# THE IMPACT OF VIDEO-BASED RESOURCES IN TEACHING STATISTICS: A COMPARATIVE STUDY OF UNDERGRADUATES TO POSTGRADUATES

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*This paper presents the results of a study investigating the use of video-based resources in teaching statistics. This study compares two cohorts of students, which were eighty-six postgraduate, and eighty-nine undergraduate students who enrolled in the subject of introductory statistics at the University of Wollongong. The comparison is based on the impact of learning resources, in particular video resources towards the student learning outcomes and student understanding of topics as well as confidence and anxiety in the subject. At the end of session, students were asked to participate in an online survey via E-learning site. The results showed significant differences in the impact of video resources between postgraduate and undergraduate students. Postgraduate students were much more confident and less anxious compared to undergraduate students after completing this subject.*

## INTRODUCTION

Historically, the learning of statistics has been associated with students having difficulties in learning it and poor academic outcomes. According to Baharun and Porter (2009a), statistics is seen as one of the most anxiety-provoking and critical subjects to many students in their courses of study. This is further supported by Onwuegbuzie (2003) who noted that the level of difficulty of learning statistics is as hard as learning a foreign language. Similarly, Pan and Tang (2004) found that a majority of students had a great deal of difficulties in learning statistics with more than 80% of them experiencing anxieties of learning this subject. As a result, many students are unable to complete their studies on time due to their delay in taking this subject until at the end of their studies where most of them often failed in their first attempt (Rodarte-Luna & Sherry, 2008). As such, statistics is one subject area that is in need of improved teaching approaches as to how to teach this subject effectively so that students can learn and understand it better.

Nowadays, it is hard to imagine teaching this subject without using some forms of technology; for instance statistical software packages (i.e., SPSS, Minitab, JMP, SAS, S-Plus), educational software (i.e., TinkerPlots), spreadsheets (i.e., Excel), applets/stand-alone applications, graphing calculators, multimedia materials and resources, web based support materials, and data repositories. The development of the technology alongside the emergence of the World Wide Web (internet) in the 1990s has led to dramatic changes to the teaching styles and learning environments. These changes include how lessons are delivered, how students learn and how feedbacks are given to students. In fact, technology has the potential to improve teaching and learning outcomes (Aminifar, 2007) and thus, it is currently used to support and facilitate student learning in many disciplines and universities worldwide (Fitzallen, 2005).

In relation to the use of video-based resources as a technological tool in teaching and learning, research has shown that it can positively impact on student learning of statistics (Baharun & Porter, 2009b; Moore, 1993; Petocz, 1998) and mathematics (Aminifar, 2007; Wood & Petocz, 1999). In the literature, there are strengths and weaknesses of using videos in teaching statistics as discussed by Moore (1993) and Petocz (1998), but more importantly the key idea of using this technological tool in teaching is to serve "as one tool for teaching, complementing but not replacing the other tools" (Moore, 1993, p. 174). In other words, the use of videos in teaching is not to replace the role of teachers in classrooms. Instead, these video resources provide significant variety for students alongside other resources such as the textbook, lecture notes, tutor, peer, online lectures, online discussion forum, etc to learn the subject. Therefore, the main issue to address in this paper is how to use these resources effectively in teaching statistics in increasing student understanding and learning of this subject.

In this paper, we have explored the perceived impacts of using video-based resources for teaching statistics on student learning outcomes. Two cohorts of students, eighty-nine undergraduate and eighty-six postgraduate students who enrolled in the subject of introductory

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statistics at the University of Wollongong were identified via the E-learning website. The outcomes from the use of the video resources show different impacts on different groups of students particularly their understanding of topics and confidence in the subject.

## METHOD

A survey questionnaire was used to collect the background information on the students, including gender and their nationality either international or domestic students. Other questions were on their use of the learning resources, their confidence in the subject particularly several topic areas, their perspectives after completing the subject, and their suggestions on areas to be improved in the subject. The types of responses to the questions were either open-ended responses or Likert scales.

The participants were 38 undergraduate and 40 postgraduate students respectively. Among the undergraduates, 17 were females and 20 males while one student did not provide any gender information. In terms of nationality, 11 were international students while 27 were domestic students. For the postgraduate students, there were 21 females, 17 males while the other two students did not provide any gender information. Among them, 22 were international students, 17 domestic while one student did not provide any information on his or her nationality.

At the end of the weeks of final examination, the students were asked to volunteer in taking part in the survey by filling out a set of questionnaires via online in the E-learning website. The students were approached initially and informed about the purpose of the study through an information sheet delivered during the lab classes in week twelve of the academic session and through postings to E-learning site. In addition to the information sheet supplied to the students, they were asked to provide a permission slip giving their consent to participate in the study. The students were told that their participation was voluntary and that they were free to refuse to participate and to withdraw from the study at any time.

The video resources that were introduced to students on the E-learning site were one of the learning resources or materials provided in the subject. The production of these videos was made using a tablet PC (Porter, Baharun, & Algarni, 2009) which was based on several selected topics such as sampling, confidence intervals, writing a meaningful paragraph about variables, correlation and regression, probability from tables, using statistical software, hypotheses testing, fitting models to data, and normal distribution. These resources aimed to help weak students to improve their learning in this subject.

