they more firmly believe in future use of statistics. Furthermore, after finishing the project they value statistics better and they believe it is less difficult. Most importantly however, the grades of students who participated in group projects improved compared to students who did not take part in any student projects in their course. Evaluations show that students start to see the added value of statistics.

Keywords: statistics projects, teaching statistics, community based projects.

INTRODUCTION

Statistics has been an obstacle for many students and for many decades, throughout universities and colleges. Not only do students dislike the topic, it frightens them to work with formulas and they fail to see the added value of statistics for their future career (Smith, 1998; Thompson, 2009; Verhoeven, 2009). However, when entering university life, statistics is a necessary step to overcome, for it is a mandatory course for many first year students, especially those who major in Social Science.

So it is up to the teachers to make statistics attractive, give clear explanations, help students learn statistics and open their eyes to the added value of statistics. One way of doing this is by introducing student projects into the classroom (Hydorn, 2007). It is a way to hit two birds with one stone: students learn to practice statistics in every day life and they learn to appreciate the added value of statistical models in society. This paper describes the result of two evaluation studies into the extent to which students attain added value to the participation in statistical student projects, using regional research questions.

Group projects can deepen the students' understanding of statistics, it increases their interest in statistical topics and they learn the usefulness to making business decisions based on statistical results (Sisto, 2009). Group projects in the Netherlands are typically used in small scale colleges, where group sizes are smaller and it is less complicated to set up these projects. The learning goals that underpin these projects are: students learn how to correctly apply statistical techniques to societal and business situations; they learn how to interpret results and develop recommendations for these businesses, how to communicate the results, and how to collaborate effectively in small groups.

Additionally, group projects may be based in the direct community, thereby strengthening the students' embeddedness in society. This urges students to think beyond the box and not only focus on empirical questions but also on questions as to how research results can be used beneficially for the community. The setting up and supervision of group projects is very challenging, both for students and teacher, as the latter should not take supervision lightly. Especially when regional questions from 'real' clients are involved, besides focussing on the application of statistical techniques, the communication of the process and results needs special attention. Supervisors need to move away from traditional teaching methods to unconventional supervision and working together with students into addressing genuine research problems (Thompson, 2009).

The projects described in this paper started in 2005, in a small-scale college in the Netherlands. The first few projects were carried out by means of a pilot, and when proven successful, the project group method was added to the curriculum as a fixed part of the 'Introductory Statistics'

course. Besides research questions from regional organisations, student also analysed applied questions they developed themselves.

Setting up student projects requires some extra effort on the part of the teacher. Firstly, research questions from regional (non)profit organisations are assessed to fit to the level of first year students. Then, the projects are announced in class. Based on their letters of motivation, interest - and competency levels, students are assigned to the available project groups. The projects start during the first few weeks of the semester, and they end with a group presentation and a research paper after 15 weeks. Supervision is provided by the statistics teacher and the content expert at the client organisation, thereby control over reliability and validity of the method is warranted.

The theoretical basis for this approach lies in constructivist theories (Thompson, 2009), whereby active engagement of students in real-world problems provides the necessary motivation and interest, it draws on past experiences and it provides that part of 'relevance' to the outside world. With this approach students do not stay within the walls of their classroom and, in later academic life, also engage in community based projects.

METHOD

The introduction of project groups was quantitatively evaluated as part of a larger study that focussed on attitudes toward statistics and the effect of individual and institutional factors on student outcomes. In 2006 and 2007, data were collected among N=2,555 college- and university students in the Netherlands and Flanders. They filled in questionnaires on two occasions, one at the start of the semester and one at the end of the semester. For this secondary analysis mainly post test data were used N=1,509). The evaluation of project groups was organized among part of these students, as n=222 students reported to have taken part in statistics projects during their first year of study.

Besides, a qualitative tool was used from 2005 until recently to evaluate the statistics course and a few open questions were added where the student could fill in their own experience with the course. This qualitative assessment was re-analyzed for 2005 – 2010, with 6 groups of students (N=135).

