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Bite-sized and Peer-assisted Video-based Learning in Statistics Education: Benefits on Attainment, Attitudes and Preferences of University Students

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Abstract

The use and acceptance of online learning have increased following the COVID-19 pandemic. This mixed-methods study examined learners' preferences and performance in online learning interactions in relation to two factors: 'bite-sized' learning and 'presenter status' in instructional videos. University students (*N* = 18) without a mathematical background utilised bite-sized online learning episodes focusing on statistics. Each episode included a 10-minute instructional video followed by an assessment. The videos implemented three alternative 'presenter-status' conditions: lecturer, student-imitating-lecturer, or student-peer-tutor. Individual students completed three episodes, one from each presenter-status condition (counterbalanced). Participants presented high performance in the post-episode assessments, irrespective of presenter status. Students also reported remarkably positive views towards bite-sized learning in user-satisfaction questionnaires. Finally, qualitative analysis of open-ended responses and interviews uncovered three main themes: positive learning experiences, divergent attitudes towards video-based learning, and differential preferences for presenter status. These findings have clear implications for teaching and learning in Higher Education.

Keywords: Online learning; Video-based learning; Bite-sized learning; Technology-enhanced learning; Statistics literacy; Higher Education; Mixed methods

Introduction

The coronavirus (COVID-19) pandemic declared by the World Health Organisation (WHO, 2020) in early 2020, has had a significant impact on the Higher Education sector. Social-distancing measures and lockdowns led to the suspension of many face-to-face teaching activities. Educational institutions responded urgently to these unprecedented challenges by transferring or redeveloping curricula on online teaching platforms (Crawford et al., 2020). These actions enabled students to access teaching materials outside conventional lectures through electronic devices and progress or start their studies with minimum disruption (Syed et al., 2020). This rapid shift towards online learning has highlighted the need for efficient teaching approaches and a deeper understanding of students' learning experiences, preferences and attainment under online teaching methods.

Video-based learning

Video-based learning has been used widely to support the rapid transition of Higher Education institutions to online and blended-learning formats (Pal et al., 2020). Video-based learning is a relatively simple to implement and versatile type of technology-enhanced learning, which enables access to the curriculum outside of conventional lectures through electronic devices (Syed et al., 2020). Different types of video have been used in Higher Education, including pre-recorded lectures (e.g., Jensen, 2011), short knowledge clips (bite-sized videos that explain a particular concept), instructional videos (videos that include a demonstration of how to solve a particular problem; e.g. Hoogerheide et al., 2016a). These resources enable educators to enrich their curriculum with supplementary materials, which facilitate the acquisition of knowledge and the development of practical skills outside of face-to-face sessions (Carmichael et al., 2018). With recent enhancements in technology and high-speed internet, as well as the increasing availability of personal and mobile devices, video-based learning has evolved into a form of learning which allows access to knowledge anywhere and at any time (Hepp et al., 2004) and has the potential to support mainstream teaching provision (Friel et al., 2000).

Several studies have shown that students perceive video-based learning to be enjoyable (Winterbottom, 2007), motivating (Hill et al., 2011), and beneficial for their learning (Salina et al., 2012), and that using video technology to learn yields positive learning outcomes (Kay et al., 2012). These benefits of video-based learning are often attributed to its flexibility. Videos enable students to learn at their own pace, pause, rewind, and revisit any part of the information at any time (Carmichael et al., 2018; Salina et al., 2012; Schreiber et al., 2010). Therefore, video-based learning supports autonomy and the managing of one's own learning (Fill et al., 2006), in line with the adult learning principles of active participation in the learning process and self-directed learning (Knowles, 1984).

From a cognitive processing perspective, the theory of multimedia learning (Mayer, 2014) suggests that when information is presented to make use of multiple channels (e.g., visual and auditory), it maximises the working memory capacity and enables users to manage more pieces of information at one time (Clark et al., 2016). Furthermore, the presentation of information using graphics or images (visual channel) and narration (auditory channel) results in better retention of information compared to when information is presented only in text or is narrated (Mayer, 2014). Clark et al. (2016) suggested that the combination of visual and auditory modalities facilitates the selection and organisation of information across the dual channels to form a 'mental model' that is suitable to be stored in long-term memory. As such, videos can support effective teaching and learning tools.

Nevertheless, students' perceptions of video-based learning are not always positive. Video-based learning appears to be less preferable to conventional teaching methods amongst students who are less familiar or lacking confidence with using computers and technology (Bueno-Alastuey et al., 2014), or when internet access and relevant equipment is limited (Boateng et al., 2016). Students also report barriers in their engagement with videos that are too lengthy or detailed. Watching a lengthy educational video can be perceived as a burdensome and time-consuming task by students, which can make them feel distracted and disengaged from learning (Boateng et al., 2016).

These limitations can be mitigated with learning designs based on bite-sized learning or micro-learning that has become increasingly popular in recent years ('the digital era'). Bite-sized learning focuses on breaking a comprehensive course into short lessons and presenting key information in a concise and engaging manner (Koh et al., 2018). It has been suggested that micro-learning approaches focusing on presenting manageable amounts of information within individual sessions could improve engagement and knowledge retention and avoid cognitive overloading, which can impede learning (Khong et al., 2020). Bite-sized learning also allows information to be accessed anywhere and in real-time. This fits well with the learning preferences and the lifestyles of young people, who are more engaged on digital devices (Shail, 2019). With advances in technology and mobile devices, bite-sized learning designs based on videos are relatively easy to implement and can support mobile learning and low-cost technological systems (Shail, 2019).

