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# LEVERAGING THE USE OF PRE-RECORDED DEMONSTRATION VIDEOS TO SUPPORT TEACHING AND LEARNING DURING COVID-19 LOCKDOWN

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**Abstract:**

Following the South African government's temporary closure of education institutions due to the COVID-19 pandemic, higher education institutions (HEIs) resorted to online teaching. In this study, we report on the perceptions of undergraduate BCom Financial Sciences and Accounting students at a South African University on the use of pre-recorded demonstration videos to support the teaching of an advanced Excel module. The study was guided by the four learning theories for the digital age on how students learn. A qualitative study was conducted using an online survey, with 512 students participating in the survey. Data was analysed using the conventional content analysis. The qualitative analysis resulted in five themes, (i) support for learning and understanding, (ii) support for self-paced learning, (iii) support for assessment preparation, (iv) comparison with face-to-face learning, and (v) criticisms and suggestions for improvement. Students felt that the pre-recorded demonstration videos played an important role in their learning. The main contribution of this study is that it has demonstrated the benefits of pre-recorded videos in facilitating online teaching and learning in periods of pandemic, especially when resources are limited.

**Keywords:** Accounting and Financial Science education, advanced Excel, COVID-19 pandemic, learning theory, pre-recorded demonstration video

## I. INTRODUCTION

The first incidence of COVID-19 was reported in Wuhan, China in December 2019 [Rodriguez-Morales et al., 2020] and it is poised to be the most significant global health crisis since the influenza pandemic caused by the H1N1 virus in 1918 [Rose-Redwood et al., 2020]. South Africa reported its first case of the virus on March 5 2020 [South African NICD, 2020a] and the country passed the one million infection mark on December 28 2020 [South African NICD, 2020b]. At the peak of the global pandemic, governments across the world instituted national lockdowns to curb the spread of the virus, with the consequent impact on several aspects of people's lives, including teaching and learning [Mishra et al., 2020]. The disruptions brought by the global COVID-19 pandemic pressed many higher education institutions (HEIs) to introduce online teaching and learning [Chen et al., 2020, Mishra et al., 2020], and HEIs had to contend with different challenges [Qazi et al., 2020, Khalil et al., 2020]. Studies published since the start of the pandemic showed that HEIs worldwide experienced similar challenges due to the sudden shift to online learning.

Poor internet connection is one of the main challenges reported by researchers from developed and developing countries [Mishra et al., 2020, Khalil et al., 2020]. Although the digital divide is a recognised problem in many developing countries, the COVID-19 pandemic exacerbated this challenge [Beaunoyer et al., 2020]. In addition, some students had to contend with a lack of space that is conducive to learning in their homes. With the lockdowns in many countries, HEI students had to compete for learning space in their homes with siblings, who were also learning from

home, as well as with parents and relatives, who were also working from home [Pokhrel and Chhetri, 2021, Assunção Flores and Gago, 2020].

Researchers also reported on pedagogical challenges with which educators had to contend. Not only did educators have to adapt their teaching strategies to align with online environments, but many also had to postpone, cancel or change their assessment methods to ensure credibility [Assunção Flores and Gago, 2020, Ashokka et al., 2020]. Keeping students engaged in online environments was difficult [Ashokka et al., 2020, Kaup et al., 2020]. Although students were 'present' in online learning platforms, educators believed that some students were 'mentally elsewhere', with the consequence that they could be 'left behind'. Another challenge that made the transition to online teaching difficult was the lack of basic digital skills, especially among educators [Farooq et al., 2020]. Some students were reported to have adapted relatively quickly because they were more digitally literate [Kaup et al., 2020].

The negative impact on students and educators' psychological well-being is another consequence of the sudden move to online teaching and learning. Authors reported various levels of anxiety and depression among students [Cao et al., 2020, Sundarasen et al., 2020]. This could be attributed to the absence of physical support from fellow students and educators, the feeling of being alone and the lack of immediate feedback from educators [Kaup et al., 2020]. There was also concern over the possibility that the 2020 academic year could be lost [Hasan and Bao, 2020].

The main research problem that we address in this paper relates to the challenges that we had to contend with due to the rapid transition from face-to-face teaching to online teaching at the peak of the COVID-19 pandemic. The context of the study is an advanced Excel module presented to more than 900 students registered for the BCom Financial Sciences and BCom Accounting degrees at a South African HEI, the University of Pretoria. Concepts covered in the module include (i) the application of logic in business decisions using Boolean Logic and Nested If functions, (ii) analysis and organisation of numerical and text-based data, (iii) retrieval of data from lookup tables, (iv) the use of Pivot tables to analyse data, and (v) analysis of financial implication of loans and investments. To accommodate the 900 students registered for the module, 12 lectures were presented weekly per study unit. The lectures were presented in the University's computer laboratories which seated between 75 and 80 students. Each two-hour lecture consisted of a short discussion and subsequent demonstration of the Excel features in each study unit. The students were able to follow the lecturer's demonstration on a dedicated workstation.

