

# Report: Videos in biological statistical education: A developmental project

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## **1. Introduction**

bioSTATS is a project embedded within bioCEED – Centre of Excellence in Biology Education (bioCEED, 2013) that aims at facilitating student understanding and competence in statistics. The bioSTATS platform is an online resource where statistical analysis and data manipulation use biological data and examples to increase student interest and motivation.

During autumn 2015 and spring 2016 the bioSTATS-team created four videos in various topics in basic statistical analysis (mean/median, variability and distributions). The scripts for the movies were created by members of the bioSTATS team, and filming and post-editing of the videos was performed in collaboration with MatRIC at the University of Agder. The bioSTATS team consisted of a combination of statistics experts, teachers and educational researchers.

In this report we will present preliminary results from a pilot study of students' perception of these videos as well as reflections based on the experience of making the videos. We will focus on a) the developmental process of creating videos, and b) the assessment of the effect of videos.

Research on the use of videos has previously been found to increase student achievement (Dupuis, Coutu, & Laneuville, 2013; Wieling & Hofman, 2010), competence (Orús, Barlés, Belanche, Casaló, & Fraj, 2016), and learner satisfaction and engagement (Sherer & Shea, 2011; Zhang, Zhou, Briggs, & Jr., 2006). It is important to note that videos have limited effect on learning unless the videos are pedagogically developed and employed to facilitate learning (Conole, Laat, Dillon, & Darby, 2008; Raaheim, 2013).

The theoretical approach used in this pilot study is Self-Determination Theory (SDT). SDT is especially useful in understanding which factors that facilitate student interest and motivation, and how in turn this motivation would predict achievement (Deci & Ryan, 1985; Ryan & Deci, 2000). According to SDT, students that perceive a sense of volition, choice and competence will exhibit more intrinsic motivation. Intrinsic motivation (acting for the satisfaction of the behavior) has several behaviors accompanied with it such as interest, enjoyment, and mastery. Several studies indicates that opposed to extrinsic motivated students, intrinsically motivated students persist longer at difficult tasks (Moller, Deci, & Ryan, 2006), achieve at a higher level (Vallerand & Reid, 1984, 1988), and are more creative (Koestner, Ryan, Bernieri, & Holt, 1984). Thus, a further understanding of how videos contribute to achievement and indirectly through intrinsic motivation, is important.

## 2. Design and procedure

BioCEED's student representative recruited the participants in the pilot study by means of e-mail or direct contact.

The experiment was performed in the following three phases:

1. Conditions (viewing film or reading literature);
2. Quantitative test, including questionnaire and test;
3. Group interview.

The participating students were aged 20-25, two were bachelor students, while four were master's students (four women, two men, all Norwegian). The students were randomly assigned to two groups where one group watched the videos (experimental-condition) while the other group were given literature based on Sokal and Rohlf (1995) *Biometry* concerning the same subject matter (control-condition). After the two groups had seen the movie or read the text (approx. 15 minutes) they were given a questionnaire assessing intrinsic motivation, perceived competence and importance. The students were then given an achievement test on the statistical topic with 6 questions.

All measures are validated subscales obtained from [www.selfdeterminationtheory.com](http://www.selfdeterminationtheory.com) measuring intrinsic motivation, perceived competence and value of activity. A biologist developed the achievement test and all answers could be found both in the movie and in the text. All students were ensured of their anonymity and that their answers would be treated confidentially. The participants were then debriefed and given lunch as compensation.

In the subsequent interview both control and experimental groups were invited to a discussion where our aim were to gain insight into how the students responded to the following themes: a) how the students learn statistics, b) how they use movies to learn, and c) what role statistics has to play in biology education. Students were given follow-up questions to each of the above focuses, subsequent analysis also categorized according to these main themes. There were two interviewers present, and the interview was sound recorded with permission from the participants.

## 3. Results and discussion

### 3.1 Survey

The experimental-condition that watched the movies had a higher mean on all variables, except competence and usefulness (Table 1). The largest difference between the groups was in boredom, where participants that read the book (control) perceived the statistical topic to be more boring than the movie (experimental) group. There were also a large mean difference between groups in the participants' confidence in abilities, where the experiment group reported a higher confidence in abilities. Despite this, the achievement test shows no significant differences in test scores between the control and experiment group. None of the mean differences were statistically significant.