Instruments and analysis

In order to obtain information on student learning behaviour, attitudes and student outcomes, the Survey of Attitude toward Statistics was used (Schau, Stevens, Dauphinee & DelVecchio, 1995) as well as global study attitudes such as questions on self-confidence and perceived statistics mastery. Besides, individual background questions were asked and questions on the set up of the courses the students were enrolled in, such as teaching and assessment methods, organisation of projects (if any), class size and course duration.

In a separate set-up course evaluations were used to qualitatively assess the students' opinions on the course as a whole, also split up into separate parts (their own learning, course organisation, assessment and grading, number of hours spent et cetera). Students could fill in open ended questions on what they liked most about the course and what suggestions for improvement they would make. These two questions formed the basis for the qualitative analysis.

The quantitative data were analyzed using independent samples t-tests, with $\alpha < 0.05$ and Cohen's D for Effect Size. Qualitative data were analyzed by looking for sensitizing concepts (Glaser & Strauss, 1967) in the open questions.

RESULTS

Looking at the first results of the quantitative analysis, the students seem to positively evaluate group projects during the stats course. Tables 1 and 2 present the results of independent samples t-tests on the whole dataset, split up into two groups: students who participated in a group project (n=222) and students who did not (n=2,333). However enormously skewed, the results still show that group projects are highly valued by students. Table 1 shows the results of the analysis of post-test attitudes across group projects. Except for Affect (t (1509)=-0.301; p=0.763), students believe themselves to be more competent, they value statistics more, they are more interested and they believe it is less difficult compared to students who did not take part in a group project. Moreover, they put in more effort ($\Delta\bar{x}_{effort}$ *=0.53; t (249.542) = 6.297; p = 0.000*) than students who did not participate. Effect sizes are high, resp. from 2.2 to 10.6 for the significant differences.

	t	*Df*	*P*-value	Mean Difference	Cohen's *d*
AFFECT_POST	-0.301	1509	0.763	(4.08 – 4.05) -0.03	0.5
CCOMP_POST	1.216	192.982	0.225	(4.61 – 4.73) 0.12	2.2
VALUE_POST	2.080	1509	0.038	(4.63 – 4.79) 0.16	3.5
DIFFICULTY_POST	3.801	1509	0.000	(3.20 – 3.46) 0.26	5.8
INTEREST_POST	2.192	1509	0.029	(4.16 – 4.37) 0.21	3.5
EFFORT_POST	6.297	249.542	0.000	(5.21 – 5.74) 0.53	10.6

Table 1 Independent t-test for the difference in attitude across (non) project group (note: group means in brackets).

Table 2 shows the results of t-tests on the differences across groups with regard to more general characteristics, such as self confidence, expected future use of statistics, stats and math experience, math results, perception of math ability and number of hours spent. All variables but mathematics experience (*t(236.257)=-0.364; p=0.716*) show significant differences in the expected direction: more hours were spent, self confidence and math results (+ the perception thereof) are higher, and student have more math and stats experience than students who did not take part in project groups. Cohen's D is high for all results, ranging from 2.4 to 6.0.

	t	df	*p*-value	Mean Difference	Cohen's *d*
N_hours	5.986	2495	0.000	(3.35 – 5.23) 1.88	6.0
Self_conf	4.055	2534	0.000	(4.23 – 4.58) 0.35	4.0
Math_res	2.224	251.622	0.027	(4.43 – 4.66) 0.23	2.4
Good_math	2.439	255.483	0.015	(4.12 – 4.37) 0.25	2.5
St_future	3.129	248.986	0.002	(3.70 – 4.00) 0.30	3.5
Math_exp	0.364	236.257	0.716	(5.86 – 5.90) 0.04	0.3
Stat_exp	3.813	225.173	0.000	(0.28 – 0.63) 0.35	4.7

Table 2 Independent t-test for the difference in background and experience across (non) project group (note: group means in brackets).