Before the national lockdown, the process to review how the module can be best facilitated was underway through an application for the University's Scholarship of Teaching and Learning (SoTL) grant. Being a 'service' module, an historical challenge faced by lecturers of the module was students' attitude towards the complexity and relevance of the module to their learning programs. The advent of COVID-19 compelled the lecturers to move the module review process forward, and the 12 weekly practical demonstrations to total online learning. Following the national lockdown announced by the South African President on March 23 2020 [South African Government News Agency, 2020], students in HEIs across the country had to leave their campuses and return to a home environment where the majority have limited internet access [Statistics South Africa, 2018]. Hence, the practical sessions presented to students in the computer laboratories on campus had to be replaced by activities accessed through the University's learning management system (LMS). We realise that any meaningful use of online teaching had to take cognisance of the module's practical nature, students' learning preferences, and the personal circumstances of the majority of students who had limited internet access at home. Although students could download contents from the University's LMS through a partnership between the University and the major internet service providers in the country, for many students the connections were often very slow and unstable.

Due to the prevailing home conditions of the majority of our students, we resorted to creating pre-recorded demonstration videos of the module content as a form of asynchronous online teaching. Although we could have delivered the practical demonstrations synchronously over the University's LMS, this option was impractical for our students' context because synchronous

online teaching requires fast, uninterrupted internet connection [Cong, 2020]. The use of pre-recorded videos has been shown to be effective in online teaching and learning due to their benefits, which include relative simplicity, convenience of access, the ability to review lecture materials multiple times, and self-paced learning [O'Callaghan et al., 2017, Cuschieri and Calleja Agius, 2020].

In this paper, we report on students' perception of the use of pre-recorded demonstration videos to support teaching and learning during the national lockdown in 2020. The research question that we answer in the study is: how do students at the University of Pretoria perceive the use of pre-recorded demonstration videos to support online teaching and learning during the period of a pandemic?

In the next section, we present an overview of the concepts that form the theoretical background for the study. The overview is followed by the research methodology, the research results, the discussion and the conclusion.

# II. THEORETICAL BACKGROUND

## Learning Theories in the Digital Age

Learning is a process of acquiring new knowledge, understanding, skills, behaviours and values [Ambrose et al., 2010]. The learning process could result in a change in knowledge or behaviour in an individual through experience. Learning is not something that is done to an individual. It is an action taken by individuals and the consequence of how individuals interpret and respond to their experiences [Ambrose et al., 2010]. Educators can optimise their students' learning through a better understanding of the learning process. There are four generally acknowledged learning theories for the digital age, namely behaviourism, cognitivism, constructivism [Ally, 2008], and connectivism [Goldie, 2016].

Behaviourist theorists hold the view that positive and negative reinforcement are effective tools of learning and behaviour modification. Therefore, effective and meaningful learning occurs through a series of rewards or punishments. In contrast, cognitivist theorists reject the idea that students are passive and simply react to stimuli in the environment. Instead, learning takes place through the use of memory, active mental processing of information and problem-solving [Ally, 2008].

Constructivists see students as constructors of their knowledge. Students link new information to existing knowledge, and based on previous experiences, construct new meaning. Learning is enhanced by social interaction with peers but optimised by collaboration with those whose proficiency level is higher [Ally, 2008]. Connectivism is a relatively new theory for understanding learning in a digital age. It acknowledges how internet technologies contribute to new ways of learning that were not possible before the digital age [Goldie, 2016, Ally, 2008]. Technologies like web browsers, wikis, online discussion forums, such as Microsoft Teams, Blackboard Collaborate (LMS platform), Zoom, and Google Meet, have enabled people to learn and share information via the internet and among themselves. Connectivitist theorists believe that knowledge is personal since the same concept can be interpreted differently. Knowledge creation is also context-dependent and is influenced by different world-views and connections with other people [Goldie, 2016, Ally, 2008].

Rather than being seen from a divergent view, Ally [2008] believes that there is overlap between the principles that influence the behaviourist, cognitivist, and constructivist learning theories. Therefore, the design of online learning materials can incorporate principles from these three learning theories. In the next section, we provide an overview of online learning approaches.

## Online Learning Approaches

With the advent and adoption of information and telecommunication technologies worldwide, the practice of online learning has been steadily increasing for the past decade. The COVID-19-induced upheaval to people's lifestyle made online learning a standard instructional delivery mode

in various educational institutions worldwide. Ally [2008] defines online learning as "the use of the Internet to access learning materials; to interact with the content, instructor, and other learners; and to obtain support during the learning process, in order to acquire knowledge, to construct personal meaning, and to grow from the learning experience".

Online learning can be conceived as a continuum between synchronous and asynchronous learning (see Figure 1). In synchronous learning, educators and students interact online in real-time. The interaction is made possible through communication tools like video and audio-conferencing tools, live chats, whiteboards, as well as document and application sharing [Tartavulea et al., 2020].