Table 1: Independent t-test of all study variables between the movie and text groups

Variables	Experimental	Control	95 conf. Interval		t-test	P value
Enjoyment	4,33	2,67	-2,62	5,96	1,11	0,33
Confidence	5,33	4,00	-0,72	3,38	2,00	0,13
Boredom	3,00	5,00	-4,27	0,27	2,45	0,07
Competent	3,33	3,67	-6,20	5,53	0,22	0,84
Importance	6,00	5,00	-1,48	3,48	1,73	0,23
Usefulness	5,00	5,33	-6,53	5,86	0,21	0,85
Achievement	4,67	4,33	-0,98	1,64	0,71	0,52

Note. Comparison of movie (experiment) and text (control) groups.

The 95 % confidence interval shows the range of the difference that we would expect to include the true difference on 95% of occasions. All variables including achievement ranges from 1-7.

### 3.2 Interview

Below are excerpts of the interview. All names used are pseudonyms; the text is the authors' translation from Norwegian. The excerpts were selected to illustrate the students' iterations about learning statistics, the use of videos and how videos is important in biology. Overall, the students had some disagreements between themselves about all themes of the interviews. They also provided some feedback on the videos themselves which is summed up in section 4.

The below excerpt shows how the students see the learning of statistics in different ways, with Carrie firmly rejecting any notion that statistics is an undesired topic as a biologist. Further, it is interesting to note that Gro finds that statistics is mastered through practice.

- Tine: I understand that we have to have it, but it is not very fun  
 I: Yes, that is the general impression I have. What is your impression?  
 Carrie: I think I prefer statistics. You feel more of a utility value with working with statistics.  
 Gro: But typically, like ecology, it is easier to learn by reading text. As opposed to statistics where you have to. It is like mathematics, you learn it first [...] do it yourself.

One student mentioned how she would employ videos where an instructor used drawing to explain a phenomena, which she found to be "very thorough" and that they provide information "with a teaspoon so that you can understand". Another student said how she found that because "I am lazy, so sometimes I don't feel like reading everything, whereas in a film you kind of have to look at through it at the tempo that is set". However, another student had a different experience here, finding that he regularly skipped sections of movies and was generally less patient in movie watching, he found it more rewarding to read a text several times in order to understand a concept as opposed to watching a movie several times.

The interview of students showed three main experiences among the participants: a) Students use videos to find small and concrete descriptions of phenomena. b) The students have a complex and different conception of the integration between statistics and biology. c) The students found the movies to be engaging, though slight technical issues such as camera focusing incorrectly and faulty audio had an impact on their perception of the video.

There are several limitations worth mentioning before interpreting the results. Firstly, the results of the study were all non-significant, this may be due to low power. Although the results are in line with our assumptions and previous literature, the present study had only 6 participants and thus we need to increase the number of participants to assert causal inferences. Future study should include more students to increase the power. Secondly, the participants had different experience with statistics, thus for some of the participant the concept of variability was familiar and for some it was unfamiliar. This might contribute to explain some of the results in the achievement scores. Lastly, the present study is a simple 2x1 experimental design, future studies should expand on the results and have more complex designs to further increase knowledge gains, for instance a repeated-measure design.

### 3.3 Summary

The survey data suggests that students in the movie (experimental-group) had a slightly higher mean difference in enjoyment, confidence and abilities, and slightly lower mean in boredom. The students had different views of how they learned statistics, some preferring to read text books while others favored short videos focused on specific points of interest.

## 4. Further work in videos

Overall, the pilot study might suggest that video resources are an effective tool as a supplement to regular teaching. It can have some effect on the students' perception of the fun and interest of the subject matter and can thus have motivational consequences. Videos are also very diverse, and some have a narrow approach to a specific subject while others are more comprehensive. For many students a narrow and focused video seems most useful and easier to employ in addition to other resources (textbooks etc.).

Based on feedback from the participants in the group discussion, suggestions in video production and pedagogical practices emphasis should be put on making the next videos:

- 1) Short, concise and to the point
- 2) More intelligible in audio (pronunciation)
- 3) Less acting and more focus on the subject matter
- 4) Implementing video resources in biology courses and on Internet for easy use

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