In addition to the risk of video-based learning being perceived as burdensome by some students, another limitation of video-based learning, which might challenge engagement, refers to its reliance upon the sense of self-discipline of individual students (Kay, 2012; Sun et al., 2012). The lack of interaction and guidance could be seen "as an abdication of responsibility on the part of the teacher" by some students who have difficulties with self-monitoring and regulating (Conacher et al., 2004, p. 21). One approach to mitigate this limitation is the inclusion of a presenter within videos (Guo et al., 2014; Pi et al., 2017). This approach draws upon the social presence theory (Lowenthal, 2010), which posits that social cues provided by the presenter (e.g., facial expressions, gestures, and body language) help build connections with the learner and improve their engagement with course content. Further improvements in learners' performance and confidence are possible when videos use instructor models that are similar to the learner in terms of age, gender, or training/skills (Bong et al., 2003). These findings open up opportunities to integrate peer-assisted learning formats into video-based contexts to improve learning.

Peer-assisted learning

Peer-assisted learning aims to cultivate collaborative learning and typically involves a senior student who has recently completed a course and who acts as a facilitator to support students from other cohorts in their learning (Keenan, 2014; Power et al., 2010). During a typical peer-assisted learning session, tutees share their study notes, discuss potential test elements, and complete problem-solving together (Jacobs et al., 2008). The session is normally guided by a senior student, who acts as a facilitator or tutor and initiates discussion, encourages communication between students, and probes questions, whenever necessary, to aid understanding within a subject area (Malm et al., 2012). Through these interactions, tutees build learning strategies that enable them to cope with the academic requirements and attain better results (Power et al., 2010).

A large body of research has demonstrated that peer-assisted learning supports academic success and retention (Arendale, 1994; Malm et al., 2012; Martin et al., 1997; Paloyo et al., 2016; Peterfreund et al., 2007). For example, Paloyo et al. (2016) found that attendance in peer-assisted learning sessions, even of short duration, was associated with improvements on academic results across subjects that are deemed to be challenging by university students (e.g., statistics, engineering, accounting). Improvements in academic grades have also been reported in longitudinal work by Peterfreund et al. (2007) in the Science, Technology, Mathematics, and Engineering (STEM) discipline, who found that students who participated in peer-assisted learning sessions presented significantly better learning performance compared to students who did not participate in peer-assisted sessions. Furthermore, these gains were remarkable for students coming from underrepresented minority groups.

Two related theoretical approaches, namely the cognitive congruence theory (Lockspeiser et al., 2008) and the social congruence theory (Bulte et al., 2007), support the effectiveness of peer-assisted learning. The cognitive congruence theory suggests that students learn more effectively from a peer, who has a similar knowledge base as them, rather than from an expert in the field (Lockspeiser et al., 2008). This is because students perceive a larger 'cognitive gap' between themselves and the experts, or think that experts are too advanced to recognise their difficulties and provide support (Ten Cate et al., 2007). Alternatively, the social congruence theory (Bulte et al., 2007), focuses on the positive role of a non-threatening and conducive learning environment, which allows peer tutors to be more effective in identifying and bridging knowledge gaps (Bulte et al., 2007). Within peer-assisted learning, tutors function as facilitators rather than lecturers and ultimately create a favourable environment that has the potential to optimise learning (Ten Cate et al., 2007).

With regard to the potential implementation of peer-assisted learning within video-based approaches, the Model-Observer similarity theory (Schunk, 1991) is relevant. This theory, which applies to all forms of observational learning (including video-based), highlights the role of perceived similarity between a learner and a model. When a model presenting knowledge or demonstrating a skill resembles the learner in terms of age or ability, this may help the learners develop self-efficacy and feel confident that they, too, can achieve the targeted performance outcomes (Schunk, 1987). However, evidence on the benefits of perceived similarity between the model and the learner in video-based learning is mixed. Similarities between the model and the observer in competency were shown to have positive effects on video-based learning of writing skills (Braaksma et al., 2002). On the other hand, model-observer similarity in terms of age did not bring any additional benefits in video-based learning on how to troubleshoot electrical circuit problems (Hoogerheide et al., 2016a). Another study, conducted by Hoogerheide and colleagues, showed that gender similarity between the model and the learner did not increase students' perceived competency in solving calculation problems (Hoogerheide et al., 2016b).

The current study

In this study, we explored the experiences of university students who did not have a mathematical background with a bite-sized video-based learning design which aimed to reinforce previously learnt statistics skills. We selected statistics as a target learning domain for two reasons. Firstly, it is a challenging subject to teach within the curricula of academic institutions (Parashar, 2014). It is well reported that many students, and especially those pursuing non-mathematical disciplines, find statistics challenging or boring, and sometimes develop a sense of hatred towards this subject (Tishkovskaya et al., 2012; Verhoeven, 2006). Secondly, there is an emphasis within the Higher Education sector on statistical literacy (QAA, 2007), which has been identified as a 21st-century skill. Educational institutions are therefore challenged to reform statistics education (Tishkovskaya et al., 2012), to address gaps and deficiencies in basic mathematical knowledge (Garfield et al., 1988), and to mitigate students' difficulties in relating learnt concepts to real-life (Allen et al., 2010).

The learning design developed in this study was administered before the arrival of COVID-19, in the form of a brief learning intervention via a user-friendly online platform, Qualtrics (Qualtrics, Provo, UT). This intervention comprised three bite-sized sessions, which included watching a video followed by an online assessment of statistics competence. We explored students' learning experiences when peer-assisted learning was integrated to a different extent. This was done by including sessions in which the content was delivered by a student peer tutor, either in their own words or by repeating in verbatim a lecturer's wording, and sessions in which a lecturer presented the learning content.

We used a mixed-method approach to evaluate the online learning design based on bite-sized sessions and produced comprehensive and meaningful inferences regarding students' experiences of using it, their preferences towards key features of the design, and their learning outcomes (Tashakkori et al., 2007). The mixed-methods included interconnected quantitative and qualitative components, which addressed the following research questions: 1) Does the integration of video-based learning and peer-assisted learning result in improved statistics attainment compared to the lecture-led format? (quantitative); 2) What are the perceptions of students towards the impact of the bite-sized video-based learning approach on statistics attainment? (qualitative); and 3) What are their attitudes and preferences towards the combination of video-based learning with peer-assisted learning as an alternative to lecture-led formats? (qualitative).