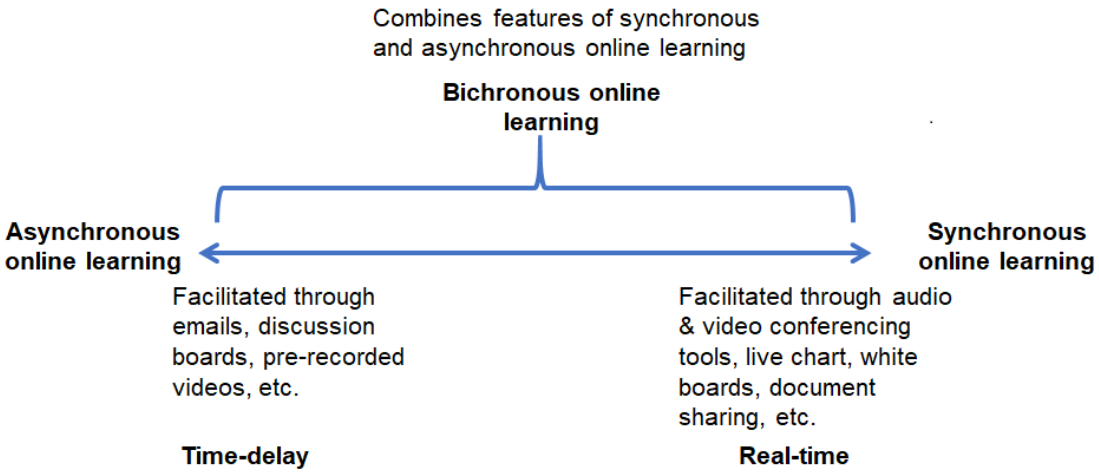


Figure 1: The continuum of synchronous, asynchronous and bichronous learning (adapted from [Martin et al., 2020])

Students can interact with one another, and with educators. The communication tools also enable students to get real-time feedback from educators, thus avoiding the frustration that could result from feeling isolated from other students and educators.

In contrast, asynchronous learning supports teaching and learning when it is not feasible for students and educators to be present online at the same time [Hrastinski, 2008]. Asynchronous learning can be facilitated by using emails, discussion boards, voice-over presentations in Microsoft PowerPoint™, and pre-recorded videos [Azlan et al., 2020]. The benefits of asynchronous online learning include self-paced and self-directed learning [Mukhtar et al., 2020]. More specifically, other benefits of pre-recorded video as a form of asynchronous learning include the ability to watch and re-watch content, or skip some content, depending on a learner's needs [O'Callaghan et al., 2017]. The main shortcomings of asynchronous online learning are delayed feedback from educators and the feeling of isolation [Mukhtar et al., 2020].

A practical approach combines synchronous and asynchronous online learning activities into what is referred to as bichronous online learning (see Figure 1) which is situated between the two online learning modes [Martin et al., 2020]. In bichronous learning, students participate asynchronously in learning anytime, anywhere and at their own pace. This is followed by real-time participation in learning activities using any of the tools that support synchronous communication [Martin et al., 2020]. Bichronous online learning allows teaching and learning to be tailored to the needs of a particular course, using tools and technologies that are readily available. The goal is to capitalise on the advantages offered by the connectivitist approach through a judicious combination of time-delay and real-time technologies to offer students an optimal learning environment [Ally, 2008]. Thus, bichronous learning takes advantage of the benefits of synchronous learning while avoiding some of the drawbacks of asynchronous learning by

providing an opportunity for real-time interactions between and among students, as well as with educators during the synchronous sessions.

## III. RESEARCH METHODOLOGY

The national lockdown prevented us from accessing the University of Pretoria's video recording facilities on campus. Consequently, we did not have access to the sophisticated lecture recording platforms such as educators in Europe [Cuschieri and Calleja Agius, 2020]. Therefore, we carried out practical demonstrations of advanced Excel functions from our homes. The demonstrations were captured using the Microsoft PowerPoint™ screen and audio recording functionality. These demonstrations enabled us to deliver audio comments through each step of the practical sessions. The recordings were sub-divided into smaller logical sections to ensure that the resulting video files were not too large, while at the same time not compromising the logical flow of the lessons. The smaller video files made it relatively more accessible for students to download over slow internet connections from their homes. Thus, the screen and audio recording functionality in Microsoft PowerPoint™ enabled us to switch to asynchronous online teaching in the shortest possible time without investing in expensive video recording software. Quality assurance was built into the process where a lecturer other than the presenter would review the practical demonstrations. This process ensured that essential concepts in a topic had been adequately covered in each recording.

We monitored students' interactions with the videos through the LMS data analytic tools that record the number of times each student accessed a module content area. It should be noted that the LMS data analytics' reports are outside the scope of this paper. We could not embed questions in the pre-recorded demonstration videos as this would require uninterrupted internet connections. So, students were 'tested' on their understanding of the concepts covered in each video using online quizzes. The quizzes were formative in nature and marks were awarded mainly to motivate students.

The study employed a qualitative research approach [Creswell, 2014], which enabled us to get deeper insight into students' perceptions on the use of pre-recorded demonstration videos to support online teaching and learning. During the 2020 academic year, the annual module evaluation was implemented as an online survey using the Watermark EvaluationKIT™. The survey was administered by the Department for Education Innovation to ensure an objective and independent evaluation process. The survey included general-purpose questions that were developed by the Department for Education Innovation. The general-purpose questions focused on module organisation, lecturers' preparedness, and the extent to which a specific module meets students' overall expectations. In addition to the general-purpose questions, we contributed a set of module-specific questions to obtain students' perception on the use of pre-recorded demonstration videos that we created to support online teaching during the lockdown. The module-specific questions consisted of two main closed questions with sub-statements that students could respond to using three qualitative categorical labels, as well as two open-ended questions which students could provide as much detailed response as they wished. The online survey was opened to all Excel module students from April 1 - 30 2020 on the LMS. Students' participation in the survey was voluntary and they provided their feedback anonymously at their convenience during the period that the survey was available.

This paper reports on the qualitative feedback provided by students. However, we also provide the results of the qualitative categorical data using graphs, since they served as the baseline for interpreting the more in-depth qualitative feedback. The qualitative feedback was coded in ATLAS.ti™. The responses to each open-ended question was imported into ATLAS.ti™ as portable document form (PDF) documents.

