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University Life in an Era of Disruption of COVID-19: A Meta-Methods and Multi-Mixed Methods Research Study of Perceptions and Attitudes of South African Students

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ABSTRACT

On 18 March 2020, all South African universities and colleges were closed due to the COVID-19 virus. By early April, 10 universities announced that they were planning to resume teaching and learning online, including the University of the Witwatersrand (i.e., Wits University), Johannesburg, which is the joint highest ranked university in Africa. Therefore, the purpose of this editorial was to examine the perceptions and attitudes of these students regarding online learning in an era of disruption of COVID-19, uniquely using both *multi-mixed methods research approaches* (i.e., involving the partial integration of multiple methods research approaches and mixed methods research approaches) and *meta-methods study approaches* (i.e., involving the full[er] integration of multiple methods research approaches and mixed methods research approaches). A total of 4,419 Wits University students completed an online survey. A principal components analysis of one of survey's scales, namely, the Attitude of Students Towards COVID-19 and its Impact on Higher Education scale, revealed 2 subscales, namely, Students' Self-regulation Towards COVID-19-Based Higher Education and Attitudes Toward Teaching, Learning, and Assessment in COVID-19-Based Higher Education. Nonparametric analyses revealed that scores on these measures discriminated gender, age group, level of student (i.e., undergraduate vs. postgraduate), locality status (i.e., local vs. international student), and registration status (i.e., full-time vs. part-time). A multiple analysis of the open-ended responses by the VOSviewer 1.6.14 text mining software program led to the identification of 6 metathemes. Similarly, WordStat 8.0.29 topic modeling yielded 5 metathemes that mapped onto VOSviewer's 6 metathemes, indicating triangulation of findings. A sentiment analysis revealed negative sentiments that identified not only the biggest challenges for students but also the characteristics of students who experience these challenges. Finally, a cluster analysis, combined with chi-square analyses, led to the identification of 4 clusters of students who differed with respect to their attitudes and online experiences. Implications of these findings are discussed.

KEYWORDS

South African universities; University of the Witwatersrand; Wits University; COVID-19; mixed methods research; mixed research; meta-methods research; multi-mixed methods research; crossover mixed analysis; quantitizing; qualitizing

According to the World Health Organization (WHO, 2020a), the COVID-19 pandemic broke out in Wuhan, China in December 2019. Within a few months, the pandemic had spread across the world and was declared a global pandemic by the World Health Organization on 11 March 2020 (WHO, 2020b). In many countries, total lockdown was the immediate response to the pandemic due to the inability of scientists to understand the behaviour of the virus causing this pandemic. Although at the time of the writing of this editorial, the lockdown gradually is being relaxed in many countries across the world, what is glaring is that a second wave is a possibility, should we not be careful with how we manage the health protocols necessary for us to manage a post-COVID-19 global economy.

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The total lockdown, which became effective in many countries during March 2020, has slowed down the global economy with a high possibility of a global recession. It has also impacted higher education, with universities closing across the globe. South African universities are not spared in the impact of the pandemic. On 16 March 2020, through an official communique from the South African Department of Higher Education, Science and Technology (DHEST), "many institutions had already taken tough decisions in a number of areas, including the cancellation of large events, such as graduations, contact lectures and other ceremonies" (DHEST, 2020, para. 24). On 17 March, Blade Nzimande, Minister of Higher Education, Science and Technology announced that all South African universities and colleges would be closed from 18 March due to the coronavirus (Chothia, 2020; Crawford et al., 2020). However, by approximately the first week of April 2020, a number of South African universities announced that they were prepared to resume teaching and learning online (Dell, 2020). In total, by early April 2020, 10 South African universities had announced that they were going online. Although the universities that decided to go online were doing so to save the teaching block and the academic year, the initial response to the decision was not so much of a favorable one (Lederman, 2020). There was a strong argument against it, with critics contending that going online would bring back the memories of the past in which only the privileged would be catered for (Behari-Leak & Ganas, 2020). In addition to this argument, social justice became a phrase used to argue against online teaching and learning in higher education (Nowicki, 2020; Osman, Ojo, & Hornsby, 2018). Despite all the arguments against going online, the University of the Witwatersrand, Johannesburg, moved swiftly and switched to remote online teaching and learning. According to the online announcement made on 14 April 2020, this was an emergency remote teaching and learning programme aimed at mitigating against the loss of the academic year (WITS, 2020).

This editorial represents an attempt to understand how university students at one of the South African universities that instituted the emergency remote teaching perceive their readiness and understand their attitudes in responding to the disruption to teaching, learning, and assessment caused by COVID-19. Making sense of the readiness and attitudes of university students helps to fill a research gap, which, in turn, can lead to policies and strategies that can help to combat this era of disruption (Deng, Benckendorff, & Gannaway, 2020; Nistor, Stanciu, Lerche, & Kiel, 2019).

The Emergence of Online Teaching and Learning, and Understanding Students' Coping Strategies

The COVID-19 is a *black swan event* and its impact on higher education is evolving. The closure of South African universities due to COVID-19 and the move online has put enormous pressure on university students, especially those whose home situation might not be conducive to learning. The swift move online also has placed a significant amount of pressure on the faculty, many of whom do not have training to teach online effectively. We acknowledge the pressure that the emergence of online teaching places on the faculty and the claim by Cross, Adam, and Ojo (2009) to consider "wider domain of ICT [Information and Communications Technology] education and the challenges it poses to higher education in South Africa" (p. 1188). However, our focus in this editorial is on the students. The satisfaction of the students and their ability to persist (Arbaugh, 2014; Joo, Lim, & Kim, 2011), as well as their self-regulation (You & Kang, 2014; Yukselturk & Bulut, 2007; Zimmerman & Martinez-Pons, 1988) are success factors critical to learning online. Self-regulation is about how students engage and direct their thoughts, feelings, and actions to achieve their learning goals (Zimmerman & Martinez-Pons, 1988).

As noted earlier, the decision by South African government to support universities to adapt and to persevere through the total lockdown with teaching and learning online came with mixed feelings. A similar decision was taken by the Chinese government in the early spring of 2020 (Bao, 2020). A number of researchers have attempted to investigate higher education and COVID-19 (Abbasi, Ayoob, Malik, & Memon, 2020; Bao, 2020; Nabukeera, 2020; Toquero, 2020). However, what is missing in the literature is an in-depth understanding of university students using simultaneously a meta-methods and multi-mixed methods research approach to engage their perceptions and attitudes of contingency online teaching and learning.

Purpose of the Study

The purpose of the study presented in this editorial was to examine the perceptions and attitudes of students enrolled in a South African university regarding online learning in an era of disruption of COVID-19. Specifically, the study involved an investigation of different demographic data (i.e., gender, age, the student's level of study, locality of students, enrolment status, and home situation) as variables to provide insights into their experiences of the emergency remote teaching.