Methods

Participants

All participants were psychology students from a university in the North of England (6 males, 12 females) with a mean age of 24.47 years (*SD* = 5.42) enrolled in undergraduate (*N* = 14) and postgraduate (*N* = 4) psychology courses. Participants signed up as peer tutees through the university's research participation scheme and the Psychology department's social media on a voluntary basis. Participants reported that their most recent statistics module grades were 40-49% (*N* = 2), 50-59% (*N* = 2), 60-69% (*N* = 4), and 70% and above (*N* = 8).

Materials

Pre-recorded instructional videos

Nine instructional videos were created using the lecture capture software, Panopto. Each video lasted between seven to 13 minutes (*M* = 10.86, *SD* = 2.19) and focused on a demonstration of how to conduct a given statistical analysis (test) using the statistical software, SPSS (IBM Corp. 2017) and the explanation of the analysis results. Three learning videos focused on One-way ANOVA, another three videos focused on Repeated-measure ANOVA, and another three on Linear Regression. These topics were selected to correspond to key learning areas for psychology students after consultation with a subject-matter expert (a senior lecturer of a university-level statistics module) and a review of a core statistics textbook for psychology students (Dancey et al., 2017). The three topics are prerequisites for more advanced statistical analysis, such as Factorial ANOVA, Mixed-design ANOVA, and Multiple Linear Regression.

Three alternative types of video were recorded for the three target statistical topics (One-way ANOVA, Repeated-measure ANOVA, and Simple Linear Regression). This enabled us to implement the following three video-based learning conditions: (a) the 'lecturer' condition, in which an academic (lecturer) delivered the learning content by presenting the slides given; (b) the 'student-imitating-lecturer' condition, in which a peer tutor delivered the same learning content by reading the lecturer's explanations in verbatim; and (c) the 'student-peer-tutor' condition, in which a third-year psychology student ('peer') delivered the learning content by presenting the slides using words of their choice. These three learning conditions were counterbalanced across participants and sessions as shown in Table 1.

[Insert Table 1 about here]

These learning videos (image and voice-over) showed a presenter (lecturer or peer tutor) delivering the learning content based on 15 slides prepared by the researchers using Microsoft PowerPoint®. The slides included texts presenting key information, as well as visuals illustrating the steps of statistical analyses with the SPSS software (IBM Corp., 2017). Visuals were included to reduce cognitive loads of information processing (Kester et al., 2006).

In the videos, a presenter appeared at the bottom right-hand corner of the video (see Figure 1) to improve engagement with the video (Guo et al. 2014). The academic tutor and student peer tutor had the opportunity to familiarise themselves with the slides prior to the recording of the sessions. Furthermore, videos for the ‘student-peer-tutor’ condition were recorded before videos for the ‘student-imitating-lecturer’ condition. This ensured that there was no interference in the way the peer tutor presented the learning content in the ‘student-peer-tutor’ condition from the ‘student-imitating-lecturer’ condition.

[Insert Figure 1 about here]

User-satisfaction questionnaire

A five-item questionnaire was developed to collect participants’ views towards the use of video-based learning for statistics learning. This questionnaire was based on Bueno-Alastuey et al. (2014), who created a survey to evaluate students’ satisfaction with the virtual learning courses.

Participants used a 5-point Likert scale (from 1, ‘very dissatisfied’ to 5, ‘very satisfied’) to rate the video-based learning sessions on the following characteristics: 1) enjoyability; 2) usefulness of video resources for statistics learning; 3) appropriateness in terms of difficulty; 4) resourcefulness – the breadth of skills and areas covered; and 5) quality of the structure and organisation of learning sessions.

Open-ended questionnaire / Semi-structured interviews

An open-ended questionnaire or a semi-structured interview were used to assess in greater detail the following areas: i) the tutees' experiences from their involvement in the study (e.g., "Did you enjoy taking part in the study?"); ii) their views on the effectiveness of the intervention on improving statistical knowledge (e.g., "How do you feel the intervention in improving statistical knowledge?"); iii) their views on the effectiveness of the intervention with regards to supporting more general and transferable skills - for example, effective study and communication skills (Topping, 1996; e.g., "Are there any other outcomes or skills you feel that these sessions have helped you achieve/develop?"); and iv) their views and preferences for videos presented by lecturers vs. peer tutors (e.g., "How would you compare the sessions in which the material was presented by the lecturer to the sessions in which the material was presented by a peer?"); and v) their opinion on the potential of this intervention to support learning and development (e.g., "How would you compare a video-based learning scheme like these online sessions to traditional lecture sessions?"). The semi-structured interviews lasted about 15 minutes. All audio recordings of interviews were transcribed verbatim to allow analysis.

Statistics competence assessments

Three statistics competence assessments (one for each targeted topic) were developed to measure attainment at the end of learning sessions. Each assessments included six multiple-choice questions and four short-answer questions. The assessments were based on material and performance records from web-based assessments within the second-year "Research Methods and

Statistics" module of the University's BSc Psychology Programme. Within the curriculum, these web-based assessments are completed weekly to track students' learning progression throughout the module. For the purposes of this study, we used anonymised data from web-based assessments of previous academic years to identify challenging questions. These were questions that were answered incorrectly by more than a quarter of students in previous cohorts. From these, we selected six multiple-choice and short-answer questions that best addressed the learning objectives of the sessions and that were similar to the questions found in the relevant chapters of a core textbook (Dancey et al., 2017).

