DO VIDEO CLIPS AND ONLINE SELF-TESTS HAVE ADDING VALUE IN EDUCATING STATISTICS?

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A recurring issue with teaching statistics is that students vary in quantitative skills and interest in statistics, as well in learning style. For this reason lectures might not be equally effective for all students. Recently, at Wageningen University, video clips and self-tests have been added as an integrated part of a basic course in statistics. The year previous to the introduction of the clips and self-tests, 524 students filled in a questionnaire asking them about their course experiences and motivation. After the introduction 611 students from the same fields of study were presented with the same questionnaire, but with ten additional questions about the online teaching methods. In this talk, we show the positive effects of introducing clips and self-tests on students' motivation and interest.

INTRODUCTION

At Wageningen University bachelor students of nearly all programs of Plant Sciences, Animal Sciences, Environmental Sciences, Food and Nutrition and Social Sciences follow in their first or second year a basic course statistics (Statistics 2). It is the first course in which Inferential Statistics is taught. The three week, Dutch spoken, course consists of three tutorials and two computer practicals a week. The course comprises the Normal distribution, the distributions of the mean and the sum, the *z*-test for one mean, the one sample, the independent and paired samples *t*-tests, confidence interval estimation, simple linear regression and correlation. Tutorials are given in groups of max 45 students. During the tutorial, a lecturer explains the theory, shows how to solve a related exercise, gives students in class the opportunity to solve an exercise themselves and gives – on demand as well as proactive- individual feedback. Computer practicals are given in groups of ca 24 students. During the practical, students work in pairs to solve exercises by means of statistical software (SPSS). A tutor and a student assistant are available to answer questions and to give hand on guidance. Moreover, their role is proactive; they will ask students to explain why the chosen analysis is appropriate, how to interpret the output, etcetera. An extensive text book (Ott and Longnecker, 2015) is used. A printed 'study guide' (in Dutch) provides a reading guide, some extra explanations and extra exercises. Solutions to exercises and short explanations, and hand-outs of the in class used power point presentations, are available on Blackboard.

Despite of this quite intensive course, many students seem to experience problems with fully grasping (some of) the elementary concepts of statistics. Self-study does not solve this for all students. Students come from different backgrounds with respect to study program, previous education and prior knowledge, and they may also have different learning styles. It is obvious that students vary in interest and skills in statistics. Although the course is highly valued by the students, its set-up may serve the 'average student', but is not tailored for each one individually. With online activating methods, like video clips and self-tests we hoped to introduce more differentiation in the available teaching material and to serve students at different levels of interest and capacities. A grant of the educational board of Wageningen University and Research (WUR) made it possible to develop online self-tests, and to produce video-clips with the team of lecturers of Biometris (i.e. the Mathematical and Statistical Methods Group of the WUR). The grant also made it possible to monitor the value of the self-tests and video-clips as perceived by the students. In this paper we report the findings of this survey.

THE SET-UP

Within the course schedule of Statistics 2 possibilities for online activating methods were investigated and subsequently planned. We distinguished six different kinds of clips: motivation -, knowledge -, instruction -, comprehension -, simulation - and feedback clips. The self-tests adapt to the level of the student such that students with difficulties with a question get more feedback and

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are presented with more questions. The clips and self-test are connected to the learning cycle in the course as follows:

- Motivation clips are mainly for *orientation* on the subject.
- Knowledge -, instruction -, comprehension -, and simulation clips help to *acquire* the topics of the course.
- Self-tests to *apply* the learned subject.
- Feedback of the self-test and the feedback clips are for the *evaluation* of the learned knowledge.

Where possible, suitable clips readily available on the internet have been used, but most clips were made in-house, as are the self-tests. Clips and self-tests were made available to the students on Blackboard in December 2016 (Period 2 of the academic year 2016-2017). From the same period and onwards, it was indicated per lecture in the Study Guide which clips are available and which self-tests should be made.