Lastly, it was tested to what extent final grade differs for students who took part in the stats projects compared to students who did not. The test results show that the final grade is higher for project students (6.7/10) than for students who did not take part (5.7/10) in a project (*t (322) = 8.98; p = 0.000*).

The qualitative analysis during the last 5 years shows similar results. From the total number of students (*N*=135), only one student wrote a negative remark on the stats project. Sixty students pointed out that they liked the project most during the semester, compared to the other course elements. Key words are: learning experience, interesting projects, application of knowledge, acquiring of skills, group collaboration, and time spent. Figure 1 shows the diagram with key concepts of 'what students liked best'.

CONCLUSION AND DISCUSSION

Evaluation results obtained from students taking part in statistics project groups in 5 consecutive years show, that group projects can add value to introductory statistics. Overall students are enthusiastic about these projects; they believe it is exciting that they can contribute to policy decisions in (non)profit organizations in the region and they are willing to 'go the extra mile' to bring the project to a successful conclusion. The main conclusion is that students really appreciate the fact that they can put theory into practice and exercise the acquired skills in a real life setting.

Quantitative research results revealed that students who are taking part in research projects have had more prior math and stats experience, they feel more confident that they can obtain the necessary knowledge and skills, they see the added value of statistics and there attitude toward statistics is more positive. Most importantly however, students who participated in research projects get higher grade than those who did not.

Looking into the future a few remarks need to be made. Students reported that they have to put in more Effort to finalize the projects compared to standard teaching and learning. This needs to be addressed by the curriculum developers, by means of adding extra supervisory possibilities, extending deadlines or weighing project grades higher. Furthermore, students mentioned the challenges these projects have, partially in regard to communication. Group work needs to be closely monitored for two reasons. Firstly, free rider problems need to be addressed. The aforementioned college has established an extensive grading / weighing system. Besides grading the project paper as a whole, each group member is responsible for a specific part of the paper, i.e. introduction, method, results or conclusion. So, besides the group effort, individual effort is graded separately. The first signs show that free rider behaviour is kept to a minimum. Secondly, groups do not always collaborate well, due to differences of opinion, time management or communicative skills. Teachers need to pay special attention to these processes, and, if necessary mediate to keep the groups together.

Future research should focus on further improvement of project based learning. Additional attention must be paid to client evaluations, as the clients' opinion on how to collaborate with student groups gives insight in how students can effectively put theory to practice and, at the same time, the clients can benefit from the acquired results.

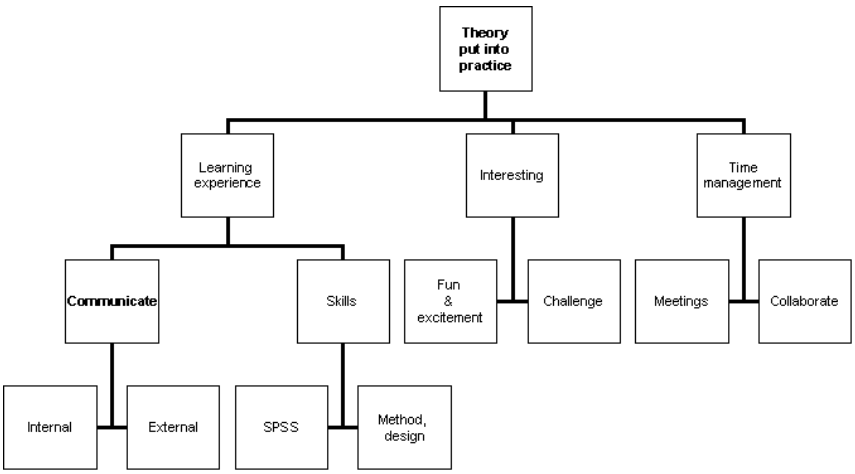

Figure 1 Concept diagram qualitative evaluation statistics project groups

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