Research Questions

For the current study, combination research questions were used. According to Plano Clark and Badiee (2010), combination research questions represent at least one mixed methods research question combined with separate quantitative and qualitative research questions. Specifically, the following research questions were addressed:

1. What is the structural validity of the following instrument: *students' attitudes Towards COVID-19 and its impact on higher education among students enrolled in a South African university*? (Quantitative Research Question)
2. To what degree are there gender differences in attitudes towards COVID-19 and its impact on higher education among students enrolled in a South African university? (Quantitative Research Question)
3. To what degree are there age differences in attitudes towards COVID-19 and its impact on higher education among students enrolled in a South African university? (Quantitative Research Question)
4. To what degree are there differences in attitudes towards COVID-19 and its impact on higher education as a function of level of study among students enrolled in a South African university? (Quantitative Research Question)
5. To what degree are there differences in attitudes towards COVID-19 and its impact on higher education as a function of locality of student among students enrolled in a South African university? (Quantitative Research Question)
6. To what degree are there differences in attitudes towards COVID-19 and its impact on higher education as a function of enrollment status among students enrolled in a South African university? (Quantitative Research Question)
7. To what extent do students enrolled in a South African university consider their current home situation suitable for online learning? (Qualitative Research Question)
8. What are the similarities and differences in attitudes towards COVID-19 and its impact on higher education among students enrolled in a South African university? (Mixed Methods Research Question)

The present study, in part, was a response to the call made by Toquero (2020) to educational institutions "to produce studies to proliferate and document the impact of the pandemic to the educational system" (p. 1). It was hoped that findings from this study would provide useful information for administrators of South African universities. Also, it was hoped that researchers involved in higher education would find the study to be useful in understanding the impact of COVID-19 on university students.

Method

Institutional Context

This study was conducted on students enrolled at The University of the Witwatersrand—more commonly known as *Wits University* or *Wits*—which represents a multi-campus public research university that is located in the northern area of central Johannesburg, South Africa. The university is a research-intensive, globally ranked public institution that attracts a significant number of postgraduate students as well as international students.

This university has its roots in the mining industry, being founded in Kimberley in 1896 as the South African School of Mines. Wits University is the third oldest South African university in continuous operation. The university is divided into five academic campuses. According to the University of the Witwatersrand (2019), as of 2018, the university contained 40,259 students, with approximately 20% residing on campus in the university's 17 residences. Nearly two thirds (i.e., 63%) of the student body was represented by undergraduate students, with the remaining students being either postgraduate students (i.e., 35%) or Occasional Students (i.e., 2%). With regard to gender composition, 54.63% of the students were women and 45.35% were men. The racial composition was as follows: 58.55% Black, 16.33% White, 11.70% Indian, 3.93% Coloured, 0.39% Chinese, 9.09% International, and 0.01% Undisclosed (University of the Witwatersrand, 2019). The 2019 Academic Ranking of World Universities (ARWU) places Wits University, alongside the University of Cape Town, as the joint highest ranked university in Africa (Academic Ranking of World Universities, 2019).

Participants

The participants were 4,419 students attending the University of the Witwatersrand, which, as noted previously, is a leading Higher Education Institution located in Johannesburg, South Africa. These participants, who were selected via convenience sampling, represented slightly more than 10% of the total student body (i.e., 10.98%). In fact, this sample size far exceeded the recommended minimum sample size of 380 for a population size of 40,000 individuals (Krejcie & Morgan, 1970).

With respect to gender composition, 61.6% (*n* = 2,724) were women, 37.1% (*n* = 1,641) were men, and 1.1% (*n* = 48) self-identified themselves as *non-binary* (i.e., a term used to describe gender identities other than strictly male or female, including agender, bigender, genderfluid, genderqueer, and third gender; also referred to as NB or enby). In terms of age, the 18-24 age group was the largest group (77.0%; *n* = 3,402), followed by the 25-35 age group (15.5%; *n* = 683), the 36-45 age group (4.6%; *n* = 202), 17 year olds (4.0%; *n* = 16), the 46-55 age group (2.1%; *n* = 91), and the 56-65 age group (3.0%; *n* = 15).

In terms of year of study, the vast majority were undergraduate students (74.9%; *n* = 3,312), with 1,078 reporting themselves as postgraduate students (24.4%). With regard to degree enrollment, the most common was a Bachelor's degree (72.5%; *n* = 3,202), followed by an Honours degree (14.0%; *n* = 620), a Master's degree (9.5%; *n* = 421), a Doctoral degree (2.1%; *n* = 93), and a Bachelor's Honours (1.6%; *n* = 72). The overwhelming majority of students were local (95.6%; *n* = 4,223), with 188 (4.3%) representing international students. In terms of forms of registration, the vast majority of students were enrolled full-time (87.8%; *n* = 3,878), with 523 (11.8%) students being enrolled part-time. Finally, with respect to the students' areas of studies, the Faculty of Humanities was the most represented (31.8%; *n* = 1,405), followed by the Faculty of Engineering and the Built Environment (19.6%; *n* = 867), the Faculty of Commerce, Law, and Management (19.6%; *n* = 864), the Faculty of Science (15.0%; *n* = 663), and the Faculty of Health Sciences (12.9%; *n* = 569). The remaining Faculties were represented by a total of 1.1% of the sample.

Because all 4,419 participants contributed to both the quantitative and qualitative phases of this research study, and the qualitative and quantitative data were collected concurrently, the mixed sampling design used was a Concurrent Design using Identical Samples (Collins, Onwuegbuzie, & Jiao, 2007; Onwuegbuzie & Collins, 2007).

Research Approach and Research Philosophy

This investigation involved use of both a *multi-mixed methods research study* and a *meta-methods study*. According to Onwuegbuzie and Hitchcock (2019), who coined these terms, a multi-mixed methods research study is a study that involves the partial integration of multiple methods research approaches and mixed methods research approaches. In contrast, a meta-methods research study is a research study that involves the full(er) integration of multiple methods research approaches and mixed methods research approaches. The multi-mixed methods research study phase included, at a macro level, the use of two computer-assisted data analysis software programs to conduct text mining of the same set of open-ended responses (see description of these two analyses in the analysis section); at a meso level, the use of both an orthogonal rotation and an oblique rotation in the principal components analysis; and, at a micro level, examination of both the factor pattern matrix and the factor structure matrix after the oblique rotation in order to determine the most meaningful factor solution. The meta-methods research study phase included conducting a quantitative analysis (i.e., chi-square analysis) of both quantitative data (i.e., demographic data) and qualitative data (i.e., open-ended responses) that had been transformed to qualitative data (i.e., *quantitizing*; Miles & Huberman, 1994; Onwuegbuzie & Teddlie, 2003; Sandelowski, Voils, & Knafl, 2009; Tashakkori & Teddlie, 1998)—a process that represents *qualitizing*, which involves transforming quantitative data into a qualitative form in order to explore the meaning of numerical data (Onwuegbuzie & Leech, 2019).