In the academic year 2015-2016 during the last mandatory computer practical, Statistics 2 students between February and July (Period 4 – 6), were asked to fill in a questionnaire with questions related to students' own learning, perceived knowledge and teaching skills of the lecturers, the set-up of the course in general, and students' interest and motivation towards statistics (see Table 2). Questions/items could be answered on a 5 point Likert scale. Students enrolled in Statistics 2 in the same periods of the academic year 2016-2017 were also asked to fill in the questionnaire, this time with an additional ten questions related to the video clips and self-tests (see Table 1).

To find significant different items from the survey before and after the introduction of the video clips and self-tests, a linear model has been used. Factors in this model were study, self-reported attendance and a factor describing if the student took the course before or after the inclusion of video clips and self-tests. This latter factor was added by the researchers. Two-way interaction effects between these factors were also included in the model. Students from studies with a small number of participants (< 30) were excluded.

RESULTS

In the academic year 2015-2016 524 students from seven different bachelor programs were included and in 2016-2017 611 students from eight different studies. In both years the largest number of students came from Company and Consumer Sciences (150 and 142 respectively) and Nutrition and Health (125 and 143). In both surveys all programs had about equal number of students in both academic years, except Agro-technology which program was only included in the second survey (n = 34).

In Table 1 the results for the questions with respect to the clips and self-test (which were in the second survey only) are presented. Per item and score (1 = disagree, 5 = agree) the percentages are given. From the scores on the first and sixth item it seems that not many students did watch the majority of the clips. Furthermore it seems that students are not very positive about the added value of the clips. However, most students are positive about the added value of the self-tests.

Table 1. Percentage per score (1-5) per item for items related to the clips and self-tests.

ITEM (ANSWERING SCALE: 1 = DISAGREE, 5 = AGREE)	*1*	*2*	*3*	*4*	*5*	*N*
I have watched the knowledge clips.	44	24	16	11	6	587
In my opinion the knowledge clips are a useful supplement to the meetings.	27	22	31	16	5	577
In my opinion the knowledge clips are a useful supplement to the book, reader and Blackboard.	27	21	30	18	5	576
The knowledge clips helped me to understand the subject material.	30	20	31	16	3	575
In my opinion the clips with applications of statistics are motivating.	34	26	28	11	2	574
I have watched the clips in which some subjects are discussed more in depth.	53	21	15	9	2	581
I made the self-tests.	20	15	22	22	23	586
The self-tests made me aware of the knowledge I had and what I was lacking.	11	9	28	37	16	584
The feedback on the self-tests helped me to perform better the next time.	11	9	27	38	16	584
The self-tests helped me to prepare for the exam.	8	5	23	41	23	585

From Table 2, in which the differences between the estimated means in Likert scores - corrected for bachelor program, attendance and interaction – per item are reported, it becomes clear that the effect of the introduction of clips and self-test on student's learning is modest. Despite several of these items show an increase of one point or more, most items didn't show a significant increase. However it is apparent that students are more positive about the teachers and the course. Moreover, students report to be more motivated for the course and mathematics and statistics in general.

Table 2. Difference (DIFF) and associated P-values of estimated means in Likert scores (corrected for bachelor program, self-reported attendance and interaction between these two factors) between prior and after the introduction of clips and self-tests, per item.

