Traditional versus interactive teaching: Out with the old, in with the new?

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TEACHING STYLES contribute to the success of learning and the overall student experience at university. Numerous studies suggest that interactive teaching can facilitate higher levels of student performance and satisfaction. I aimed to assess the relative benefits of traditional versus interactive (coined Citizen Science) teaching practices when delivering research methodology and statistics content within large first-year psychology laboratories. During two consecutive studies (Year 1 experienced teacher; Year 2 novice teachers), measures of student satisfaction and performance were recorded after exposure to each teaching method. I found little difference between the two teaching styles as there were high levels of satisfaction and performance observed following both Traditional and Citizen Science approaches. This held true for experienced and novice teachers. Interestingly, student performance was poorer following initial exposure to Citizen Science in Semester 1. However, by Semester 2, students performed at equivalent levels irrespective of teaching style. This suggests that students are unlikely to be disadvantaged by the teaching approach adopted, giving teachers the confidence to choose the style they feel is most appropriate for their content, and themselves as educators. Furthermore, the unexpected nature of these findings demonstrates the importance of considering the specific educational environment when assessing best teaching practice.

Reasons for introducing the Citizen Science teaching method

A traditional approach to teaching occurs when a teacher delivers knowledge and information to a largely passive student. It has long been argued that, due to the passive nature of the student, traditional approaches do little to: enhance the student learning experience; encourage student engagement with the learning process; or, improve students' conceptual understanding, problem solving and ability to evaluate and synthesise ideas (Butler, 1992; Chilwant, 2012; Hake, 1998; Halloun & Hestenes, 1985; Reif, 1974).

Given the potential deficits of the traditional approach, there has been a drive to employ more interactive styles of teaching, whereby students are actively engaged with both the curriculum and with one another (Ahlfeldt et al., 2005). Interactive teaching environments help students transition from a 'consumer' of information to a generator of knowledge (Bonwell & Eison, 1991) and help to create an educational setting that inspires and supports student engagement, while developing high order skills and a deeper level of knowledge and understanding (Biggs, 1999). This is supported by a meta-analysis of 225 studies which confirms greater academic achievement following interactive approaches to teaching and learning (Freeman et al., 2014). Student satisfaction also improves following interactive sessions (e.g. Chilwant, 2012; Luckie et al., 2004; Wilke, 2003).

To develop an interactive teaching condition, I utilised the 'Citizen Scientist' approach. Citizen Science is defined as, 'scientific activities in which non-professional scientists volunteer to participate in data collection, analysis and dissemination of a scientific project.' (Haklay, 2011, para.3). Typically, the Citizen Scientist approach has been used for large scale biological projects aiming to monitor wildlife and environmental markers (Bonney et al., 2009). I hypothesised that this approach would be beneficial in a ter-

tiary education setting with undergraduate students serving as the Citizen Scientists. I wanted to devise and trial a methodology for appropriately assessing this teaching approach in an ethically and experimentally sound manner. As such, in order to advance our understanding of the benefits of interactive teaching and to shape my own teaching practice using an evidence base, I employed a repeated-measures counterbalanced mixed design to assess and compare the Traditional and Citizen Science teaching approaches.

General lesson plan for the Citizen Science method:

Students were initially presented with a broad research question. In groups of five to six, students planned an experiment to test a hypothesis they formulated within this research area, and reported this back to the class. The teacher then provided the class with a small pre-prepared study (relating to the general research area) which the students undertook. The students' data were collated and the hypothesis was discussed. The teacher then reviewed the data set and presented the appropriate statistical tool for analysis. The theory behind the statistics and the steps required to perform the analysis were explained. The class analysed their data set and interpreted the results with respect to the hypothesis.

General lesson plan for the Traditional method:

The teacher presented a statistical tool, explained the theory behind it and detailed the steps involved in the analysis. The teacher then described the pre-prepared study, including the hypothesis being tested. Students were given a pre-prepared data set to analyse and interpret with respect to the hypothesis. Within this condition students did not participate directly in the study. In order to fulfil ethical requirements, that all students are exposed to the same content, students were given access to all materials of the study at the completion of the week's lab sessions.