## RESULTS

### *Value of learning resources*

Students were asked to rate each of the learning resources in terms of their usefulness in helping them learn and understand the subject. In comparison, several learning resources were valued significantly higher by postgraduate students compared to undergraduate students such as lab tests ($Z=1.81$, $p<0.05$), lecture notes ($Z=2.13$, $p<0.05$), video resources ($Z=6.99$, $p<0.001$), Edu-stream ($Z=5.54$, $p<0.001$), and online discussion forum ($Z=5.16$, $p<0.001$). All postgraduate students claimed that the lab tests were useful compared to 92 percent of the undergraduate students. In terms of lecture notes, 95 percent of them felt that they were useful while 79 percent of undergraduates noted the same. When asked about the videos, 98 percent of the postgraduates agreed they were useful while only 40 percent of the undergraduates felt the same way. When it came to the Edu-stream, 82 percent of them responded that it was useful while a small percentage that was only 29 percent of the undergraduates saw it that way. When asked to rate the discussion forum, 77 percent of them responded that it was beneficial while again, a small percentage of only 26 percent of the undergraduates rated the forum useful.

Regarding the use of video resources for learning, a majority or 80 percent of the postgraduate students responded that these resources were helpful in variety of ways. These resources help them improve their understanding and learning of the topics covered in the subject, working on calculations, explaining subject lectures and lab work, using statistical software, applying statistical theory and concepts, and clarifying unclear information outside the class lectures. They also found that the resources help to increase their confidence in completing tasks

such as assignments, lab works, quizzes, and final examination. On the other hand, 55 percent of undergraduate students responded they did not use these resources at all, 11 percent found it was time consuming for them to use, 10 percent found it was difficult to use, and only 23 percent found they could solve problems well when they use these resources. The lacks of student access to these resources were identified based on some of their comments as shown below.

"I did not use the video resources. More awareness to students not from the Wollongong campus should be made so that they know about these resources."

"Tell the lecturers to remind students that they are available. I only discovered them a couple of days before the final lab exam."

"It would be really useful if E-learning would indicate when a new video has been uploaded. I didn't know that the videos even existed until about 2 weeks ago."

"I couldn't find them, maybe make them easier to access."

*Confidence with statistics topics*

At the end of session, students were asked to indicate how confident they were in relation to each of the major topics. The postgraduate students were significantly more confident compared to the undergraduates in the topic of confidence intervals ($Z=2.24$, $p<0.05$) where 92 percent of them were confident in doing this topic as compared to 74 percent of the undergraduates. On the other hand, undergraduate students were significantly more confident compared to the postgraduates in writing meaningful paragraphs on variables ($Z=2.57$, $p<0.05$) where 97 percent of them were confident in this topic compared to 80 percent of postgraduate students (see Table 1).

Table 1. Percentage of "moderately confident" and "can do" with major topics

| Topics | Undergraduate | Postgraduate |
|---|---|---|
| Confidence intervals* | 73.7 | 92.3 |
| Using statistical software | 81.6 | 84.6 |
| Writing meaningful paragraphs about variables* | 97.4 | 79.5 |
| Normal and/or Exponential | 63.2 | 79.0 |
| Fitting models to data (Goodness of Fit) | 68.5 | 77.0 |
| Binomial and/or Poisson | 68.4 | 76.9 |
| Correlation and regression | 76.3 | 80.4 |
| Hypotheses | 79.0 | 77.0 |

**significant at p<0.05*

*Change in perspective at the end of session*

In regards to students' changes in perspective after completing the subject, postgraduate students were significantly more comfortable or less anxious compared to undergraduate students in most aspects related to the subject. These aspects were as listed in Table 2.

Table 2. Percentage of "little comfortable" and "much more comfortable" in aspects related to the subject

| Aspects | Undergraduate | Postgraduate |
|---|---|---|
| Explaining statistical findings* | 55.3 | 76.9 |
| Calculating probabilities* | 55.2 | 73.6 |
| Formulating and testing hypotheses | 55.2 | 71.0 |
| Taking a subject that involves mathematics** | 23.7 | 66.6 |
| Solving statistics questions using computer* | 52.6 | 79.0 |
| Taking a subject that involves statistics* | 39.4 | 64.1 |
| Tackling tasks which are difficult* | 36.8 | 69.3 |
| Working with numbers* | 36.8 | 69.2 |
| Taking this subject** | 34.2 | 74.3 |
| Working with mathematical equations** | 31.6 | 71.8 |
| Taking a subject that involves computing* | 28.9 | 59.0 |

**significant at p<0.05*

*** significant at p<0.001*

## CONCLUSION

The findings revealed that the impact of video-based resources used in teaching statistics is influenced by the student learning contexts, i.e., different students signify different impact. It would be of benefit to conduct a study involving several groups of students within different learning contexts to identify which learning resources benefit different student learning approaches. In this paper, we were able to highlight the results on the experience of video resources from two cohorts of students, postgraduate and undergraduate students. Although the resources in the subject were similar and the video resources were the same, the manner in which the resources integrated differed and the student responded to them differently. The undergraduates commented more about the failure to locate the resources. Thus, it is essential to identify how to display the resources effectively in teaching this subject so that it will beneficial for students within a particular learning context.

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