Procedure

Participants were asked to complete three learning sessions via the online platform, Qualtrics (https://www.qualtrics.com) at a time of their choice on the same day of testing. Participants first completed a session on One-way ANOVA, followed by Repeated-measure ANOVA, and Simple Linear Regression. For each session, they watched a bite-sized video, involving either a lecturer or a peer tutor in demonstrating and explaining the statistical analysis test. The three learning sessions were presented to each individual participant in one of the three conditions ('lecturer', 'student-imitating-lecturer', and 'student-peer-tutor') in a counterbalanced order across participants and across sessions. At the end of each learning video, participants completed the corresponding statistics assessment. Subsequently, participants completed the user-satisfaction questionnaire and were invited to answer some open-ended questions relating to their experience of using a video-based learning approach for statistics.

Measurement and analysis

Data from the user-satisfaction questionnaire (N = 17, one participant did not complete the questionnaire) were analysed per item - enjoyment, usefulness, appropriateness in terms of the level of difficulty, resourcefulness, and structure. Statistical analysis showed that the internal reliability of these five measures was high (Cronbach's α = .93) and therefore, it is acceptable to say that the questionnaire is an internally valid instrument as it falls within the range of 0.70 to 0.95 (Tavakol et al., 2011). All participants completed the questionnaire, except for one participant who lost to attrition and did not respond to emails during follow-up.

Qualitative data from the open-ended questions (N = 14) and the semi-structured interviews (N = 3) with tutees were analysed with thematic analysis based on Braun et al. (2006)'s framework of six phases. The researchers first familiarised themselves with the data by reading the open-ended responses and the transcripts repeatedly several times. Subsequently, the researchers coded the entire dataset by generating labels that capture the key features of the dataset, followed by examining these codes to generate potential themes. Finally, the selected themes were reviewed, defined, and reported with supporting quotes.

Data from the statistics competence assessments were scored to yield a measure of accuracy in a given session. A correct response was awarded 1 mark, while an incorrect response was awarded 0 mark for both multiple-choice and short-answer questions. From the scored assessments, we calculated measures of overall accuracy in each of the three video-based learning conditions. Assessment scores were calculated as the percentage of correct responses (%), as the number of questions varied slightly across sessions. We compared these scores across learning conditions with ANOVAs conducted on the overall data as well as on individual sessions.

Ethical Approval

Ethical approval was obtained from the University's Centre of Learning and Teaching and the Research and Ethics Committee of the Department of Psychology.

Results

Statistics attainment scores

In the statistics assessments scores, participants achieved an average accuracy score of 72.40, *SD* = 14.52 (see Figure 2).

[Insert Figure 2 about here]

We first established that the normality assumption of normality was met for all measures in our data using Kolmogorov-Smirnov tests (all *ps* >.05). Next, we established that the assumption of sphericity had not been violated using a Mauchly's Test of Sphericity, $x^2(2) = .95$; $p = .67$. The results of these two pretests suggested that it was appropriate to analyse our data with parametric statistical procedures with learning conditions as a within-subject factor.

Subsequently, we conducted a repeated-measures ANOVA with learning conditions as a within-subject factor ('lecturer-led', 'student-imitating-lecturer', and 'student-peer-tutor'). This showed no significant effect of learning condition on participants' average accuracy scores, $F(2, 34) = 0.07$, $p = .94$, $MSE = 20.14$, $\eta_p^2 = 0.004$.

Additionally, we compared participants' accuracy scores across different learning conditions focusing on individual learning sessions. Again, there were no significant effects of learning condition (between-participants factor) on accuracy in either the One-way ANOVA session, $F(2, 15) = 0.51$, $p = .61$, $MSE = 171.49$, $\eta_p^2 = 0.26$, the Repeated-measures ANOVA session, $F(2, 15) = 0.53$, $p = .60$, $MSE = 151.24$, $\eta_p^2 = 0.27$, or the Regression session, $F(2, 15) = 1.59$, $p = .24$, $MSE = 370.55$, $\eta_p^2 = 0.46$.

Perceptions towards the bite-sized video-based learning episodes

Participants' responses from the user-satisfaction questionnaire were generally positive across all five items (see Table 2).

[Insert Table 2 about here]

Questions on the usefulness and structure of these sessions received the most positive responses, with 100% of the participants rating themselves to be somewhat satisfied or highly satisfied on these two items. The other three items received more than 50% of moderately to highly positive responses (see Figure 3).

[Insert Figure 3 about here]

Attitudes towards video-based and peer-assisted learning

The thematic analysis of the interview transcripts identified the following main themes: “Positive learning experiences”, “Differential attitudes towards video-based learning”, and “Differential preferences towards presenter status”. The first main theme, “Positive learning experiences” included a sub-theme, “Improved confidence in statistics skills”. The second main theme, “Differential attitudes towards video-based learning” included a sub-theme, “Supplementary learning aid”. The following sections present themes in further detail.

Positive learning experiences

Overall, participants reported positive learning experiences from the bite-sized video-based learning approach. They suggested that the video-based sessions reinforced what has been taught in class and clarified concepts that were confusing to them before. This was consistent with the aim of this intervention to reinforce previously learnt statistics skills and knowledge. In response to a question that asked if the sessions had helped them to develop certain skills, participants’ responses were:

“Yes, it (the learning session) serves as a refresher and also informs me of something that I don't know before.” (Participant 204)

“Yes, I learn something new but the better thing is that I understood some concepts that before weren't so clear.” (Participant 306)

“It (the learning session) helps me to improve my knowledge on the subject, which I need help anyway.” (Participant 304)

Some participants also commented that the learning sessions helped them improve their conceptual and practical knowledge with the information provided within the sessions and the assessments at the end of the sessions.

“Information provided during the three sessions is very useful in enhancing both conceptual and practical knowledge. Now, I can better interpret the data.” (Participant 303)

“It [the learning session] did improve a lot because they didn’t speed in the video, they didn’t go fast, so I understand it when it moves along and it also reinforces it when I was doing the questions after.” (Participant 102)

Improved confidence in statistics skills. When asked about other positive outcomes, other than academic gains following the participation in this study, several participants reported increased confidence in dealing with statistics.