The research philosophical stance for our study was what Onwuegbuzie and Frels (2013) refer to as a critical dialectical pluralistic stance, which operates under the assumption that, at the macro level, social injustices are ingrained in every society. As part of this stance, ultimately, the goal of this research study was to provide information that would empower students enrolled in South African universities to negotiate successfully their learning processes during this COVID-19 era.

Mixed Methods Research Design

Using Leech and Onwuegbuzie's (2009) typology of mixed methods research designs, this study was classified as a fully mixed concurrent equal-status design for three reasons. First, the qualitative and quantitative approaches were mixed within multiple stages of the research process, namely, the data collection, data analysis, and data interpretation stages. Second, the initial quantitative and qualitative data were collected and analyzed simultaneously. Third, the quantitative and qualitative phases were given approximately equal weight.

Instruments and Procedure

The data for this study were collected via an online survey between 20 May 2020 and 8 June 2020 after the University's Human Research Ethics Committee (non-medical) granted the ethics clearance on 18 May 2020. The targeted population was all registered undergraduate and postgraduate students registered in the 2020 academic year (N = 38,472). The online survey was disseminated to all university students via an email administered through the Office of the University's Deputy Registrar.

The survey contained four parts: (a) Section I: biological information; (b) Section II: university students' perception of readiness and motivation for online teaching, learning, and assessment (i.e., Scale 1); (c) Section IIII: students' attitudes towards COVID-19 and its impact on higher education (i.e., Scale 2); and (d) Section IV: reflection on the current era of disruption. Sections II and III represented Likert-format scale items with the following response options: 1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree. Section IV contained the following three open-ended items: "To what extent do you consider your current home situation suitable for online learning?;" "What personal challenges do you have that could hinder your ability to successfully learn online?"; and "Please provide any general comment that you think might be useful to share." For the purpose of this editorial, and keeping in mind the amount of data generated by this instrument, (a) of the two scales, only responses to Scale 2 were analyzed; and (b) of the three open-ended items, responses to only the first item were analyzed.

Analysis

Quantitative analysis phase. To determine the hierarchical structure of the Attitude of Students Towards COVID-19 and its Impact on Higher Education (ASTCIHE) scale (i.e., Research Question 1), the decision was made to conduct a principal components analysis, as recommended by Field (2018). Principal components analysis is a variable-reduction technique that is used when variables are expected to be significantly correlated. This technique reduces the number of observed variables to a smaller number of principal components that account for most of the variance of the observed variables. Principal components analysis (PCA) involves the use of the total variance of each variable to assess the shared variation among the variables. Simply put, PCA uses "1s" on the diagonal of the correlation matrix, which is then *factor analyzed*—in contrast to exploratory factor analysis, wherein the estimates of common variance or reliability are used on the main diagonal (Onwuegbuzie & Daniel, 2003; Thompson & Daniel, 1996).

Research Questions 2-6 were answered via the use of a series of Kruskal-Wallis tests. These tests were used because each analysis involved one independent variable that represented a nominal (i.e., categorical) variable and one interval-level dependent variable (i.e., attitudes towards COVID-19 and its impact on higher education) whose scores deviated from normality to some degree. The Bonferroni adjustment was used to ensure that the total experimentwise error rate did not exceed 5% (e.g., Chandler, 1995; Ho, 2006; Manly, 2004; Vogt, 2005). All statistically significant Kruskal-Wallis tests were followed up by Mann-Whitney U tests to examine pairwise differences, again using the Bonferroni adjustment.

Qualitative analysis and mixed analysis phase.

Quantitizing phase. To address Research Question 7, consistent with multiple research approaches, two computer-assisted data analysis software programs were used to facilitate the analysis, specifically, the VOSviewer 1.6.14 software program (released 27th January 2020) and the WordStat 8.0.29 software program (released 29th May 2020). VOSviewer is a software tool that has a text mining option, which can be used to construct and to display co-occurrence networks (i.e., network maps) of important words extracted from a corpus of words (Van Eck & Waltman, 2014, 2017). These co-occurrence networks led to the identification of metathemes and themes that facilitated a sentiment analysis, which refers to conducting a text analysis to identify, to extract, to quantify, and to interpret affective/emotional states—in this case, to classify the polarity of statements into negative and positive statements.

WordStat, developed by Normand Peladeau (Provalis Research), is a content analysis and text mining software program. For the purposes of the present study, WordStat 8.0.29 (Provalis Research, 2020) was used to conduct topic modeling via a factor analysis to extract the main themes from the responses to the open-ended question. As such, the use of topic modeling represents a mixed methods analysis approach, specifically a crossover analysis approach (Hitchcock & Onwuegbuzie, 2020; Onwuegbuzie & Combs, 2010; Onwuegbuzie, Leech, & Collins, 2011). Specifically, the factor analysis component of the Topic Extraction feature of WordStat was used. This extraction is undertaken by computing a word x word correlation matrix and then conducting a factor analysis in order to extract an appropriate number of factors. All words with a factor loading higher than a specific criterion then are retrieved as part of each extracted topic. In contrast to hierarchical cluster analysis, wherein each word appears only in one cluster, in topic modeling, the factor analysis might result in a word being associated with more than one factor, which, is "a characteristic that more realistically represents the polysemous nature of some words as well as the multiplicity of context of word usages" (Provalis Research, 2014, p. 45). In the current study, in order to maximize the stability of the factoring solution, all low frequency items were excluded. Specifically, as recommended by the software developer, any word occurring less than 10 times were removed from the data set prior to the topic extraction (Provalis Research, 2014).

Qualitizing phase. To address Research Question 8, narrative profiles were produced—wherein narrative descriptions were constructed from quantitative data (Onwuegbuzie & Leech, 2019). Specifically, a cluster analysis was conducted on the factor solution arising from the principal components analysis of the ASTCIHE scale. Specifically, a twostep cluster analysis was conducted. For many applications, the twostep cluster analysis facilitates identification of the best number of clusters by providing analysts with measures for choosing among cluster models. These cluster models simultaneously can be based on categorical and continuous variables.

Results

Attitudes of Students Towards COVID-19 and its Impact on Higher Education

Quantitative phase.

Research question 1: What is the structural validity of a measure of students' attitudes towards COVID-19 and its impact on higher education among students enrolled in a South African university? As noted previously, a principal components analysis was conducted in an attempt to assess the dimensionality of the ASTCIHE Scale. The Kaiser-Meyer-Olkin (KMO) measure suggested good sampling adequacy, KMO = .74 (Field, 2018; Hutcheson & Sofroniou, 1999). Further, the anti-image correlation matrix revealed that all KMO values for the items were greater than the acceptable limit of .5 (Field, 2018). Bartlett's test of sphericity indicated that the correlations between the items were sufficiently large for the principal components analysis, $X^2(10) = 12452.15$, $p < .0001$.