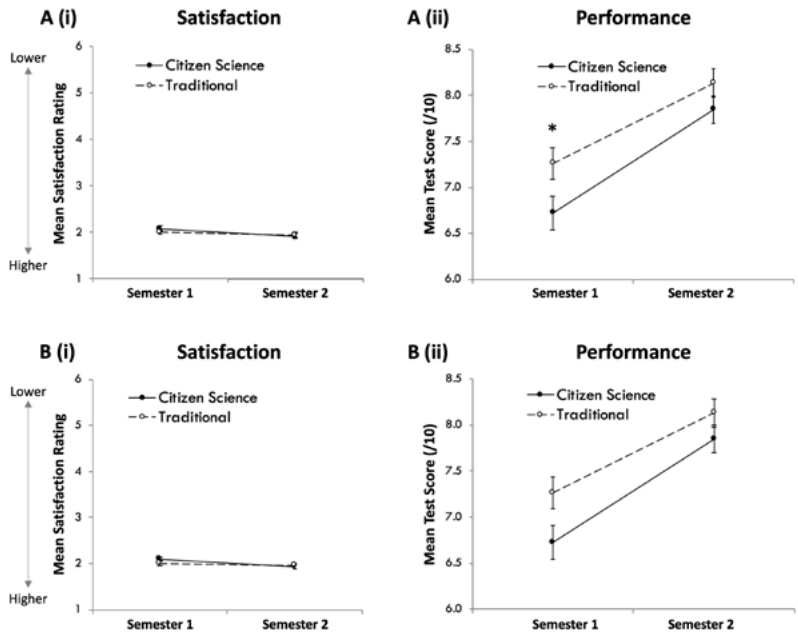
Benefits

In order to assess the effectiveness of the two teaching approaches, I measured levels of student satisfaction (via a questionnaire) and student performance (via a series of multiple-choice tests) following each encounter with the Citizen Science and Traditional methods. The data were analysed for Semesters 1 and 2 in Year 1 (experienced teacher), and Year 2 (novice teachers). Unexpectedly, the Citizen Science and Traditional teaching approaches did not differentially affect the student experience in my first-year psychology laboratory classes. Following both teaching methods students performed well and reported high levels of satisfaction (see Figure 1). These findings were consistent with both the experienced and novice teachers. Interestingly, performance was poorer following the Citizen Science approach in Semester 1, but by the end of the academic year, students achieved equivalent, high levels of content retention irrespective of the teaching method experienced. These findings contradict previous work which demonstrate the advantages of interactive teaching methodologies over traditional approaches. Thus, this study highlights the importance of properly assessing the effectiveness of our teaching strategies employed in our specific classes. We should not rely solely on a gut instinct, or even general literature, without carefully measuring a new approach within our environment. In this case, the findings tell us that students are unlikely to be disadvantaged by the teaching style adopted. This gives teachers the scope to choose the style that they feel most confident using or to consider using a mix of the two approaches within their teaching.

Peer Observation:

> *I am extremely impressed by the energy, enthusiasm, patience, and considered approach Paula adopts in her course. She makes sure to situate every statistics problem in an understandable, relevant context. Paula excels at motivating her students to develop research questions and become actively involved in*

Figure 1: Effect of exposure to Citizen Science and Traditional teaching methods on student satisfaction and performance across Semester 1 and 2 of an academic year. A(i), Mean (±SE) satisfaction ratings (low numbers = high levels of satisfaction) in Year 1 with sessions delivered by an experienced teacher (N=104). A(ii), Mean (±SE) test scores (from 10-question multiple-choice test) as a measure of content retention in Year 1 with sessions delivered by an experienced teacher (N=104). B(i), Mean (±SE) satisfaction ratings (low numbers = high levels of satisfaction) in Year 2 with sessions delivered by two novice teachers (N=105). B(ii), Mean (±SE) test scores (from 10-question multiple-choice test) as a measure of content retention in Year 2 with sessions delivered by two novice teachers (N=105).



data collection, processing, and analysis. The interactive, relaxed, and stimulating environment allows students to engage with course materials, and have the confidence to interpret their data outcomes in a wider context. Paula's teaching approach is truly inspiring and having observed her teaching strategies, it is clear to me that she excels at creating an environment in which students are not only able to learn, but are also able to ask questions and truly get their heads around statistics in a fun and stimulating way, instilling a growing confidence in their abilities, leading to noticeably less anxiety and higher satisfaction and enthusiasm from students. (Dr Lizzie Bradford).

When I began teaching I was asked to identify a mentor who would provide me with guidance on my pedagogical methods and ideas. I chose Paula as I was acutely aware of her reputation as an excellent teacher and a highly approachable colleague. Paula provides me with regular and consistent guidance on my teaching materials and methods, always steering me towards an interactive approach whenever possible. My students regularly comment that they particularly enjoy this aspect of my teaching and as a result I have received two teaching awards. I believe my success in teaching is due in no small part to Paula's input and encouragement. In broader terms, Paula is always willing to share her experience and to disseminate her pedagogical research findings to colleagues throughout the university and as such has become our go-to person for best practice advice. (Dr Maggie Ellis).