The coding was conducted iteratively by the three authors to ensure inter-rater reliability. The first cycle involved the review of students' feedback independently by each author to familiarise ourselves with their content. During the second phase we agreed on the code set to use (see Figure 2). In the third phase each of us independently assigned the codes to the qualitative data. We then consolidated the codes and agreed on them before going through another round of

coding where we inductively identified the themes that emerged from students' responses. Finally, we categorised the coded data into themes using the conventional content analysis approach [Hsieh and Shannon, 2005]. The transition of the codes employed in the data analysis is illustrated in Figure 2. A screenshot of an instance of the coding process in ATLAS.ti™ is depicted in Figure 3.

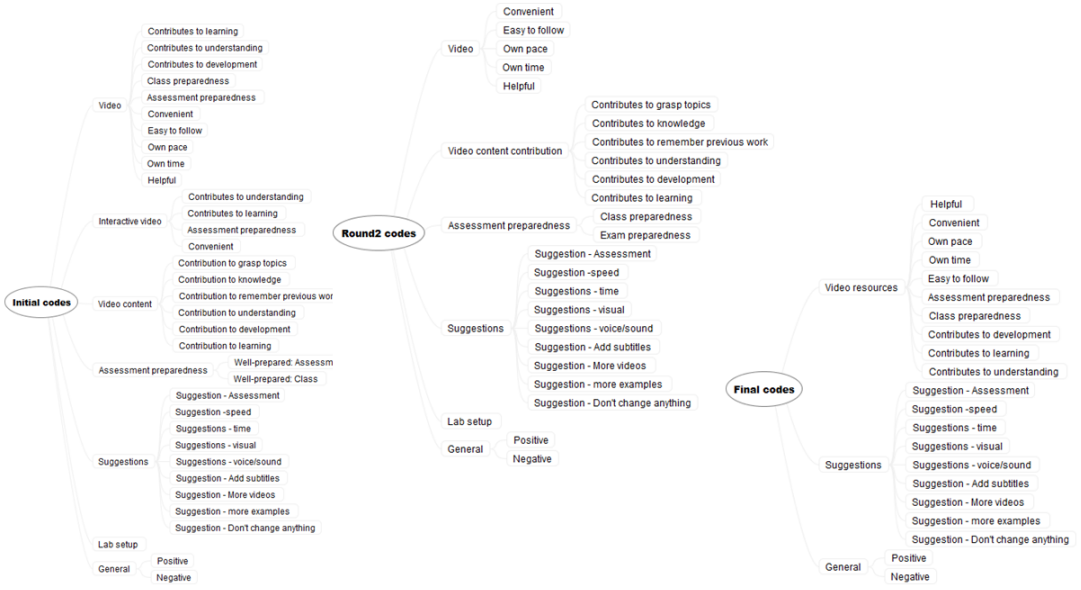


Figure 2: Data analysis codes from initial codes to final code set

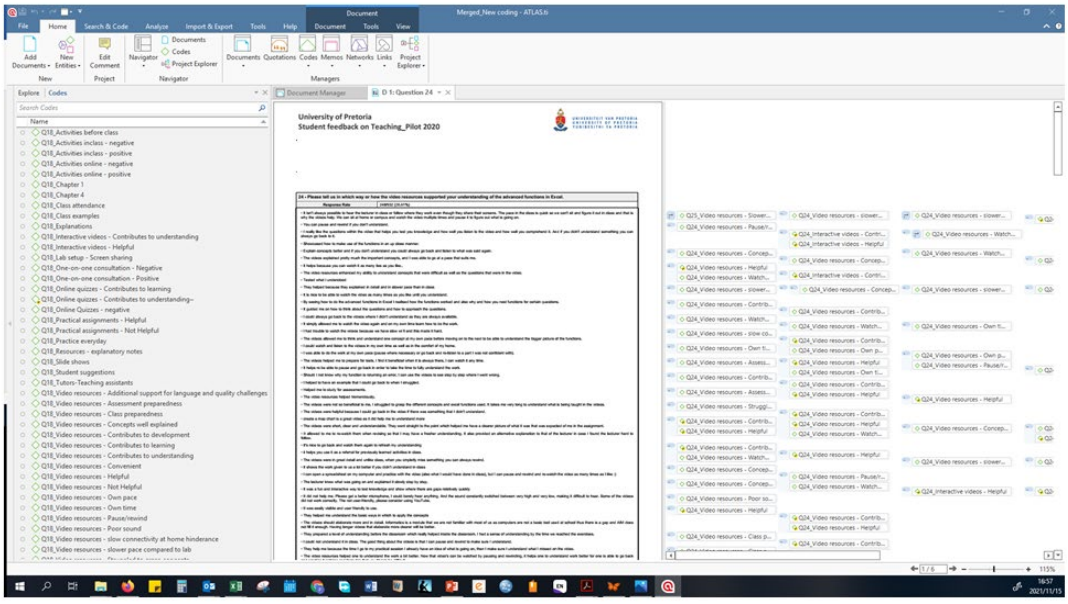


Figure 3: Screenshot of coding in ATLAS.ti™

The Faculty of Economic and Management Sciences (EMS) Research Ethics Committee at University of Pretoria granted ethical approval for the study.

# IV. RESEARCH RESULTS

## Response Rate

From the 932 students registered for the Excel module, 512 students participated in the survey. This number represents a participation rate of almost 55%. The participation rate through the online evaluation method was higher than in previous years. Students' feedback was also more informative, making the feedback more valuable and actionable. As part of their response to the general-purpose questions, the vast majority of students had positive views about the online module evaluation, with 90% of students indicating that the online evaluation process was 'user-friendly' or 'extremely user-friendly'.

