Online seminars in statistics for doctoral students: A case study

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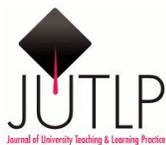*University of Wales Trinity Saint David, Wales*, christine.davies@uwtsd.ac.uk

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The Doctorate in Professional Practice (DProf) programme at the University of Wales Trinity Saint David (UWTSD) provides a means for practitioners in a range of professions to undertake research, and achieve doctoral status, whilst maintaining their professional roles. The programme is generic, covering a wide range of professional backgrounds, though most are allied to the social sciences. Students on the programmes are generally mature individuals, senior in their fields, from across the world. They have significant expertise in their professional fields, but often have limited understanding of quantitative research processes, including the use of statistics. This deficit is addressed via a module in Quantitative Research delivered via a series of seven online seminars utilising meeting/webinar applications. Though the use of online technology has become commonplace since the advent of COVID19, its use as a means of delivering a series of discursive, problem-orientated statistics seminars for small groups of students is innovative. Also, learners are required to undertake specific reading and viewing of videos before each seminar so that they become acquainted with key points in advance. During seminars, students discuss specific topics, participate in problem-solving, and learn how to use software for statistical tests. Screen-sharing permits real-time observation of the use of software. At the end of the seminar series, students are provided with at least one individual online tutorial so that specific issues can be addressed. This Case Study examined learners' views of the Quantitative Research module by means of dialogic interviews. Thematic analysis of interview transcripts indicated that the use of an online seminar series to deliver the module was viewed positively by learners. They particularly appreciated the social aspects of the seminars which helped to remove fears and encourage participation. Understanding was enhanced by viewing short videos before and after the seminars, and by activities during the sessions. This innovative way of teaching statistics appears to have been effective in equipping DProf candidates with the statistical knowledge and skills required to undertake their Part 2 research.

Keywords

Online seminars, statistics, doctoral

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Abstract

The Doctorate in Professional Practice (DProf) programme at the University of Wales Trinity Saint David (UWTSD) provides a means for practitioners in a range of professions to undertake research, and achieve doctoral status, whilst maintaining their professional roles. The programme is generic, covering a wide range of professional backgrounds, though most are allied to the social sciences. Students on the programmes are generally mature individuals, senior in their fields, from across the world. They have significant expertise in their professional fields, but often have limited understanding of quantitative research processes, including the use of statistics. This deficit is addressed via a module in Quantitative Research delivered via a series of seven online seminars utilising meeting/webinar applications. Though the use of online technology has become commonplace since the advent of COVID19, its use as a means of delivering a series of discursive, problem-orientated statistics seminars for small groups of students is innovative. Also, learners are required to undertake specific reading and viewing of videos before each seminar so that they become acquainted with key points in advance. During seminars, students discuss specific topics, participate in problem-solving, and learn how to use software for statistical tests. Screen-sharing permits real-time observation of the use of software. At the end of the seminar series, students are provided with at least one individual online tutorial so that specific issues can be addressed. This Case Study examined learners' views of the Quantitative Research module by means of dialogic interviews. Thematic analysis of interview transcripts indicated that the use of an online seminar series to deliver the module was viewed positively by learners. They particularly appreciated the social aspects of the seminars which helped to remove fears and encourage participation. Understanding was enhanced by viewing short videos before and after the seminars, and by activities during the sessions. This innovative way of teaching statistics appears to have been effective in equipping DProf candidates with the statistical knowledge and skills required to undertake their Part 2 research.

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Introduction

Higher Education (HE) students of many non-mathematical subjects need to gain an understanding of quantitative research and statistics. Consequently, there is great demand for introductory courses on basic statistics, even to the point of lacking suitable teaching staff (Soler, 2020). Statistics courses are important for students who need to undertake mixed methods research, for example in the social sciences, so that they have a sound understanding of how quantitative data can be generated and analysed.