“First of all, my confidence. I love it, because something I thought I didn’t know, I finally understand that if you have a little bit more thought about it, you know the answer is just about the confidence. So I think the practical exercise in the end, helped me to em…tell myself that you actually know some of that stuff.” (Participant 205)

Participant 103 also reported a reduced in anxiety when looking at SPSS tables as he/she reported:

“the sessions made me realise that SPSS tables are more simple to read than they seem.”

Divergent attitudes towards video-based learning

Another theme that emerged from participants' responses was their differential attitudes towards video-based learning as a general learning approach. Several participants suggested aspects of video-based learning that were beneficial to them in learning. In response to a question asking participants to compare video-based learning schemes to traditional lecture formats, many reported very positive experiences such as:

"I think a video-based learning scheme is good because people can watch the video according to their learning effectiveness. Some people who are slow learners could re-watch the video or pause at some point and rewind to link things together, or to process what was taught." (Participant 106)

"I think it's good because you can do it in your own time. And you can pause the video if you don't understand something and go back I guess. Em…and you can rewind and stuff like that to do it at your own pace. Whereas face-to-face you can't do that." (Participant 102)

However, other participants did not hold positive attitudes towards video-based learning and noted the lack of communication and interaction between presenters and students.

"Much harder to sustain attention when it is a web-based video. It is also harder to remain engaged in the topic when the lecturer cannot make use of the physical space in a way that facilitates engagement (e.g., moving around the room, writing on the board, interacting with students by posing or answering questions, etc.)." (Participant 307)

"I think they [video-based learning sessions] are useful but lack communication so would be a good additional resource." (Participant 309)

Supplementary learning aid. Despite the mixed opinions on video-based learning, most participants acknowledged that video-based learning had a great potential to be used as a supplementary material to support learning.

"Access to online materials is always useful as a revision tool, or as backup for people who may be unable to attend a lecture for any reason." (Participant 203)

"It could certainly be useful and it could be supplemented on BlackBoard [higher education software platform] for people who are really struggling with the PowerPoint and the textbook as a point of alternative need. It is sort of like the last stage of things, if you don't understand the PowerPoint, you don't understand the lecture, you are struggling with the textbook, here is the YouTube video that might help." (Participant 205)

Differential preferences towards presenter status

When asked to compare sessions presented by a lecturer and a peer tutor, participants expressed mixed preferences. The majority of the participants reported they would prefer the session presented by the lecturer and commented that the lecturer was more confident, engaging, and easy to understand as compared to the peer tutor. Some of those responses were:

"I think that the lecturer had a slightly more logical presentation of the material, and seemed to pre-empt which areas might need extra explanation and I found the session presented by the lecturer easier to understand." (Participant 203)

"Not sure if it's the authority or experience level has a difference. The lecturer is definitely easier to understand." (Participant 202)

"It was easier for me to understand what the lecturer is doing and explaining than the student explaining. Probably the lecturer has some years of teaching experience, and she can cut down at different pace." (Participant 205)

By contrast, some participants reported they would prefer sessions led by peer tutor due to the similarity in age, knowledge, and experience.

“When it’s someone similar to your age, they know the way best to describe it for you to understand it. Em…whereas when you are old, when you have this knowledge for a long time, you might be able to explain it in a simple term. So when it’s someone who knows it, I don’t know maybe for a couple of years, they will be able to explain to you how they learn it and how they explain to you.” (Participant 102)

“Maybe the sessions presented by a 3rd-year peer were more simple to understand.” (Participant 303)

Discussion

Video-based learning is a versatile and widely-used form of technology-enhanced learning, which has been employed widely during the rapid transition of higher education institutions to online and blended-learning formats in response to the COVID-19 pandemic (Pal et al., 2020). Gaining insights into factors relating to student performance and student preferences for such interactions is key for the development of effective video-based learning designs. In this study, we developed a video-based learning design that brought together elements that were associated with positive student perceptions and good learning outcomes in previous studies. The design was based on a bite-sized learning approach and featured a presenter who, in some cases, was a peer student. We administered the bite-sized video-based learning design, pre-COVID, to Higher Education students without a mathematical background, aiming to reinforce their previously learnt statistical skills. We used a mixed-methods approach to evaluate the students' performance and preferences for this learning design, in particular, whether ‘presenter status’ had an impact on learning outcomes, and whether students responded positively to this video-based learning approach.

With regards to the impact of presenter status (lecturer vs. peer) on learning outcomes, the quantitative competence assessment data revealed that average student scores were uniformly high (corresponding to a ‘first class’ score) in the three learning conditions, and with no substantial differences in accuracy across the three conditions. In contrast to what the Model-Observer Similarity theory (Bandura, 1977; 1986) and the cognitive and social congruence theories (Lockspeiser et al., 2008; Bulte et al., 2007) would predict, we found no improvement statistics performance in sessions in which peer-assisted learning was used. These results are inconsistent with earlier peer-assisted-learning studies who reported benefits from peer-assisted learning, for example, Paloyo et al. (2016) and Peterfreund et al. (2007), who addressed the learning of statistics or STEM-related subjects, and Braaksma et al. (2002), who showed a positive impact of peer-assisted learning in video-based settings.

Nevertheless, our results also suggested that there were either no benefits when a lecturer served as a presenter in the videos. Although such benefits are opposite to the hypothesis in this study grounded on the Model-Observer Similarity (Bandura, 1977; 1986) and the cognitive and social congruence theories (Lockspeiser et al., 2008; Bulte et al., 2007), one could expect lecturer-related benefits based on the lecturer’s authority status (Esmaeili et al., 2015), their formal training (Azam et al., 2014), and their experience in a virtual teaching environment (Guasch et al., 2010). Our findings suggested that the student peer presenter was as effective as the academic lecturer in terms of the students’ statistics performance.