An initial principal components analysis was conducted to compute eigenvalues (i.e., indicates overall strength of relationship between a factor and the items) for each component in the data. The eigenvalue-greater-than-one rule (i.e., K1; Kaiser, 1958) and the scree test (representing a plot of eigenvalues against the factors in descending order; Cattell, 1966; Zwick & Velicer, 1986) (not presented) were used to determine an appropriate number of factors to retain (cf. Kieffer, 1999). Both methods suggested that two factors be retained. In addition, a parallel analysis was conducted as a validity check to the K1 and scree test—thereby providing another example of multiple methods. Parallel analysis is superior to K1 and scree test and typically yields optimal solutions (Zwick & Velicer, 1982, 1986). Indeed, Thompson (2004) stated that "parallel analysis appears to be among the best methods for deciding how many factors to extract or retain" (p. 34). Parallel analysis involves extracting eigenvalues from random data sets that *parallel* the actual data set with respect to the sample size and number of variables. For the current data of 4,419 participants and eight items, a series of (i.e., n = 1,000) random data matrices of size 4,419 x 8 was generated, and eigenvalues were computed for the correlation matrices for the original data and for each of the 1,000 random data sets. The eigenvalues derived from the actual data then were compared to the eigenvalues derived from the random data, in order to identify the number of components that account for more variance than do the components derived from random data. More specifically, as recommended by many factor analysts (Cota, Longman, Holden, Fekken, & Xinaris, 1993; Glorfeld, 1995), the eigenvalues that corresponded to the 95th percentile of the distribution of random data eigenvalues were generated. Factors or components were retained providing that the ith eigenvalue from the actual observed data was greater than was the ith eigenvalue from the random data. Using the syntax written for SPSS by O'Connor (2000), the parallel analysis also suggested retaining two factors.

As recommended by Onwuegbuzie and Hitchcock (2019), consistent with multiple methods approaches, because principal components analysis does not involve *p* values, both an orthogonal rotation and an oblique rotation were conducted, and then both sets of solutions were compared and contrasted. The pattern/structure matrix stemming from the varimax (i.e., orthogonal) rotation is presented in Table 1. With respect to the oblique rotation, a direct oblimin rotation with a delta value of zero was used—known as a direct quartimin rotation (Costello & Osborne, 2005; Field, 2018). The pattern matrix and structure matrix stemming from the direct quartimin rotation are presented in Table 2 and Table 3, respectively. It can be seen from these two tables that the two sets of coefficients almost were identical to the varimax rotation table. Thus, the interpretation of the two-component solution was extremely straightforward: Using a cutoff correlation of 0.3 recommended by Hair, Anderson, Tatham, and Black (1995), Lambert and Durand (1975), and Tinsley and Tinsley (1987), as an acceptable minimum value for pattern/structure coefficients, the pattern/structure matrix (Table 1), the pattern matrix (Table 2), and the structure matrix (Table 3) each revealed that Factor 1 contains five items and Factor 2 contains three items. Further, the first component, which explained 33.02% of the variance, was labeled as *Students' Self-regulation Towards COVID-19-Based Higher Education*; the second component, which explained 29.33% of the variance, was labeled as *Attitudes Toward Teaching, Learning, and Assessment in COVID-19-Based Higher Education*. These two factors combined to explain 62.06% of the total variance. Interestingly, this proportion of total variance explained was greater than that typically explained in factor solutions (i.e., *M* = 44.92%, *SD* = 16.55%, Range = 12.80% to 70.20%; Henson, Capraro, & Capraro, 2004; Henson & Roberts, 2006). Moreover, this total proportion of variance could be considered as representing a large effect size. With respect to score reliability, Cronbach's alpha pertaining to scores yielded by the Students' Self-regulation Towards COVID-19-Based Higher Education (SSTCHE) subscale was .77 (95% confidence interval [CI] = .75, .78) and for scores yielded by the Attitudes Toward Teaching, Learning, and Assessment in COVID-19-Based Higher Education (ATTLACBHE) subscale was .84 (95% CI = .83, .85).

Table 1. Pattern/structure coefficients from principal component analysis (varimax): Two-factor solution.

Variable	1	2	Communality Coefficient
The university's decision to use information and communications technology (ICT) to deliver programmes online at a distance to enrolled students is an inevitable decision and necessary for us to complete the semester.	**.84**	-.06	.29
I am taking on the challenge to continue to learn in the current state of disruption even if classes are now taking place online.	**.80**	.02	.55
The decision by the university to lockdown was timely and an important measure to contain the spread of the COVID-19 virus on campus.	**.73**	.10	.71
I trust that the university shall do all to support me to successfully get through this phase of disruption caused by COVID-19.	**.69**	-.11	.64
The disruption caused by the COVID-19 provides an opportunity to rethink higher education in South Africa and globally.	**.52**	.14	.49
Learning within an online environment is significantly different from learning in a contact classroom situation.	.01	**.92**	.80
Teaching within an online environment is significantly different from teaching in a contact classroom situation.	.03	**.90**	.84
Assessment within an online environment is significantly different from assessment in a contact classroom situation.	.03	**.80**	.63
Trace	2.67	2.30	4.97
% variance explained	33.02	29.03	62.06

Note: Coefficients in bold represent pattern coefficients with the largest effect size within each theme using a cut-off value of 0.3 recommended by Hair et al. (1995), Lambert and Durand (1975), and Tinsley and Tinsley (1987).

Table 2. Pattern coefficients from principal component analysis (oblimin): Two-factor solution.

Variable	1	2	Communality Coefficient
The university's decision to use information and communications technology (ICT) to deliver programmes online at a distance to enrolled students is an inevitable decision and necessary for us to complete the semester.	**.85**	-.09	.29
I am taking on the challenge to continue to learn in the current state of disruption even if classes are now taking place online.	**.80**	-.01	.55
The decision by the university to lockdown was timely and an important measure to contain the spread of the COVID-19 virus on campus.	**.73**	.08	.71
I trust that the university shall do all to support me to successfully get through this phase of disruption caused by COVID-19.	**.70**	-.13	.64
The disruption caused by the COVID-19 provides an opportunity to rethink higher education in South Africa and globally.	**.52**	.12	.49
Learning within an online environment is significantly different from learning in a contact classroom situation.	-.02	**.92**	.80
Teaching within an online environment is significantly different from teaching in a contact classroom situation.	.01	**.90**	.84
Assessment within an online environment is significantly different from assessment in a contact classroom situation.	.01	**.80**	.63
% variance explained	33.34	28.72	62.06

Note: Coefficients in bold represent pattern coefficients with the largest effect size within each theme using a cut-off value of 0.3 recommended by Hair et al. (1995), Lambert and Durand (1975), and Tinsley and Tinsley (1987).

Table 3. Structure coefficients from principal component analysis (oblimin): Two-factor solution.