It has become part of university folklore that statistics is a difficult and/or boring, and students of non-mathematical subjects often undertake statistics training unwillingly (Gordon, 2004). Postgraduates may be no less anxious than undergraduates about statistics (Koh and Zawi, 2017) and might even feel horror when contemplating the topic (Breitenbach, 2016). The titles of some statistics textbooks may reinforce fears, as in the case of *Statistics Without Tears* (Rowntree, 1981). For mature and/or professionally-based students, such fears may be compounded by relatively low familiarity with academic processes.

Statistics has traditionally been taught in a highly didactic way using lectures. Even though approaches such as problem-based learning have been used within some statistical courses for many years (eg. Hillmer, 1996), only recently has this become more widespread, coupled with increasing group work and related collaborative approaches (Jones and Palmer, 2020). Directive tutor guidance has also been shown to enhance student perceptions and achievement (Budé et al., 2009), and the value of using real data and contexts has been highlighted (Bebermeier & Hagemann, 2019). Increasingly, statistics courses, particularly those deemed 'service' courses are taught using a blended learning model involving online technologies (Hilliam & Calvert, 2019). For example, Wessa et al. (2011) introduced a 'Statistics Learning Environment' and computer-aided workshops into undergraduate statistics courses at Aston University and the University of Leuven.

Some statistics courses are completely online, as described by Yang (2017). In this instance, a series of statistics modules was delivered using the *Moodle* Virtual learning Environment (VLE), incorporating video clips, forums, chat rooms, and notes. The Open University similarly uses *Moodle* to deliver an introductory statistics module incorporating mix of resources including real data sets, commercial software packages, case studies, experiments and interactive quizzes (Hilliam & Calvert, 2019). The use of interactive elements is important, and Tsai and Wardell (2020) found that test scores were higher for students who had used interactive online resources compared to students who had not. Whilst it is important to use realistic, interesting contexts, it also appears to be important to make the study of statistics and associated quantitative research methods a distinct part of the curriculum, and to allocate sufficient time (Khan et al., 2017).

This case study focuses on a module within a generic Doctorate in Professional Practice (DProf) at the University of Wales Trinity Saint David (UWTSD). This is a part-time doctoral programme designed for individuals in senior roles to undertake Level 8 research within the workplace whilst maintaining their professional roles. The programme recruits approximately ten new students per annum (referred to as 'candidates'), not all of whom need to undertake the module in question because of prior learning. The programme usually takes 5-6 years to complete and comprises a taught Part 1 and research-based Part 2. Part 1 modules prepare candidates for undertaking research and cover aspects of academic communication and learning, and research skills. Most modules are delivered sequentially, with each module delivered once per annum. Study of the first two Part 1 modules (which does not include the module on Quantitative Research) commences at

residential workshops which allow candidates to meet each other and form social groupings as well as peer-support networks. The candidates taking the DProf programme are mostly mature individuals with senior professional roles. None are campus-based, and many are international. Hence, their learning is mainly self-directed and undertaken at a distance. These individuals have significant expertise within their professional areas but may lack knowledge of research processes and are frequently unfamiliar with quantitative research and statistics. The Part 1 module on quantitative research is designed to address this deficit and gives candidates the knowledge and skills in quantitative research and analysis required for their Part 2 research. Candidates are generally highly motivated to learn, though frequently lack confidence in their ability to master numerical topics. The approach to the teaching of this and other Part 1 modules therefore avoids a didactic approach and makes use of facilitation and 'learning conversations' involving supportive dialogue (Fillery-Travis & Robinson, 2018). The use of online resources is essential given the need for distance learning and needs to take into account potential barriers to the use of technology (Selwyn, 2011). It also needs to be suitable for time-constrained professional learners who tend to be highly strategic in the way they interact with online resources (Risquez et al., 2013; Davies & Harris, 2016). Furthermore, it has been reported that satisfaction with online statistics courses diminishes with student age (Al-Asfour, 2012).