## Students' Perception of their Level of Competencies before Module Enrolment

In this section, we discuss the results of the categorical qualitative data which specifically asked students about their perception of their level of competencies before module enrolment in the basic and advanced functions in Excel. The results of students' perception of their competencies should not be construed to imply the extent to which students have mastered the module content. Rather, the results provided the basis for the interpretation of the in-depth qualitative feedback from students.

One of the module-specific questions that we asked students was to indicate their level of competency in the use of the following basic functions (SUM, AVERAGE, MAX, MIN, LARGE, SMALL, COUNT, COUNTA), as well as the concepts of absolute and relative cell referencing in Excel, using three categorical labels where 1=novice, 2=intermediate, and 3=expert. Students' responses to this question provided us with insight into the extent to which they had confidence in their ability to apply the basic Excel functions and concepts to solve real-world problems. Because some of the basic functions were covered in a pre-requisite course for the Excel module, the vast majority of students (95.3%) indicated their competency level as either intermediate (40.6%) or expert (54.7%), while only 4.7% of students perceived themselves as novice (see the set of graphs marked (a) in Figure 4).

We also asked students to indicate their level of competency in the use of the following advanced Excel functions: Boolean functions AND, OR, NOT; relational operators >, <, >=, <=, <>; Simple IF statements; Nested IF statements; and Complex IF statements. The same three categorical labels (1=novice, 2=intermediate, and 3=expert) were applied. A well-grounded understanding of these advanced functions is necessary to solve real-world business problems using a combination of these functions to create viable solutions in Excel. It should be noted that some of the pre-recorded demonstration videos that we created focused on these advanced functions.

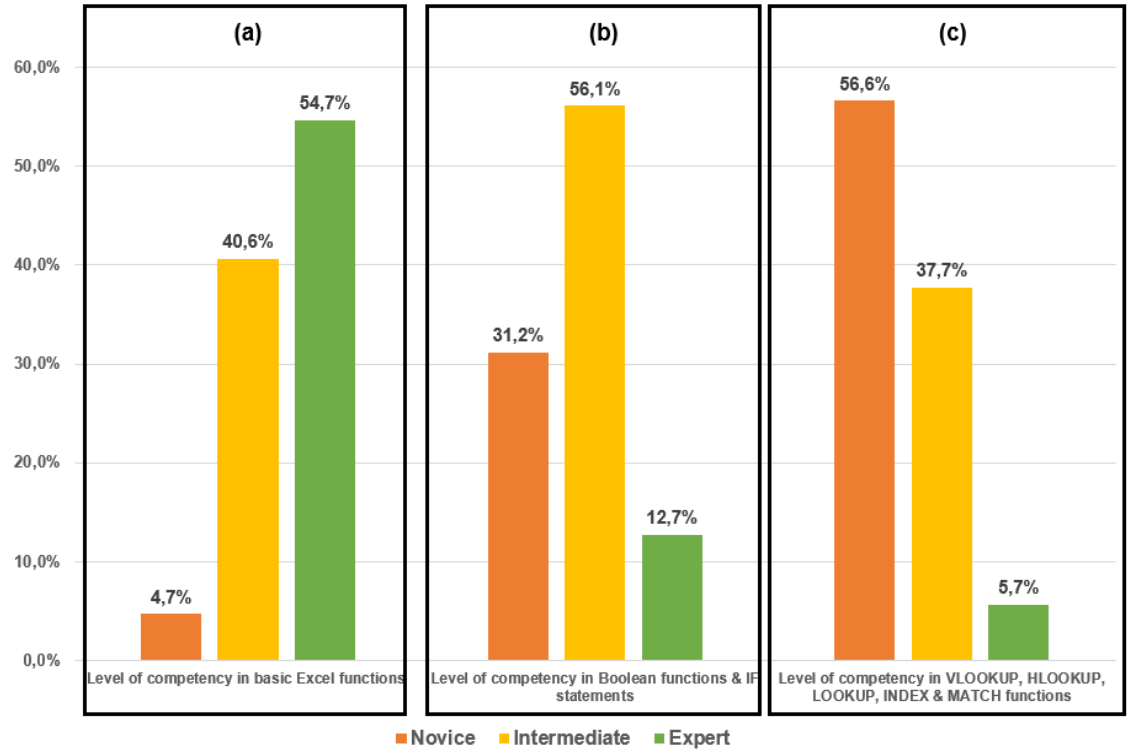


Figure 4: Students' perception of their level of competencies before module enrolment

As shown in the set of graphs marked (b) in Figure 4, only 12.7% of students perceived their competency in these advanced functions as expert, more than half (56.1%) indicated their competency as intermediate, while 31.2% viewed their competency as novice. When compared to students' perceptions of their competency in the use of the basic Excel functions and concepts, the number of students that indicated their competency as novice increased substantially for the advanced functions illustrated in Figure 4 (b), those that perceived themselves as expert decreased substantially, while the ones that viewed themselves as intermediate increased marginally.

We also asked students to indicate their competency in the use of the following advanced functions: VLOOKUP, HLOOKUP, LOOKUP, INDEX, and MATCH in Excel. It should be noted that these advanced functions form the most complex of the skills covered in the Excel module. Hence, we also created pre-recorded demonstration videos for them. As illustrated in the set of graphs marked (c) in Figure 4, only 5.7% of students indicated their competency in these advanced functions as expert, more than half of the students (56.6%) viewed their competency as novice, while the remaining 37.7% perceived their competency as intermediate.