Variable	1	2	Communality Coefficient
The university's decision to use information and communications technology (ICT) to deliver programmes online at a distance to enrolled students is an inevitable decision and necessary for us to complete the semester.	**.84**	-.04	.29
I am taking on the challenge to continue to learn in the current state of disruption even if classes are now taking place online.	**.80**	.04	.55
The decision by the university to lockdown was timely and an important measure to contain the spread of the COVID-19 virus on campus.	**.73**	.12	.71
I trust that the university shall do all to support me to successfully get through this phase of disruption caused by COVID-19.	**.69**	-.09	.64
The disruption caused by the COVID-19 provides an opportunity to rethink higher education in South Africa and globally.	**.52**	.15	.49
Learning within an online environment is significantly different from learning in a contact classroom situation.	.04	**.92**	.80
Teaching within an online environment is significantly different from teaching in a contact classroom situation.	.06	**.90**	.84
Assessment within an online environment is significantly different from assessment in a contact classroom situation.	.06	**.80**	.63
% variance explained	33.34	28.72	62.06

Note: Coefficients in bold represent pattern coefficients with the largest effect size within each theme using a cut-off value of 0.3 recommended by Hair et al. (1995), Lambert and Durand (1975), and Tinsley and Tinsley (1987).

Scores on the 5-item SSTCHE subscale range from 5 to 25, with high scores *representing positive attitudes toward the academic impact of COVID-19*. Further, scores on the 3-item ATTLACBHE subscale range from 3 to 15, with high scores representing *a belief that the COVID-19 learning context is significantly different from the Pre-COVID-19 learning context*. Finally, the 8-item ASTCIHE Scale (i.e., full scale) yields scores that range from 8 to 40, with high scores representing *an awareness and positive attitudes toward the COVID-19 learning context*. Table 4 presents the descriptive statistics associated with both the SSTCHE and ATTLACBHE subscales, as well as the ASTCIHE (i.e., full) Scale. According to Onwuegbuzie and Daniel (2002), variables for which either the standardized skewness coefficient (i.e., skewness coefficient divided by its standard error) or the standardized kurtosis coefficient (i.e., kurtosis coefficient divided by its standard error), or both, are outside the ±3 range suggest departure from normality. Using Onwuegbuzie and Daniel's (2002) criteria, the standardized skewness coefficients and standardized kurtosis coefficients pertaining to the two subscales and full scale (Table 4) provided evidence of serious departures from normality because these coefficients ranged from 12.13 (i.e., standardized kurtosis coefficient for the SSTCHE subscale) to 65.01 (i.e., standardized kurtosis coefficient for the ASTCIHE scale). More specifically, all three measures were characterized by negative skew and a leptokurtic distribution, with a shape that was more peaked. Table 5 presents the percentile rank norms for the total sample for the full ASTCIHE scale, the SSTCHE subscale, and the ATTLACBHE subscale.

Table 4. Mean and standard deviation for the acceptance, trust, and motivation towards COVID-19-based higher education subscale and the attitudes toward teaching, learning, and assessment in COVID-19-based higher education subscale.

Measure	*n*	*M*	*SD*	Skewness (*SD* of Skewness)	Kurtosis (*SD* of Kurtosis)
Acceptance, Trust, and Motivation Towards COVID-19-Based Higher Education	4,417	19.49	3.86	-0.86 (0.04)	0.90 (0.07)
Teaching, Learning, and Assessment in COVID-19-Based Higher Education	4,417	13.00	2.59	-1.68 (0.04)	2.97 (0.07)
Attitude of Students Towards COVID-19 and its Impact on Higher Education	4,417	32.48	4.74	-1.58 (0.04)	4.81 (0.07)

Table 5. Percentile rank norms for the total sample (n = 4,417) for the full scale and two subscales.

Raw Score	Total Scale	SSTCHE subscale	ATTLACBHE subscale
40	99		
39	97		
38	94		
37	89		
36	83		
35	73		
34	64		
33	54		
32	44		
31	34		
30	26		
29	19		
28	14		
27	10		
26	8		
25	6	99	
24	5	92	
23	4	85	
22	3	76	
21	2	66	
20	2	56	
19	2	44	
18	1	34	
17	1	26	
16	1	19	
15	1	14	99
14	1	9	56
13	1	7	45
12	1	5	34
11	1	3	19
10	1	2	13
9	1	2	10
8	1	1	5
7		1	4
6		1	3
5		1	2
4			1
3			1

Research question 2: To what degree are there gender differences in attitudes towards COVID-19 and its impact on higher education? Because of the large deviations from normality of the outcome measures, a non-parametric analysis of variance (ANOVA)—specifically the Kruskal-Wallis test—was used to compare sample members who self-identified as female, male, or non-binary. This analysis revealed no statistically significant difference among these groups in terms of the ASTCIHE (i.e., full) Scale, $X^2(2) = 1.07$, $p = .59$. Similarly, no statistically significant difference emerged among these groups for the SSTCHE subscale, $X^2(2) = 2.25$, $p = .34$. However, in contrast, a statistically significant difference emerged among these groups for the ATTLACBHE subscale, $X^2(2) = 6.84$, $p = .03$. The effect size associated with this latter difference, as measured by Cramer's V, was 0.03. Using Cohen's (1988) criteria, this coefficient indicates a small effect size. A series of nonparametric pairwise follow-up Mann-Whitney U tests, using the Bonferroni adjustment (i.e., adjusted $\alpha = .05/3 = .017$), indicated that the men students (M = 13.13, SD = 2.49) were statistically significantly (U = 2139500.00, $p < .017$) more likely to believe that the COVID-19 learning context is significantly different from the Pre-COVID-19 learning context than were the women students (M = 12.91, SD = 2.65). A non-parametric effect-size index for the Mann-Whitney U test is the rank-biserial correlation, which ranges from -1 to 1 (with a value of 0 indicating no relationship), and which is given by the following formula:

$$r = 1 - \frac{2U}{n_1 n_2}$$

where U is the Mann-Whitney U value, and n_1 and n_2 represent the samples sizes of each group (i.e., n_{female} = 2,724 and n_{male} = 1,639). The rank-biserial correlation was .04, which using Cohen's (1988) criteria, represents a small effect size. An alternative nonparametric effect size is denoted by

$$r = \frac{Z}{\sqrt{n}}$$

where *r* is the correlation, *z* (i.e., -2.416) is the standardized value, and *n* (i.e., 4,363) is the sample size. This formula yields an effect size value of .04, which also represents a small effect size. The two remaining pairwise comparisons, involving comparing the non-binary students to the men students and women students, were not statistically significantly different.

Research question 3: To what degree are there age differences in attitudes towards COVID-19 and its impact on higher education? In order to answer this research question, the four group sizes that were represented with sufficient statistical power were compared, as follows: 18-24 (*n* = 3,402), 25-35 (*n* = 683), 36-45 (*n* = 202), and 46-55 (*n* = 91). The two other age groups, namely, 16-18 (*n* = 17) and 56-65+ (*n* = 15) were not included. Using these four age categories, again, the Kruskal-Wallis test was employed. This test revealed a statistically significant difference among these groups for the ASTCIHE scale, $X^2(3) = 30.11$, $p < .001$, Cramer's $V = .05$; the SSTCHE subscale, $X^2(3) = 137.56$, $p < .001$, Cramer's $V = .10$; and the ATTLACBHE subscale, $X^2(3) = 55.75$, $p < .001$, Cramer's $V = .07$. A series of follow-up Mann-Whitney *U* tests, using the Bonferroni adjustment (i.e., adjusted $\alpha = .05/6 = .008$), indicated that 11 out of the 18 (i.e., 6 pairwise comparisons x 3 measures) pairwise comparisons were statistically significant (see Table 6).