These points were at the fore when we established an online mode of delivery of a module on quantitative research which is taken by many Part 1 DProf candidates. The module needed to have academic rigour, and yet be suitable for non-specialist postgraduates. We wanted the teaching of the module to be engaging as well as informative, and to build confidence rather than threaten it. This Case Study provides details of the module, and a qualitative evaluation from a learner perspective.

Method
Module set-up
Within the DProf programme, Part 1 modules generally have a delivery pattern of initial lectures, in some cases at a residential workshop, followed by guided self-study supported by online resources. This model was also used for the Quantitative Research module initially, but after the second delivery in this format it was realised that two-day residential workshops did not provide sufficient review and practice time to assimilate the knowledge and skills involved. Because initial recruitment to the programme was low, the module in its initial form was taken by only six candidates, two of whom subsequently withdrew from the programme. The remaining four candidates passed the module assignment.

It was decided to change the delivery format of the Quantitative Research Module to a series of seven hour-long synchronous online seminars delivered every fortnight to a group of around five candidates over a period of approximately two months. Candidates living close to campus were invited to attend in person if they wished, and two individuals from one group did so. Seminars were all delivered by the same tutor (who also led all tutorials) and were topic-based, covering the key themes of the module, namely:
- quantitative research design and research methods
- types of quantitative data and examples of secondary data
- descriptive statistics
- samples, populations and p values
- basic inferential statistics 1 (covering T-tests, ANOVA, and use of *MS Excel* for statistical tests)

- basic inferential statistics 2 (basic chi-squared tests of association, simple correlation and regression, and use of *MS Excel* for statistical tests)
- Review and assessment

The last seminar provided a re-cap of key statistical tests and explained the nature of the assignment for the module. This involved writing a journal article based on an analysis of secondary data selected by the candidate. Seminars were followed by at least one personal tutorial per candidate, and there was an expectation that candidates would subsequently utilise 250 hours in directed self-study.

Prior to attending each seminar, learners were directed to read specific resources, and to watch specific short videos which were mostly produced in-house to demonstrate specific elements of the module (for example, the principles of carrying out a one-way ANOVA). This 'flipped' teaching approach, as outlined by Breitenbach (2016), allowed candidates to come to seminars equipped with basic knowledge. The seminars could therefore depart from the format of a typical lecture and could be more problem-based and discursive as outlined by Jones and Palmer (2020), making use of learning conversations as promoted by Wisker (2003) and Fillery-Travis and Robinson (2018). There was a focus on the use of real data from appropriate contexts, as recommended by Bebermeier and Hagemann (2019) which was also reflected in the module assignment. A key delivery strategy within each seminar was onscreen demonstration, following the principle of 'showing' rather than 'telling' (Zhou, 2018), and candidates were led through topics in a stepwise manner at an appropriate pace. This was done using the meeting/webinar software *Skype for Business* which was chosen because it was supported by the University. Subsequently, the University shifted its support to *Microsoft Teams*, and delivery of our DProf online seminars now mainly utilises *Zoom*. Learners were encouraged to participate actively in seminars, not just within learning conversations, but by replicating statistical tests on their own devices and by taking presentation rights so that they could demonstrate techniques to the group. Candidates could also use the whiteboard to show key principles and simple calculations, and could also communicate to the tutor or the whole group via the chat pane. Sessions were recorded and made available online for learners in video form for review purposes.

An example of a typical seminar is outlined below, and relates to T tests and ANOVA (the fifth seminar):
   i. Candidates were emailed instructions two weeks before the seminar indicating materials to read and videos to watch beforehand on the course website and on *Moodle*. Candidates were also required to inspect five small *MS Excel* data sets based on real-life examples and asked to formulate appropriate hypotheses and choose suitable statistical test(s) to help decide whether to accept or reject hypotheses.
   ii. The seminar commenced with an outline of the main learning objectives of the session.
   iii. Participants were then asked to write the basic principles of T-tests (paired and independent) and ANOVA (one and two-way) on the online white board along with associated hypotheses. Specific tasks were allocated to specific participants. The tutor subsequently displayed a summary of points using no more than two power-point slides.
   iv. The *MS Excel* spreadsheet previously sent out was discussed via microphone and chat pane with learner deciding the most appropriate hypotheses and statistical tests for each data set.
   v. Relevant analyses were then performed for each data set by the tutor or a volunteer, with participants additionally carrying out all steps on their own devices.
   vi. The seminar concluded with candidates' questions and a brief summary of key points.