When compared to students' perception of their competency in the use of the basic Excel functions as shown in Figure 4 (a), and the use of Boolean functions and relational operators shown in Figure 4 (b), the number of students that viewed their competency as novice increased substantially for the advanced LOOKUP functions shown in Figure 4 (c), those that perceived themselves as expert decreased substantially, while the ones that viewed themselves as intermediate decreased marginally.

## Students' Perception of the Role of Demonstration Videos in their Understanding of Advanced Functions in Excel

Another vital aspect on which we sought students' feedback relates to their perception of the extent to which the demonstration videos that we created supported their understanding of various

advanced functions in Excel. Using three categorical labels where 1=not at all, 2=slightly, and 3=greatly, students provided feedback on ten demonstration videos that we created to support teaching and learning.

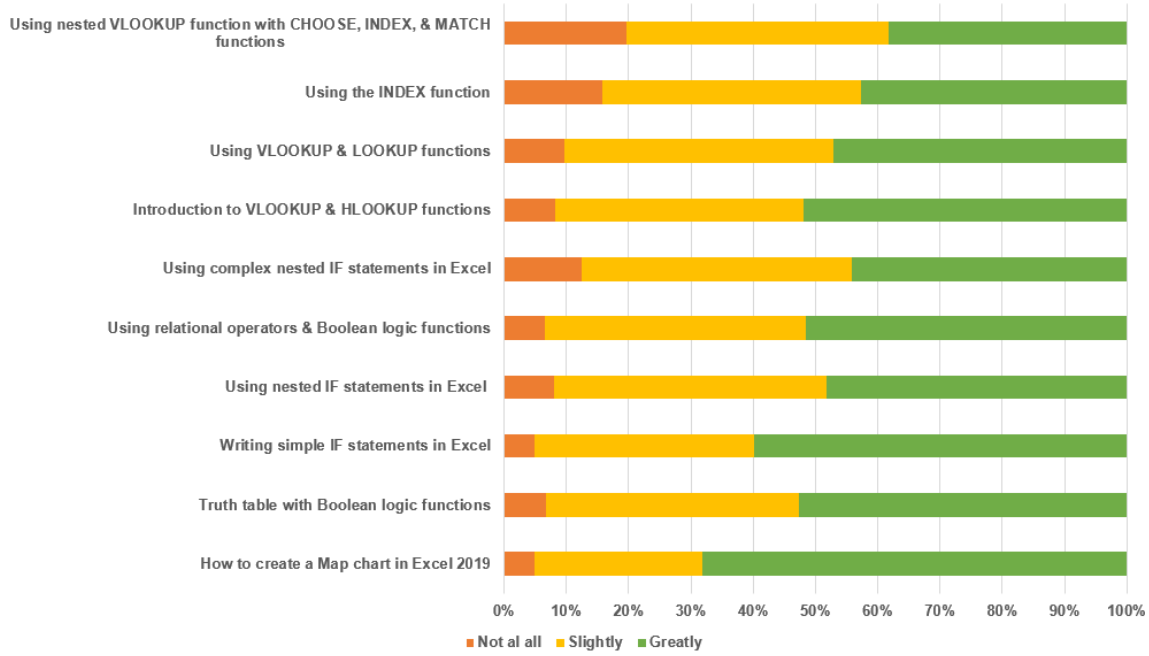


Figure 5: Students' perception of the role of demonstration videos in understanding advanced Excel functions

As illustrated in Figure 5, most students indicated that the demonstration videos supported their understanding of the corresponding advanced Excel functions greatly. The only exception was the video on using nested VLOOKUP functions with the CHOOSE, INDEX, and MATCH functions, which 42% of students perceived to have contributed slightly to their understanding of the topic. The video on how to create an Excel Map chart received the most positive feedback, with 68.2% of students indicating that the video contributed substantially to their understanding. This was followed by the video on how to write simple IF statements, which was perceived by 59.8% of students to have contributed greatly to their understanding. The videos on the use of relational operators and Boolean logic functions, as well as the introduction to VLOOKUP and LOOKUP, were also perceived by 51.5% and 51.9% of students to have contributed greatly to their understanding respectively. The remaining four demonstration videos were viewed by less than 50% of students to have greatly supported their understanding.

## Results of Open-Ended Responses

This section reports on our analysis of the qualitative feedback that students provided to the two module-specific, open-ended questions and the general-purpose open-ended question in the survey. The qualitative feedback provided us with richer insight into students' perception of how the demonstration videos that we created supported their learning during the lockdown period. Our analysis identified five main themes from the qualitative feedback. The themes are discussed in the following sub-sections.

## Theme 1: Support for Learning and Understanding of Module Content

The first theme that emerged from the qualitative data analysis relates to how the demonstration videos supported students' learning and understanding of module content. Out of the 932 students, 248 provided qualitative feedback on how the demonstration videos supported them in

mastering the module contents. Students were pleased that the demonstration videos provided step-by-step demonstrations of how to use advanced functions and features in Excel. According to these students, the demonstration videos played an important role in their learning processes. Students used keywords like 'understand', 'grasp', and 'helpful' to express their perception of the learning support provided through the demonstration videos (see Figure 6).