Table 6. Follow-up Mann-Whitney *U* values (and non-parametric effect sizes) comparing four age groups for the three measures.

	ASTCIHE Scale			SSTCHE Subscale			ATTLACBHE Subscale		
	25-35	36-45	46-55	25-35	36-45	46-55	25-35	36-45	46-55
18-24	1113272.00* (0.04)	289478.50* (0.15)	114940.00* ($0.25^{S\text{-}M}$)	1035490.50* (0.11)	222182.50* (0.35^{M})	80133.00 (0.47^{L})	1067526.50* (0.08)	261170.00* ($0.23^{S\text{-}M}$)	118294.00 (0.23)
25-35		60945.50* (0.11)	24360.00* (0.11)		51273.50* (0.25)	18765.50* (0.39^{M})		57899.50 (0.16)	26360.50 (0.14)
36-45			8209.50 (0.09)			7827.50 (0.13)			8840.00 (0.02)

Note: *$p < .001$. $^{S\text{-}M}$Small-to-medium effect size. ^{M}Small-to-medium effect size. ^{L}Small-to-medium effect size.

Even more compelling was the fact that, for all three measures, a statistically significant tend emerged. Specifically, although caution should be exercised in interpreting these findings because of the non-normality of the data, a parametric ANOVA revealed that a statistically significant linear tend emerged for attitudes towards COVID-19 and its impact on higher education (F[1, 4,372] = 21.19, p < .0001, partial η^2 = .01), wherein these attitudes increased monotonically as a function of age group, with the oldest students reporting the most positive attitudes (see Figure 1). Similarly, a statistically significant linear trend emerged for self-regulation towards COVID-19-based higher education (F[1, 4,372] = 99.10, p < .0001, partial η^2 = .02), wherein these attitudes increased monotonically as a function of age group, with the oldest students reporting the most positive attitudes (see Figure 2). In stark contrast, a statistically significant cubic trend emerged for attitudes toward teaching, learning, and assessment in COVID-19-based higher education (F[3, 4,372] = 14.48, p < .0001, partial η^2 = .01), wherein these attitudes decreased from the 18-24 group to the 25-35 group, then decreasing more sharply from the 25-35 group to the 36-45 group, before increasing from the 36-45 group to the 46-55 group (see Figure 3). In this case, the 18-24 group was the most likely to believe that the COVID-19 learning context is significantly different from the Pre-COVID-19 learning context.

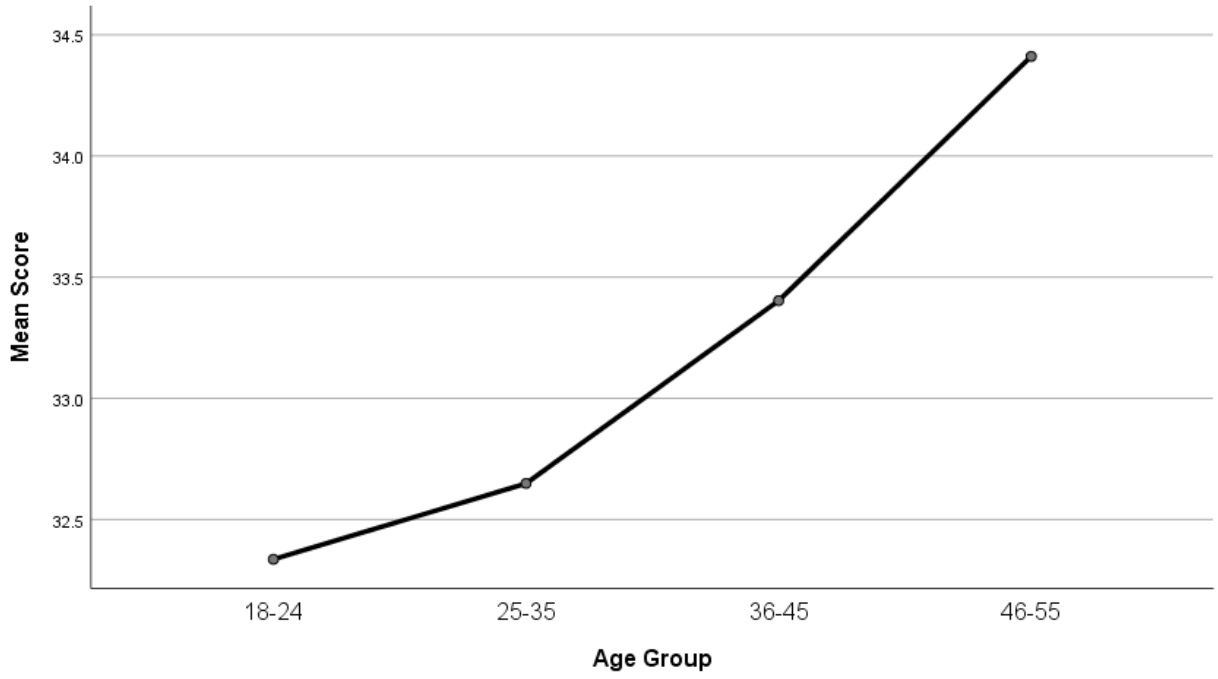

Figure 1. Attitude of students towards COVID-19 and its impact on higher education as a function of age group.