As indicated above, online seminars were supported by asynchronous resources on the University's *Moodle* VLE, including video clips, presentations, notes and links to additional guidance and sources of data. Additionally, a website (blog) was set up to present information in a different format and without the need for login. This was set up using best principles of online learning design (Laurillard, 2010), and involved significant use of colour, images and video, but very few document-based resources as recommended by Boling et al. (2012). Candidates were generally directed to study website resources before seminars, and to refer to the wider range of resources on the VLE after seminars.

Module evaluation

Eleven DProf candidates within two separate groups, one per annum, have completed the module delivered via an online format. These comprised seven females and four males ranging in age from 30 to 60 years. Of those eleven students, ten passed the module assignment, ie. 91%, and several have gone on to undertake Part 2 research that is quantitative in nature. While this may be an index of effectiveness, the small number of individuals involved is inappropriate for a quantitative study. It was therefore decided to take a qualitative approach to module evaluation. The research described is therefore based on a pragmatic paradigm and interpretivist epistemology, ie. the knowledge gained about the module and its delivery was based on an interpretation of candidates' responses.

The research method employed was an in-depth online interview or dialogue between the module tutor and three randomly selected candidates who had completed the module and its assessment. The sample comprised two UK-based women and one US-based man who had professional roles in healthcare, higher education and international sales. They ranged in ages from 40 to 53 years. The interview technique followed the phenomenographic approach of Gordon (2004) in which questions were open and designed to elicit details of the experience of undertaking the module. Dialogues were recorded in note form and were analysed manually using the reflexive thematic analysis technique described by Braun and Clarke (2006). This is a qualitative, inductive technique involving the identification of 'codes' or sub-themes. Higher-level themes emerge from an inspection of codes. The technique does not attempt to assign a hierarchy to the emergent themes, so no one theme can be assumed to be more important than any other.

DProf candidates are also encouraged to provide feedback about their studies via end of module questionnaires, student reps, the staff-student committee, and informally within tutorials or other discussion sessions. External examiner feedback is also welcomed. No feedback relating to this specific module has been received.

Results

The codes and themes that emerged from dialogue transcripts are summarised in Table 1 and are discussed individually below.

Table 1

Emergent Themes from Thematic Analysis.

Codes (sub-themes)	Social; peer support	Communication; video; context	During session; before/after session	Frequency; regularity; duration	Seminar technology; online resources
Themes	Community	Understanding	Activity	Timing	Technology

Community

All interviewees stated that they enjoyed being able to meet their peers online. The small size of the group was also appreciated. One interviewee commented:

'I really liked the sense of community and intimacy.'

Interviewees also valued the contributions that group members made to the session. An interviewee stated:

'It was good to learn with other people, and I liked listening to their questions.'

Understanding

The approach and clarity of the tutor appeared to be an important influence on learning during the sessions. One interviewee said:

'It's really important that the tutor speaks clearly and explains everything well.'

The use of data and statistical tests associated with candidates' professional roles was also deemed important, and one candidate commented:

'I learnt a lot that was applicable to my own work.'

All interviewees mentioned the value of the chat pane which enabled them to ask questions without interrupting other speakers, and all emphasised the importance of both synchronous onscreen demonstration and asynchronous video. One candidate said:

'*Being able to watch the videos in advance of the session helped me understand, and I went over them afterwards so that I knew how to do all the steps.'*

Two interviewees mentioned that short video clips were more helpful than long ones, and hence in future all video clips will be no more than 5 min in duration.