Figure 6: Word Cloud depicting keywords used by students to express the demonstration videos' support for learning

The majority of students were of the view that the demonstration videos contributed variously to their learning and understanding, with two students expressing their views as follows: "The video demonstrate on how to do the activities and actually allowed me to practice on my own on understanding the advanced functions in Excel"[1] [Student A ] and "seeing functions exactly how they are or should be with a voice explaining over it cements ones understanding" [Student B].

### Theme 2: Support for Self-paced Learning

The second theme that emerged from the qualitative data analysis relates to students' value of self-paced learning. This aspect received the most positive comments from students, who felt that the ability to watch, rewind, forward, and re-watch the videos multiple times was beneficial to their learning. One student expressed their view on self-paced learning supported by the demonstration videos thus: "the videos allowed me to think and understand one concept at my own pace before moving on to the next to be able to understand the bigger picture of the functions" [Student C] while another found that the ability to watch the demonstration videos at their own pace helped them to "…better my understanding and clear up any confusion" [Student D].

[1] Excerpts from students' responses to open-ended questions are quoted verbatim without any correction to apparent grammar or spelling error.

The relationship between students' ability to rewind, forward, and re-watch the demonstration videos multiple times, and their understanding of the content presented in the videos is evident in students' statements as quoted above. Being able to watch the demonstration videos multiple times also contributed to students' mastering of concepts.

### Theme 3: Support for Assessment Preparation

Another theme that we identified from analysis of students' qualitative feedback relates to the use of the pre-recorded demonstration videos to prepare for assessments. As stated in the research methodology section, each demonstration video had a quiz linked to it, which we used to 'test' student's understanding of the concepts covered in the video. Many students perceived the ability to go back to the demonstration videos and re-watch their contents to revise and prepare for assessments as beneficial. Their sentiments were briefly captured by the following quotations from two students' feedback thus: "…it helped as revision before a test and it was much easier to take notes at my own pace as i could re-watch and pause the videos as much as I needed to" [Student E] and "I liked that I could go and watch the videos on my own time and before assessments" [Student F].

### Theme 4: Comparison between Online and Face-to-face Sessions

Several students that provided feedback about the demonstration videos also compared them with the face-to-face practical sessions held before the national lockdown. Before the lockdown, each practical face-to-face session typically lasted two hours. To ensure that essential concepts were covered during the limited time we had, students were required to do preparatory activities beforehand. This meant that practical sessions were reserved for demonstrating the advanced and complex functions in Excel. Due to the nature of the practical sessions, it is not uncommon for some students to feel 'lost' during the demonstrations, which manifests in a one-on-one consultation with a lecturer as the only solution. With the national lockdown and campus closure, the one-on-one consultations were no longer available to students. A student felt that "the advanced functions are not easy to learn and understand in a 2 hour sitting…the videos assist in areas where one could have been absolutely lost and we have the opportunity to go back to the video as many times as we want to get proper understanding of the use of the functions" [Student G] while another was of the opinion that "the pace in the class is quick so we can't sit and figure it out in class and that is why the videos help. We can sit at home…and watch the video multiple times and pause it to figure out what is going on" [Student H].

### Theme 5: Criticisms and Suggestions for Improvement

The majority of students' feedback were positive. However, our intervention also drew negative feedback from some students. Some of the criticisms related to 'poor' sound quality and the pace of the demonstration videos. For example, one student expressed their frustrations as follow: "Some lecturers are not easy to understand over the videos, so it would be great if all the videos are made by one person who is audible" [Student I], while another was of the view that "…the sound of some of the videos can be improved, I also would love if the pace of explaining the work on the videos could be neutral in terms of speed, not too fast and not to slow" [Student J].

A negative aspect of the pre-recorded demonstration videos relates to unequal access to internet connection in South Africa (Statistics South Africa, 2019). Although this shortcoming did not fall under the 'criticisms and suggestions for improvement' theme, it is important to highlight the negative impact of lack of access to internet on education in many developing countries. We did not define a separate theme for this aspect since it was an isolated occurrence with only two students providing feedback on the connectivity problem. One of these students expressed this challenge as follow: "I had trouble to watch the videos because we have slow wifi and this made it hard" [Student K], while the second student simply wrote "dont have data" [Student L). Thus, even when lessons were pre-recorded and made available on the University's LMS to reduce the connectivity requirement of synchronous teaching, some students still found it difficult to access and use the pre-recorded demonstration videos asynchronously.

In addition to expressing negative sentiments, some students offered suggestions for improvement in future initiatives. For example, a student felt that the use of closed captioning in the videos will be helpful because “sometimes the narrator does not speak clearly it becomes difficult to hear what he/she is saying...rather put subtitles only” [Student M].

## V. DISCUSSION

The outbreak of the COVID-19 pandemic across the globe in early 2020 forced the closure of several HEIs and many resorted to online teaching to ensure that the academic year was not lost [Chen et al., 2020, Mishra et al., 2020]. Students at the University of Pretoria worked from home to prevent interrupting their studies. Qualifying students were supplied with laptops and monthly airtime to access the University’s LMS. The academic modules were presented fully online. The pre-recorded demonstration videos that we created align with Ally’s [2008] definition of online learning. Students were able to access learning materials for asynchronous use to support their learning process.