With regards to the perceptions of students towards the impact of this video-based learning design on their statistics attainment, our findings suggest that students' views were overall positive.

Data from the user-satisfaction questionnaire suggested high satisfaction rates, especially regarding the usefulness and the structure of the bite-sized video episodes. In their open-ended respoinses and semi-structured interviews, participants reported that the video-based episodes helped them build confidence in dealing with statistical knowledge and skills and develop a better understanding of the subject area. In their accounts, our participants attributed these benefits to the possibility to pause, rewind, and revisit the information provided in the video-based learning session. These findings are consistent with earlier studies, which suggested that video-based learning is perceived to be fun, enjoyable, and motivating by students (Hill et al., 2011; Winterbottom, 2007) and chime with previously-reported accounts for the benefits of video-based learning (e.g., Salina et al., 2012; Schreiber et al., 2010). In this study, we showed that these benefits of video-based learning generalise to statistics, a challenging subject (e.g., Tishkovskaya et al., 2012), in which university students present well-documented difficulties − from poor abilities to understand mathematical concepts and relate statistical knowledge to real-life settings to feelings of hatred and anxiety (Allen et al., 2012; Verhoeven, 2006).

However, some of our participants expressed preferences for conventional face-to-face lectures. These individuals recognised benefits in the opportunity to engage and communicate face-to-face with an instructor and suggested that this promotes their overall engagement with the learning process. This account is similar to alternative accounts of students' attitudes towards video-based learning approaches (Conacher et al., 2004; Kay, 2012; Sun et al., 2012), which highlight that some students prefer to receive teacher guidance in their learning interactions and that the student's sense of self-discipline is not always sufficient for successful learning. The inclusion of presenter models within the videos of the learning design (Guo et al., 2014; Pi et al., 2017), did not compensate for this limitation for some of the participating students in our study.

Nevertheless, there seemed to be a consensus amongst participating students that the video-based learning design would be valuable as a supplementary learning aid or a complementary learning approach.

With regards to participants' preferences and attitudes towards having a peer or a lecturer as a presenter, participants' views were divided. This result was to an extent expected given the individual differences in our sample. Furthermore, earlier studies have suggested that peer-assisted learning might not be appealing to the entire student population and that this divide in students' opinions can affect students' willingness and motivation to participate in peer-assisted learning programmes (Burgess et al., 2020). There are also different views on whether peer-assisted learning should be optional and voluntary or part of the mandatory programme (Burgess et al., 2020; Ross et al., 2007).

In their questionnaire responses and interviews, students who expressed a preference towards peer-led sessions alluded to similarities between them and the student tutor in terms of learning experiences and knowledge level. These accounts were consistent with the cognitive and social congruence theories (Bulte et al., 2007; Lockspeiser et al., 2008). On the other hand, students who preferred sessions with a lecturer suggested that the lecture-led sessions were easier to understand and more engaging than the sessions with the peer tutor. In their interviews, these students also alluded to the role of teacher's experience and the role of authority. These latter accounts suggested that even though video-based learning is often associated with autonomy (Fill et al., 2006) and self-directed learning (Knowles, 1984), teacher guidance is important.

In sum, our findings suggest that students showed uniformly high performance in the competence test across learning conditions, suggesting that the presenter status did not have a direct impact on their learning outcomes. Students also had overall positive learning experiences from their participation in the learning intervention, though their individual attitudes and preferences towards the use of video-based learning and peer-assisted learning as mainstream learning formats varied.

Students' performance was overall high even though individual students were exposed to videos in which the presenter status was different from their preferences (in some of the sessions). Nevertheless, individuals' learning preferences are possibly related to their learning outcomes as measured by the statistics competence tests. This idea was put forward in Braaksma et al. (2002), who reported that in videos, weaker students are likely to prefer less competent ('weak') models in observational learning, while better students would focus more on expert ('good') models.

It was not possible to investigate if a similar relationship was held for the data in this study, due to sample size and scale (three sessions, one lecturer, one peer tutor) limitations. However, our research design could be extended in future studies to systematically vary characteristics of instructors in video-based learning, such as perceived expertise levels (Hoogerheide et al., 2016a), age, and gender (Hoogerheide et al., 2016b) and examine how these impact on individual students' engagement and, more so, on their learning outcomes. The size and length of a video episode can also be manipulated to establish optimal students' engagement and learning outcomes. More generally, findings from this enterprise could inform customisable learning designs with bite-size videos and support the development of learning materials that accommodate the individual learning needs and preferences of students. This possibility is valuable as Higher Education relies increasingly on online and distance-based learning, and ensuring engagement with online materials is key.

Another aspect of student learning which was not directly addressed in this study are the experiences and learning outcomes of the students who are involved in peer-assisted learning as tutors (Lockie et al., 2008; Ten Cate et al., 2007). Peer-assisted learning is thought to offer a bi-directional learning modality, which benefits both peer tutors and tutees. For peer tutors, benefits do not arise only from the opportunity to revisit the subject but also from building new learning connections (Ten Cate et al., 2007). In line with this accounts, in the debriefing interview, the student peer tutor who was involved in this study reported that the experience of coaching others led her to further understand the course content, improved her presentation skills, and increased her self-confidence as she practised “explaining concepts that most students find challenging in a straightforward and easy to understand way”. The research design of this study could be extended to address the benefits of peer tutors in further detail. For example, it would be useful to examine potential outcomes from their involvement in peer teaching for students with different competence levels or different personality characteristics.

With regards to recent changes in the educational landscape as a result of the COVID-19 pandemic, this study adds to a growing body of evidence on students learning in online and blended-learning formats which have been widely used by universities and other education providers globally. Our approach demonstrates the usefulness of peer-assisted learning strategies (Power et al., 2010), especially in a period of social isolation and limited peer interaction (Andrews et al., 2020; Orben et al., 2020). The changing patterns of social interaction during the pandemic has a negative impact on the mental well-being of students who experience high levels of stress, anxiety, and loneliness (Elmer et al., 2020; Hemanth, 2020). Embedding elements of peer interaction into the current online learning environment could be a starting point for creating a positive virtual learning environment in which students support each other both academically and psychologically.