Activity

All interviewees liked the idea of involvement in some sort of activity within the sessions. All had attempted to follow the tutor's demonstration using an identical data set on their own devices during one or more seminars.

'*It was really good to work through the spreadsheet together*,' one interviewee said.

However, none of the candidates liked the idea of taking control of the demonstration. One interviewee commented:

> '*I'd only do that in a one to one tutorial. I'd be too embarrassed to do it in a seminar in case I made mistakes.*'

This sentiment will be borne in mind for future module presentations, and though the opportunity may be offered it will not be assumed that candidates are happy to participate in this way.

All interviewees considered it useful to undertake tasks in advance of the sessions, and to practice after the sessions.

Timing

It was generally felt that an hour was about the right duration for each seminar, and the option of longer sessions was not considered sensible. Long time intervals between seminars were deemed undesirable by all, but there were differing opinions about how frequent and regular seminars should be. One candidate said:

> '*I'd like the seminars to be weekly, at 5pm every week just after work. That's a good routine when you know you'll be meeting a group of friends, like going for coffee.*'

However, another candidate explained that her medical job involving shift work required a more flexible approach. Two of the interviewees thought the number of seminars - seven - was about right, but one wanted ten, commenting:

> '*I'd like more sessions because I worry when I miss one.*'

As a result of this feedback, future seminars will be timetabled closer together. Though it is proposed to deliver each seminar at the same time of day, different days of the week will be used to provide flexibility. Additional tutorials will be provided to candidates whose working routine causes them to miss two or more seminars.

Technology

One of the three interviewees lived outside the UK and found difficulties accessing *Skype for Business*. This was a key reason for a subsequent change to *Zoom*. However, once within the online application, there were no reports of difficulties in the use of available tools.
Two of the three interviewees preferred using *Moodle* to access resources rather than the website/blog. One commented:

> '*I've set up UWTSD login on my phone so it's easy to get into Moodle.*'

Another interviewee liked the linearity within *Moodle* sections as this tied in with the sequence of topics in the seminars. The candidate who was based outside the UK preferred the blog because of login issues with *Moodle* which may have been associated with an employer firewall. It therefore appears that both a VLE and a website/blog should be available to candidates as options for asynchronous support. In light of this, attempts will be made to rectify access issues with *Moodle,* and important *Moodle* items will also be emailed to candidates.

Discussion

This case study involved a small sample from a rather distinct postgraduate group and hence it would be wrong to generalise outcomes to other contexts. A further limitation of the study is the role of tutor as interviewer which may have influenced candidates to give positive responses.

However, the three individuals involved were mature professionals well-used to expressing opinions, and the online nature of the interviews may have reduced the potential 'power' of the interviewer (Hoffmann, 2007). Despite these limitations, it is considered that this case study provides insight into an innovative model for teaching statistics which may have value in a range of higher education programmes.

Case study outcomes indicated that the use of online seminars was perceived by doctoral students as an acceptable and effective way of learning about basic statistics. In contrast to some student experiences of statistics (Breitenbach, 2016), our DProf candidates seemed to enjoy their statistics seminars. Central to this appeared to be a sense of 'community'. This was probably due, in part, to the fact that all candidates already knew each other from previous modules and residential workshops. However, it is likely that the involvement of a small number of individuals, regular meetings, and shared experiences of tackling statistical problems were also key factors. The community theme emerging from this case study appears to be an online form of the 'cohort effect' which has been noticed in other doctoral programmes (de Lange et al., 2011). Though face-to-face learning may be superior to online forms (Breneiser et al., 2017; Davies, 2007), the use of a webinar/meeting tool gives a range of opportunities for candidates to communicate with one another as well as with the tutor, and hence can foster a sense of cohort, as noted by Ford et al. (2008). In addition to teaching statistics, our seminars appear to cultivate friendship and mutual support, and enable candidates to feel that they are not alone on their research journeys.