The results obtained from this study showed that many students were of the view that the pre-recorded demonstration videos were beneficial from four main perspectives (Theme 1 to 4). Theme 5 dealt with criticisms and suggestions for improvement. Students felt that the videos played an essential role in their learning. Several students provided positive feedback on how the videos mirrored the face-to-face contact sessions through practical demonstrations accompanied by the demonstrator’s audio narrations. Students’ feedback were in line with Mayer’s [2014] principle of redundancy, with students stating that “seeing functions exactly how they are or should be with a voice explaining over it…” reinforced their understanding.

To a large extent, students’ perception of their pre-enrolment level of competencies (see Figure 4) and their views of the demonstration videos (see Figure 5) were corroborated by their qualitative feedback as reflected in Theme 1 to 4. However, the qualitative feedback provided us with richer insights into how the videos supported students’ learning during the national lockdown. As advocated by Ally [2008], the pre-recorded demonstration videos incorporated the four learning theories (behaviourism, cognitivism, constructivism, and connectivism) for the digital age. An integral part of the module is the completion of assignments, which are ‘rewarded’ with marks. Students who do not submit an assignment miss out on the corresponding mark. In addition, marks were awarded for the online quizzes to motivate students to complete them (see the research methodology section). Reward and punishment are basic principles of behaviourism. Students’ ability to watch and re-watch the videos, actively engaging with the step-by-step demonstrations and practicing the advanced functions at their own pace are in line with cognitivism. In a student’s own words, the demonstration videos “actually allowed me to practice on my own on understanding the advanced functions in Excel”. Furthermore, alignment with the constructivism learning theory was evident in that the videos facilitated better understanding of the advanced functions. Students were able to reflect on their understanding of specific module content as they create meaning and new knowledge on the use of advanced functions in Excel to solve business problems. Students indicated that they could “think and understand one concept…before moving on to the next to be able to understand the bigger picture of the functions”. Finally, the adoption and use of the University’s LMS by students and educators, and the delivery of the pre-recorded demonstration videos through the LMS platform to support learning of module content asynchronously reflects the incorporation of connectivism to the study context.

In adapting our teaching to online delivery during the lockdown, we attempted to optimise the facilitation of learning by following a bichronous online learning approach. However, because the vast majority of our students had limited access to uninterrupted internet connection, this module manifested into an asynchronous mode of delivery at the peak of the national lockdown.

By their nature, students are not homogenous groups, and the pace of learning differs amongst students. The study results support the benefits of pre-recorded videos, as reported in education literature in general [O’Callaghan et al., 2017], and their use during the COVID-19 pandemic in particular [Cuschieri and Calleja Agius, 2020]. Many students appreciated the opportunity to

download the pre-recorded demonstration videos and watch them in their own time as they could "pause and write down notes and rewind" and "clear up any confusion".

Another benefit reported by students was that the pre-recorded demonstration videos "helped as revision before a test", and they could "watch the videos on my own time and before assessments". Our students' perception of the use of demonstration videos to prepare for assessments mirrored the findings of Whatley and Ahmad [2007], who reported on the usefulness of videos to prepare for examinations.

To a large extent, the pre-recorded demonstration videos made it easier for most students to access the lecture materials. However, poor internet connection made it difficult for a few students to benefit from the pre-recorded videos. In their study, Qazi et al. [2020] and Khalil et al. [2020] also reported that limited internet access impacted students' ability to take advantage of online lessons during COVID-19.

As acknowledged by Mishra and Koehler [2006] , the adoption of technology in and of itself is not sufficient for the achievement of the desired learning outcome. Therefore, the authors of this paper found value in applying the learning theories for the digital age to how students learn and how technology can be incorporated to facilitate intentional and effective learning for students, not only during the pandemic but also in the future.

## VI. CONCLUSION

This study investigated students' perceptions of our initiative to support asynchronous online teaching of an advanced Excel module using pre-recorded demonstration videos during the South African national lockdown. As was the case with many educators in HEIs, we had to quickly adapt to presenting a practical course using asynchronous online technology. Asynchronous online practical demonstrations of advanced Excel functions enabled us to continue teaching and learning as we would have in the physical laboratory environments. This process was facilitated through the use of Microsoft PowerPoint™ screen and audio recording functionality.

We have shown that asynchronous technologies like pre-recorded demonstration videos can be used effectively to support online teaching and learning in resource-constrained settings. The majority of students that participated in the study perceived the use of pre-recorded demonstration videos as beneficial and contributing to their learning. Students provided rich qualitative feedback through the online module evaluation, which enabled us to get richer insights about students' perception of how the videos supported them during COVID-19. This kind of deep insight would have been difficult, if not impossible, without the online module evaluation method. The first four themes identified, i.e. (i) support for learning and understanding, (ii) support for self-paced learning, (iii) support for assessment preparation, and (iv) comparison with face-to-face learning, showed alignment with the behaviourism, cognitivism, constructivism, and connectivism learning theories.

Our reflection on the research results showed that the four learning theories for the digital age provide a firm footing on which to build online teaching and learning experiences. In this module, the specific context was asynchronous online teaching of a practical subject. We used pre-recorded demonstration videos to teach advanced Excel concepts, functions and formulas. The success rate of the students, together with their feedback during this study highlighted the advantages of using pre-recorded demonstration videos in teaching a practical subject as reported in this paper. We envisage that the videos will remain a part of the teaching process even after resumption of face-to-face instruction.

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*Editor's Note:* The following reference list contains hyperlinks to World Wide Web pages. Readers who have the ability to access the Web directly from their word processor or are reading the paper on the Web, can gain direct access to these linked references. Readers are warned, however, that
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