ITEMS	*DIFF*	*P-VALUE*
Questions about your learning (Answering scale: 1 = disagree, 5 = agree)		
I came prepared (read the material, did the exercises etc.) to the meeting of this course.	0.3	0.346
I succeeded to keep up with the subject material during the course.	0.9	0.066'
I had an active attitude during the meetings of this course.	1.1	0.015*
I asked questions during the meetings of this course.	1.3	0.035*
I used the meetings to understand the subject material in the book.	-0.1	0.842
I have used the meetings to gain more understanding of the material in the book.	-0.2	0.739
I used the meetings to get the applications of the material the book gives.	-0.5	0.445
During the computer practical of this course I worked efficiently.	0.1	0.419
I understand the subject material of this course.	0.9	0.036*
I have insight in how the subject material of this course can be applied within the field of my study.	0.9	0.069'
I am able to judge what part of the material of this course I comprehend and what not.	0.7	0.069'
I looked for extra exercise when I didn't understand the material fully.	-0.6	0.351
I was able to plan my learning within this course.	-0.7	0.901
Questions about the teachers (Answering scale: 1 = disagree, 5 = agree)		
The teachers of this course ...		
... demonstrated insight in the knowledge and learning level of the individual students.	1.9	0.002**
... offered sufficient opportunity to ask questions.	-0.8	0.087'
... gave individual feedback.	2.4	0.000***
... gave feedback on group level.	-0.1	0.853
... paid special attention to students who had a problem with certain subjects.	1.6	0.005**
... offered additional material and opportunity to students who were ready for more in depth knowledge.	2.6	0.000***
Questions about experiencing the course (Answering scale: 1 = disagree, 5 = agree)		
I think this course is inspiring.	2.1	0.000***
The course meetings build on preparation assignments and the chapters that are to be read.	-1.2	0.008**
The course meetings are mainly repetitions of the preparation assignments.	-0.3	0.470
Within this course to students who are ready for it, additional material for more into depth knowledge is offered.	2.9	0.000***
Within this course, additional exercises and extra explanation material is available for students who may need this.	-0.2	0.618
The tutorials of this course have additional value to self-study activities.	1.1	0.033*
The computer practicals of this course have additional value to the tutorials and self-study activities.	1.9	0.001***
Additional questions Answering scale: give a mark between 1 and 5, 1 = low, 5 = high)		
Judge your motivation for this course.	1.2	0.016*
Judge your motivation for mathematics and statistics in general.	1.6	0.003**
Judge your competence to understand the material of this course.	0.4	0.187
Judge your competence with respect to mathematics and statistics in general.	0.6	0.102

*** $p < 0.001$; ** $0.001 < p < 0.01$; * $0.01 < p < 0.05$; ' $0.05 < p < 0.1$

CONCLUSION AND DISCUSSION

If we interpret score 1 and 2 as having watched non or a few clips, not many students seem to have watched the knowledge clips or clips for more in depth understanding. However, since the number of students that score on the items about the knowledge clips hardly differ from the number that scored on the first and sixth item, we think that most of them watched at least a few of the clips prior to the survey. That our students seem not to value the video clips very much, is comparable to the results of Nolan and Swarts (2015). They report that, compared to other learning material, students judge clips to be at least useful and even to be boring. Furthermore, our survey shows that students do value the self-tests. It seems that the more positive attitude of the students towards the teachers, the course and their own motivation, is due to the self-test and not in so much to the video clips. However, from the tracking we know that between the last course meeting and the exam, the number of views for the clips increase considerably. In addition, it becomes clear from the common course evaluation -which is presented to all students at Wageningen University after a course has been competed- that students do appreciate the video clips. This coincides the findings of Hund and Gertrich (20115), who report that students appreciate the usability and convenience of clips, and Tan (2013) who reports a positive attitude of students towards video's as method of individual learning. The ease of access to the clips (links available on Blackboard) made it possible to watch clips where, whenever and how often it was necessary. It might be well possible, that the modest effects of the video clips with respect to students' learning we found, is due to the moment of the survey: before the self-study week in which students prepare for the exam. Based on the number of views, the course evaluation, and the in the survey found (often highly) significant items with respect to the teachers and motivation, we may conclude that by offering online self-tests and video clips we seemed to have succeeded in offering more differentiation in the available teaching material and in serving students at different levels of interest and capacities.

Since the survey was presented to students in the same period of both years so that most students came from the same programs both years, it is not likely that the differences found are due to differences in motivation between programs. Furthermore, the common course evaluations are consistent over the years, so that we may expect that cohort effect towards motivation and interest are not very likely either.

Since it is known from careful recording that grades and percentage pass for the exam fluctuates over years, it was not useful at this stage of the study to compare these figures between the pre-introduction and post-introduction year. When these results are known for several post-introduction years, it might be interesting to compare averages over e.g. five college years prior- with averages of five post-introduction years. However, the results found so far – students valuing the video clips and especially the self-tests when learning statistics- is enough reason to expand the introduction of these online activating methods to other Statistical courses at Wageningen University.

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