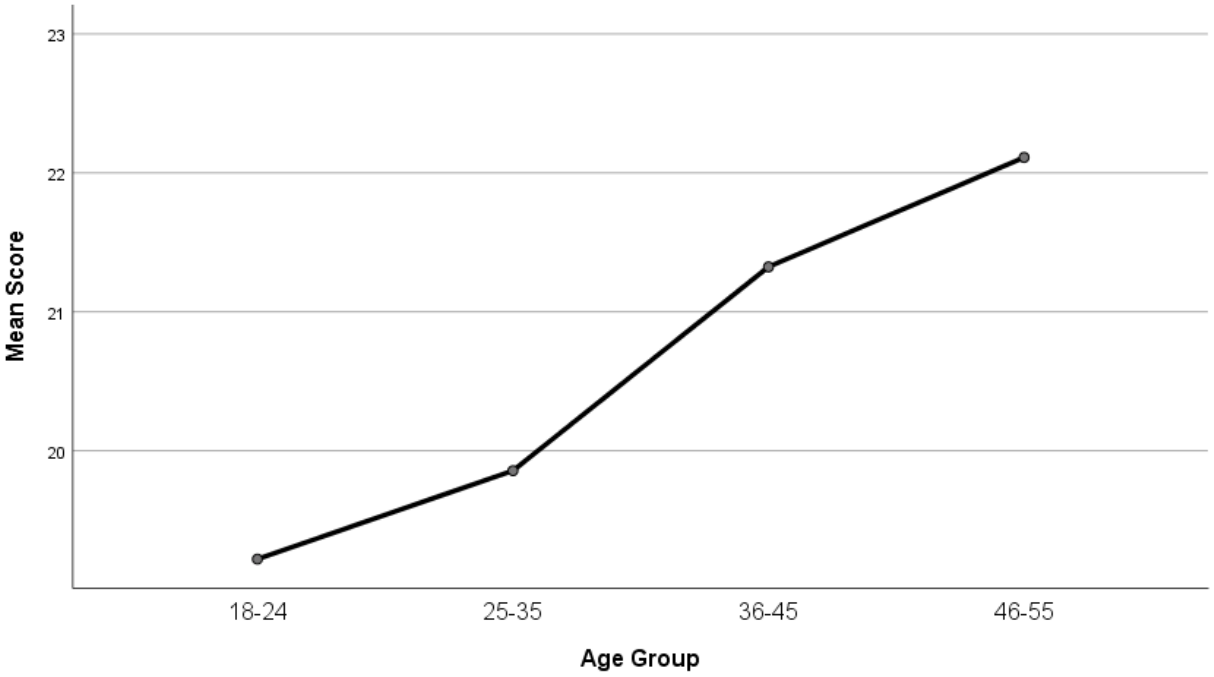

Figure 2. Students' self-regulation towards COVID-19-based higher education as a function of age group.

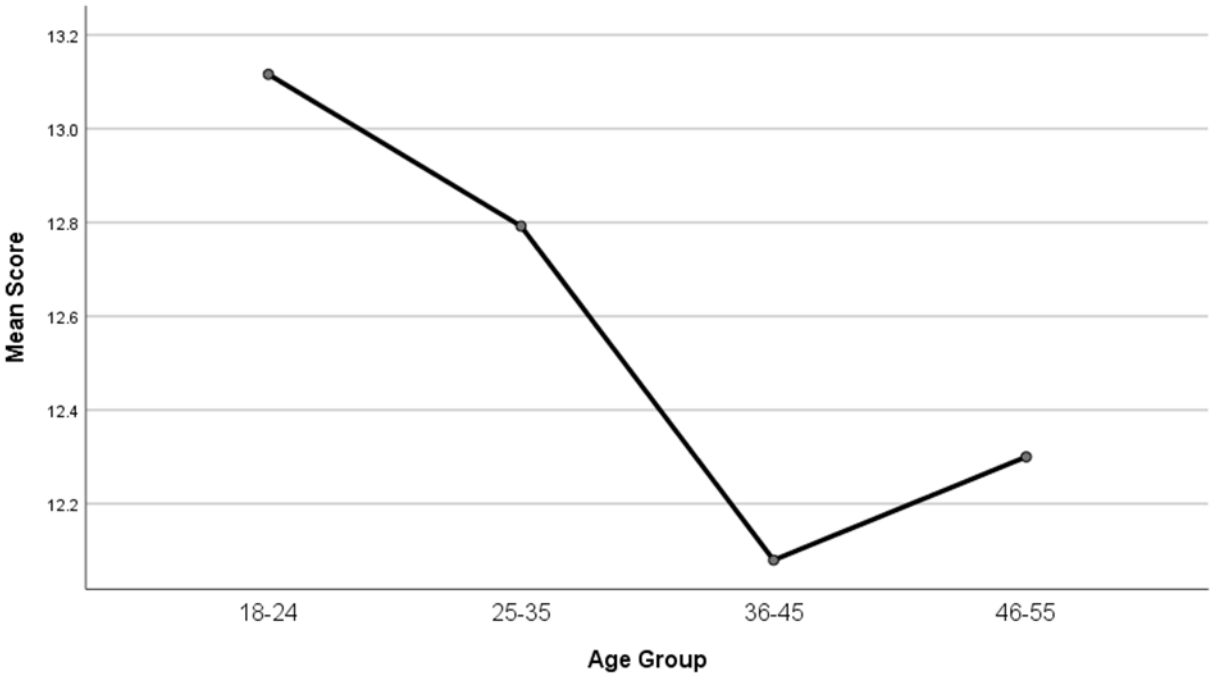

Figure 3. Attitudes toward teaching, learning, and assessment in COVID-19-based higher education as a function of age group.

Research Question 4: To what degree are there differences in attitudes towards COVID-19 and its impact on higher education as a function of level of study? A series of Mann-Whitney's *U* tests, controlling for the inflation

of Type I error (i.e., adjusted α = .05/3 = .017), revealed that all three measures discriminated the postgraduate students from undergraduate students. Specifically, the postgraduate students (M = 32.86, SD = 4.69) reported statistically significantly (U = 1659537.50, p = .001, r = 0.07) more positive attitudes towards COVID-19 and its impact on higher education than did the undergraduate students (M = 32.35, SD = 4.75). Similarly, the postgraduate students (M = 20.21, SD = 3.77) reported statistically significantly (U = 1502383.50, p < .0001, r = 0.16) more positive self-regulation towards COVID-19-based higher education than did the undergraduate students (M = 19.24, SD = 3.86). Contrastingly, the undergraduate students (M = 13.11, SD = 2.55) reported statistically significantly (U = 1585353.50, p < .0001, r = 0.11) more positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education than did the postgraduate students (M = 12.65, SD = 2.70).

Research Question 5: To what degree are there differences in attitudes towards COVID-19 and its impact on higher education as a function of locality of student? A series of Mann-Whitney's U tests, again controlling for the inflation of Type I error (i.e., adjusted α = .05/3 = .017), revealed that all three measures discriminated the postgraduate students from the undergraduate students. However, on this occasion, only self-regulation towards COVID-19-based higher education statistically significantly discriminated the two groups, with the international students (M = 20.36, SD = 3.86) reporting statistically significantly (U = 332970.00, p < .0001, r = 0.15) more positive self-regulation towards COVID-19-based higher education than did the local students (M = 19.45, SD = 3.86). The other two measures did not yield statistically significant findings, with no statistically significantly difference (U = 373796.00, p = .24, r = 0.05) in attitudes toward teaching, learning, and assessment in COVID-19-based higher education between the international students (M = 12.72, SD = 2.65) and the local students (M = 13.01, SD = 2.58); and no statistically significantly difference (U = 355378.00, p = .03, r = 0.10) in attitudes towards COVID-19 and its impact on higher education between the international students (M = 33.08, SD = 4.76) and the local students (M = 32.46, SD = 4.73).