Given that there was an assignment pass rate of over 90%, it appeared that our online seminars provided candidates with a sound understanding of quantitative research and basic statistics. The allocation of key topics to seven separate seminars provided an opportunity to deliver in a 'segmented' or 'chunked' way (Schuessler, 2017) which helped learners process information. Whilst ensuring that the time allocation is sufficient to cover all necessary topics, as noted by Khan et al. (2017), it appeared that short, frequent seminars were effective in acquiring the required statistical knowledge. The nature of tutor guidance also appeared to be important, especially in the context of working through problems, and this was also reported by Budé et al. (2009). Trying out techniques within the seminars, and subsequent self-directed practice, further improved learning as discussed by Garfield and Ben-Zvi (2007). Peer support also seemed to be an important adjunct to learning within the seminars, supporting the concept of social constructivism and linking to the work of Zhou (2018). It is likely that the one to one tutorials that followed the online seminars were also important to check learning and discuss specific queries.

Video was an important element in module delivery. Synchronous onscreen viewing appeared to be more valuable to candidates than asynchronous video, but the availability of asynchronous video was an important to aid statistical learning, as found by Breneiser et al. (2017), particularly for candidates who occasionally missed a seminar. The opportunity to view videos and other resources before the sessions in a 'flipped' way meant that candidates had already gained some understanding of concepts and techniques before the sessions, as found by Breitenbach (2016), and revisiting the videos after the sessions reinforced that learning. Video appeared to be more popular than any other type of asynchronous resource provided to candidates. Its visual nature, and the ability to start and stop and rewind, repeating the previously mentioned theme of 'chunking' (Schuessler, 2017) appeared to support learning. Interviewees preferred watching several separate short video clips rather than stopping and starting a longer clip, and this is backed up by the work of Yang (2017). Videos used within future presentations of the module will therefore be no more than five minutes in duration.

The informal tutor approach we used for the online seminars was based on learning conversations (Fillery-Travis & Robinson, 2018; Wisker, 2003). This approach appeared to reduce any apprehension candidates may have experienced about statistics (Breitenbach, 2016), and encouraged them to contribute and ask questions. The use of examples and data associated with real-life (Bebermeier & Hagemann, 2019) tapped into candidates' professional expertise and their associated applied, or 'Mode 2' knowledge (Gibbons et al., 2004). Opportunities for articulating this type of knowledge, which is frequently tacit (Collins, 2001), are important for practice-based postgraduates.

The technologies used in in the online seminars were generally problem free, though those hosted by the university and hence requiring login were sometimes associated with access issues, particularly in the case of international candidates who needed to participate in seminars and utilise resources at their place of work. It is important to check issues of accessibility to ensure that the technologies do not become a barrier to subject learning (Selwyn, 2011), and similarly, it is vital that any learners lacking technology skills are provided with appropriate support as early as possible. The provision of additional asynchronous resources in two different formats – VLE and blog – helped to cater for different learning preferences, and also allowed for some 'triangulation' in terms of understanding. In contrast to the findings of Wessa (2011), the interviewees in this case study seemed to like the linearity of the *Moodle* VLE, but differing preferences might be expected across the whole DProf cohort.

Our interviewees showed different preferences in the frequency and timing of sessions. This reflects the varied roles and time commitments of DProf candidates and highlights the importance of understanding the needs of researching professionals, and the value of building in flexibility, as indicated by Zhou (2018). More extensive studies would help to clarify the most effective delivery patterns. Future research in this area could also study candidate progress in a longitudinal way, as described by Nind et al. (2019).

Conclusion

This case study indicates that a series of short online seminars, supported by study in advance and review after, can be effective in supplying the statistical knowledge needed by non-mathematical postgraduate researchers. We believe that our DProf candidates are well-equipped to carry out basic analyses of secondary data, and to plan Mixed Methods research designs in which statistical analysis plays a key part. The online statistics provision outlined provides flexibility in terms of time and allows candidates from different professions and countries to meet together in a convenient and supportive way. The recent COVID-19 pandemic has highlighted the need for effective initiatives of this sort for many other HE subjects as well as statistics.

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