In conclusion, in this study, we evaluated an online bite-sized video-based learning design which aimed to reinforce previously learnt statistics skills in university students without mathematical backgrounds. The learning design incorporated elements that have been proposed to self-directed learning such as micro-learning sessions with bite-sized videos, the presence of a presenter, and peer-assisted learning. We identified perceived benefits, preferences, attitudes and learning outcomes of students who took part in the learning intervention. Our research design could be extended to gain further insights into online video-based learning and support the development of efficient video-based learning tools, which are warranted in the current educational landscape. Our current research examines the use of precision teaching (Kubina et al., 2000; Lindsley, 1992), whereby the learning of individual students is closely monitored, in online video-based learning designs for statistics (Tan et al., 2021).

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Figures

Figure 1

Screenshot of a 'lecturer-led' learning video.

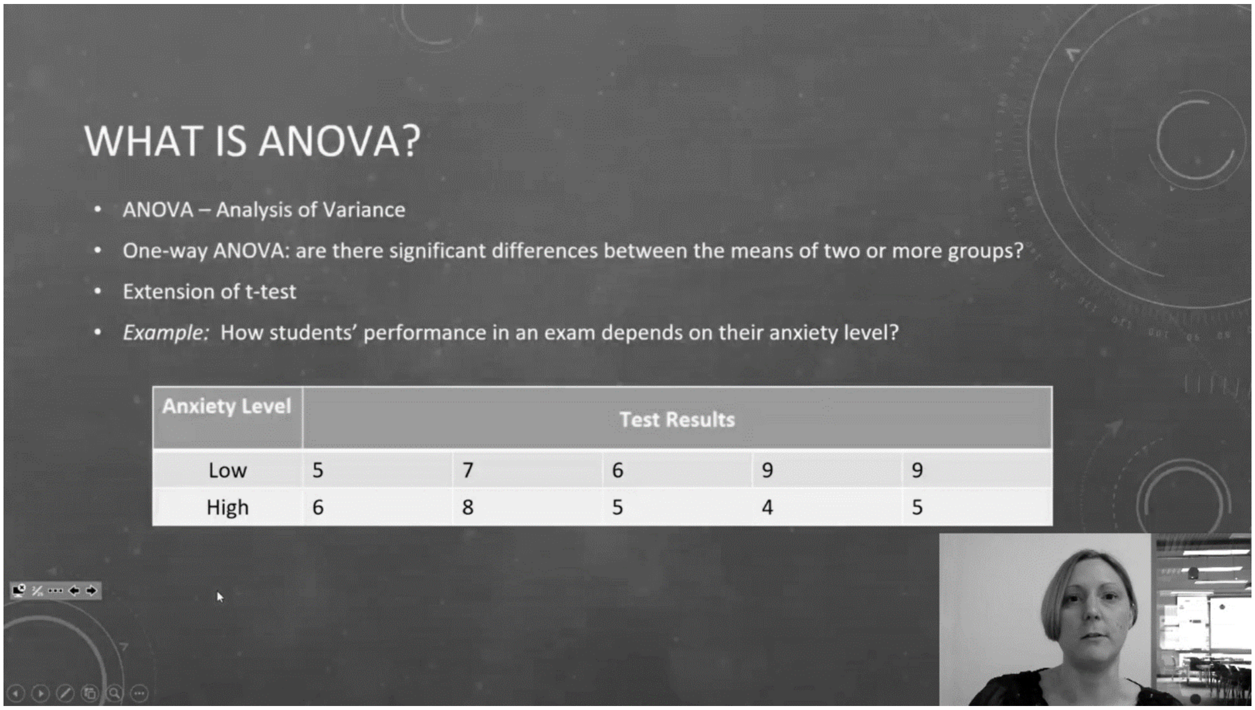


Figure 2

Participants' accuracy in statistics competence assessments across learning conditions in the three sessions and in the combined data.