Issues

The most important limitation of this study relates to the measures used. Firstly, performance was measured via a series of multiple-choice questions. This format of assessment was chosen as it mirrors the testing utilised in the first-year laboratory sessions. It is possible that this form of assessment may have overlooked some of the learning benefits gained from an interactive teaching style. Citizen Science requires students to engage in a deeper level of learning compared to the surface approach adopted by the Traditional method. Multiple-choice tests are best suited to assess surface level learning (Scouller, 1998; Scouller & Prosser, 1994; Watkins, 1982) and may therefore more accurately reflect what a student has learnt through their involvement in a traditional session, while potentially underestimating the additional benefits a student may have gained through an interactive learning environment. Secondly, limited class time meant measures were brief (nine questions in the satisfaction questionnaire, 10 in the multiple-choice tests). This small number of questions could impact the power of these measures, preventing detection of subtle differences between the two teaching approaches (particularly given performance and satisfaction levels were consistently high).

Another consideration relates to the teacher and the nature of content delivery. I was the experienced teacher who delivered sessions in Year 1. As I was aware of the purpose of this research, it is possible that, despite efforts to ensure consistency, variable delivery of teaching may have affected student satisfaction and performance. However, in opposition to this, analyses of measures of satisfaction relating directly to myself as the teacher (teacher enthusiasm, organisation of the content, ability to explain material clearly) revealed equivalent ratings across both methods of teaching. I felt it was still important to control for this potential bias and therefore engaged two independent teachers in the second year to deliver the sessions. These teachers also received equivalent ratings of teacher performance across both teaching styles. These findings, along with the similarity seen in the pattern of results for satisfaction and performance (see Figure 1), gives me confidence that the potential impact of the teacher has been well controlled.

A practical issue not to be overlooked is that Citizen Science requires more teaching time to implement compared to the Traditional method. From a practical point of view, if one does wish to employ the Citizen Science approach, timing issues will need to be carefully considered in the planning stages of the course.

Student perspective

While results suggest no measurable increase in satisfaction or performance across the cohort, individual student feedback demonstrated that the Citizen Science approach was well received by students:

> *…the idea of studying statistics for two hours a week was a little daunting!… We are usually presented with a pre-prepared data set; are told the correct statistical test to use to analyse it; and are told how to interpret the information. This method can be a little dry… like you are 'going through the motions' and you are not connected to the data. The difference with the 'Citizen Science' approach is immediately noticeable as you are actively engaged with the material. Because you are actively involved in the data collection before the statistical analysis you are inclined to fully understand the results, the reasons why you chose the specific statistical test and the research process as a whole. I believe that using the 'Citizen Science' approach in psychology laboratories is a fantastic method of teaching and really improves students learning, understanding and memory of the statistical analyses – much more than in the ordinary 'demonstration' method of teaching.*

> *Paula Miles is a brilliant teacher, who has the talent of delivering the most difficult aspect of Psychology for many (statistics) in an easy and comprehensible manner.*

> *…this gave us a feel for what research is really like.*

This feedback highlights the importance of considering individual differences when assessing the relative benefits of teaching approaches. Further investigation is warranted to better understand the impact that individual variables (e.g. gender, language, faculty, previous maths experience), may have on the effectiveness of these teaching methods.

Reflections

I am passionate about teaching and am committed to ensuring that our students have the best experience possible at university. I want to educate our students in the best way that I can. This case study demonstrates one approach I employ to help ensure I do just that, by empirically assessing whether or not I am delivering material and engaging with students in the most effective way. It is not always easy to carry out pedagogical research, but the surprising findings of this work highlight exactly why we should try. My results show us that sometimes we simply cannot predict the success of a teaching practice, no matter the teaching experience we may have, nor the body of literature that may exist on the topic. Beyond empirical investigation, I think it is also important to consider the following in our teaching practices: (1) knowing our students – understanding their strengths and weaknesses and knowing their previous educational experiences so content is pitched appropriately; (2) having transparent learning objectives – making key points clear so students know why they are pivotal to their learning; (3) being flexible in approach – making teaching adjustments as needed during the course; (4) ensuring continuity – within a single lesson and throughout the course and degree programme; (5) valuing feedback – giving students feedback throughout the course so they can develop; being receptive to and using student feedback to strengthen our teaching.

Dissemination and publication

I have presented my findings at a number of local (5), national (1) and international (2) events: a keynote presentation, invited talks and workshops. I have received three institutional awards for this work. I have written a case study of good practice which has been disseminated via the University's website and a manuscript is currently in preparation.

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