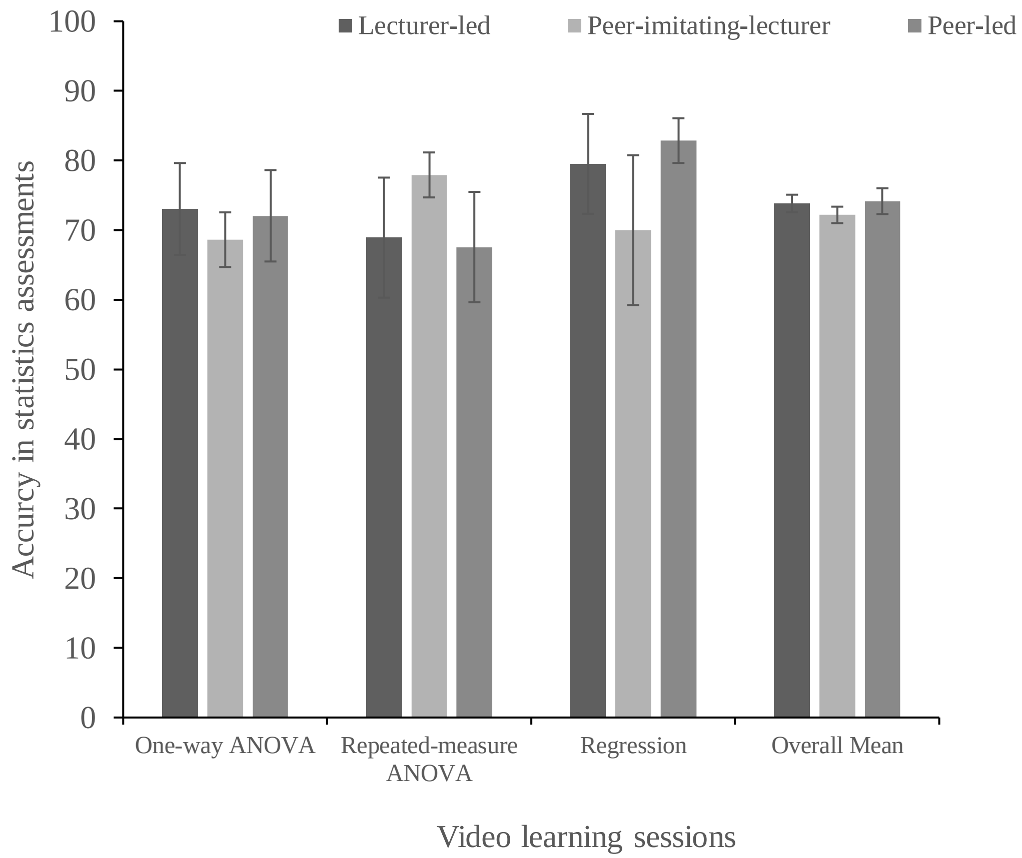
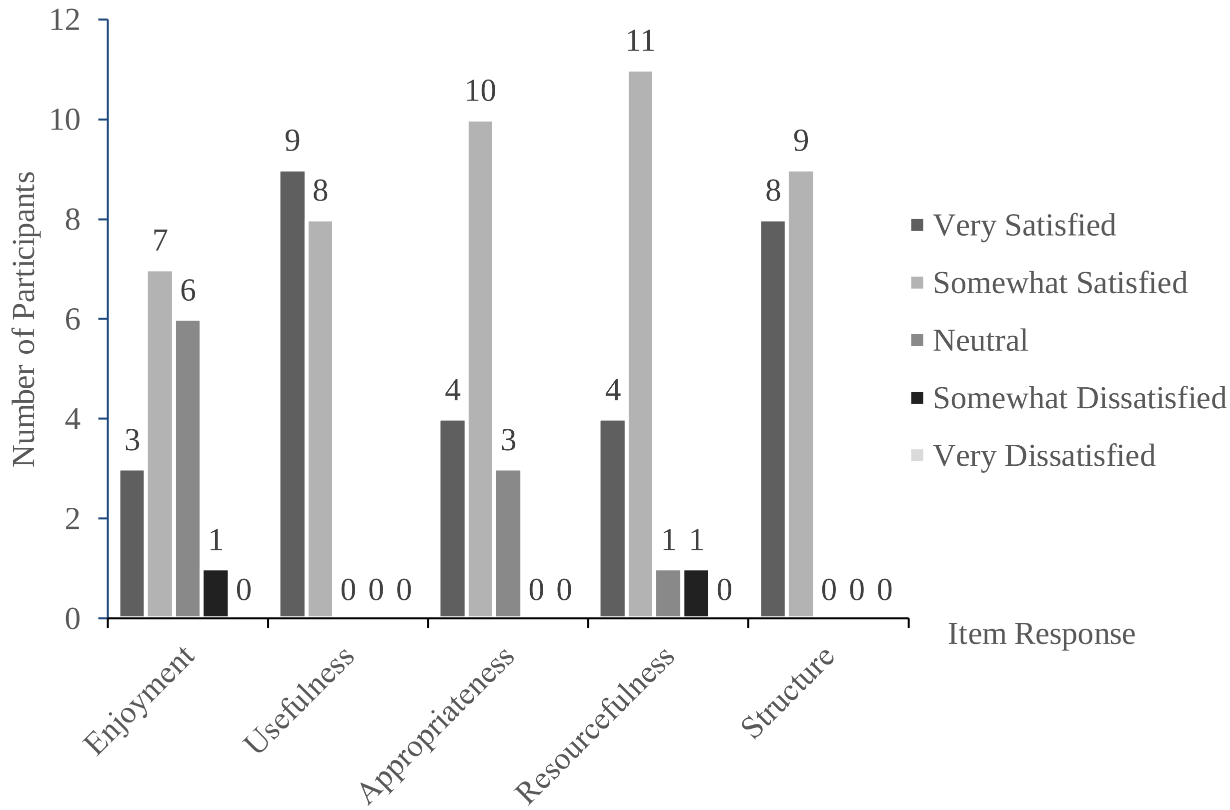


Figure 3

Participants' responses for the five items on the user satisfaction questionnaire.



Tables

Table 1

Counter-balanced order of conditions across sessions and across participants.

	Video 1	Video 2	Video 3
Participant 1-6	Condition a: lecturer	Condition b: student-imitating-lecturer	Condition c: student-peer-tutor
Participant 7-12	Condition b: student-imitating-lecturer	Condition c: student-peer-tutor	Condition a: lecturer
Participant 13-18	Condition c: student-peer-tutor	Condition a: lecturer	Condition b: student-imitating-lecturer

Table 2

Mean and standard deviation of satisfaction scores per item.

Items	Means*	SD
Enjoyment	3.71	0.85
Usefulness	4.53	0.51
Appropriateness	4.06	0.66
Resourceful	4.06	0.75
Structure	4.47	0.51

*Participants indicated their level of satisfaction on a 5-point Likert scale (from 5, ‘very satisfied’ to 1, ‘very dissatisfied’).

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Authors' contributions

Tan, A. J. Y. and Karaminis, T. conceived and planned the study. Kaye, L. K. contributed to the development of the learning videos used in this study. Karaminis, T. supervised the project. Tan, A. J. Y. wrote the manuscript with support from Kaye, L. K., Spiridon, E., Davies, J., Nicolson, R. I., and Karaminis, T. All authors provided critical feedback and helped shape the analysis and the manuscript.

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Availability of Data and Materials

The datasets generated during and/or analysed during the current study are available from the corresponding author on reasonable request.