Research Question 6: To what degree are there differences in attitudes towards COVID-19 and its impact on higher education as a function of enrollment status? A series of Mann-Whitney's U tests, again controlling for the inflation of Type I error (i.e., adjusted α = .05/3 = .017), revealed that all three measures discriminated full-time students from part-time students. Specifically, the part-time students (M = 33.53, SD = 4.31) reported statistically significantly (U = 865868.00, p < .0001, r = 0.14) more positive attitudes towards COVID-19 and its impact on higher education than did the full-time students (M = 32.34, SD = 4.78). Similarly, the part-time students (M = 20.98, SD = 3.39) reported statistically significantly (U = 743281.50, p < .0001, r = 0.27) more positive self-regulation towards COVID-19-based higher education than did the full-time students (M = 19.28, SD = 3.88). Contrastingly, the full-time students (M = 13.05, SD = 2.59) reported statistically significantly (U = 877118.00, p < .0001, r = 0.13) more positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education than did the part-time students (M = 12.56, SD = 2.61).

Qualitative and mixed analysis phase: Research Question 7: To what extent do students enrolled in a South African university consider their current home situation suitable for online learning?

Co-word analysis of responses. Figure 4 displays the key responses provided by the participants to address Research Question 7. The most frequently co-occurring keywords, respectively, were as follows: home, online learning, time, work, distraction, home situation, online, environment, day, access, family, current home situation, study, noise, space, and disruption. Represented in Figure 4 are six co-word clusters. Each of these clusters is discussed, with the metatheme(s) derived from these cluster elements presented in bolded italics, and the extracted theme(s) presented in italics.

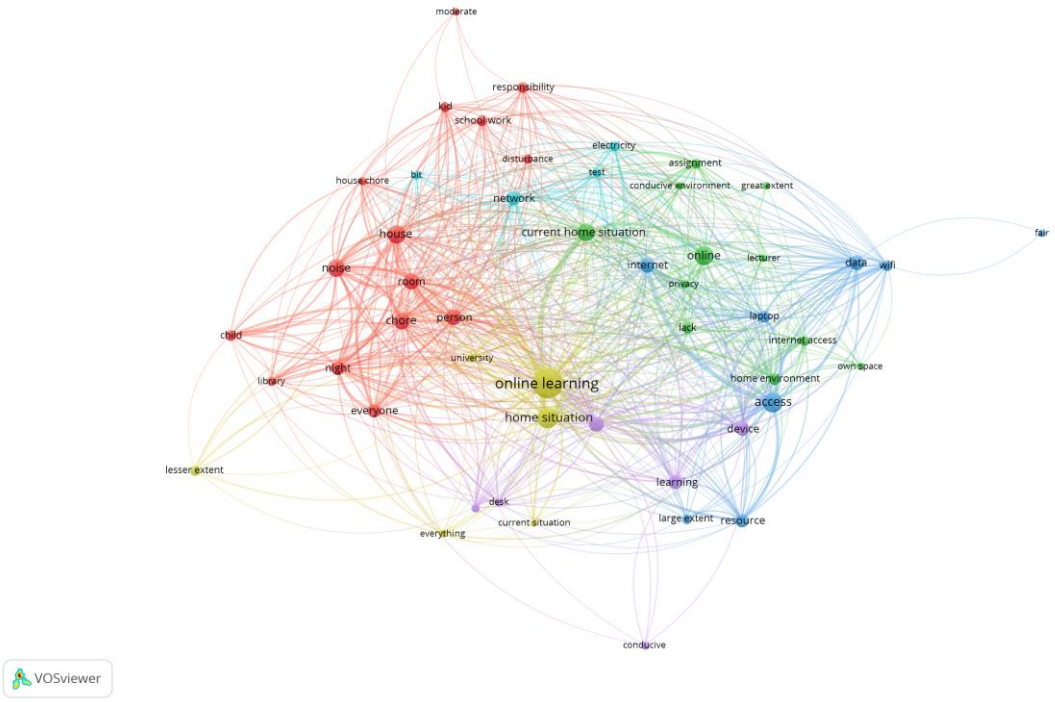

Figure 4. Keyword co-occurrence map of responses to the following question: To what extent do students enrolled in a South African university consider their current home situation suitable for online learning? Note: Keyword threshold was set at a minimum of 20 with 50 keywords selected for display.

Cluster 1. Cluster 1 (Red color) characterizes ***Non-Academic Home Characteristics*** (i.e., metatheme) that represents a focus that centers on *disturbance* (i.e., theme), including chores, responsibility, children, persons, everyone, noise, room, school work, and night. Examples of statements related to this theme of disturbance are presented in Table 7.[1] This table indicates that the majority (i.e., 81.3%) of statements related to this theme of disturbance was of a negative nature (i.e., negative sentiment). Quantitizing these negative statements further revealed that the majority of them were made by women (61.5%), students in the 18-24 age group (73.1%), undergraduate students (69.2%), full-time students (96.2%), students undertaking a Bachelor's degree (65.4%), and local students (96.2%). Interestingly, the most common fields of study were the Humanities (34.6%) and the Engineering and the Built Environment (34.6%). Interestingly, a sentiment analysis conducted via a series of Fisher's Exact Tests revealed no statistically significant relationship between Metatheme1 and any of the demographic variables.

Table 7. Negative and positive statements pertaining to the non-academic home characteristics meta-theme in general and disturbances theme in particular.

Negative Statement	Positive Statement
"It is not suitable at all, there are too many disturbances and the environment is not conducive for learning." (Man in the 36-45 age group, who was a full-time, local postgraduate (i.e., Honours) student, representing the Humanities field)	*"It is fine for online learning but there are some disturbance there and there."* (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Science field)
"… because there are disturbances that could not have been there if I was at school." (Woman in the 18-24 age group, who was a full-time, local postgraduate (i.e., Honours) student, representing the Humanities field)	*"It is suitable, I can study without much disturbance. The problem is Internet connection only."* (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)
"Home seems to have a lot disturbances and it make communicating and asking questions to the lecturer more difficult." (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)	*"I have my own private space where I can study without disturbance"* (Woman in the 25-35 age group, who was a part-time, local undergraduate student, representing the Commerce, Law and Management field)

(*Continued*)

Table 7. Continued.

Negative Statement	Positive Statement
"Not suitable, there is a lot of disturbance and Internet connection is very poor in my area, the environment is just not student friendly." (Woman in the 18-24 age group, who was a full-time, local postgraduate (i.e., Honours) student, representing the Engineering and the Built Environment field)	*"It is extremely suitable because, I don't have kids currently. I have a few other responsibilities besides working from home, it is therefore easy to manage my time between the two. I do not have disturbance in the house during the day."* (Woman in the 25-35 age group, who was a part-time, local postgraduate (i.e., Honours) student, representing the Commerce, Law and Management field)
"I do not consider it suitable due to disturbances and family life stressors which I am usually away from when I attend contact classes." (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)	*"I'm constantly alone in my room with no disturbances that allows me to at least try to focus on my studies."* (Non-binary student in the 25-35 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)
"A little extent since there are many disturbances because of which I have to work at night only." (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Health Sciences field)	
"Not suitable because of a lot of interruption on my phone, I wish I had a laptop. It is hard to concentrate as people call and send messages. Disturbance is so huge." (Man in the 36-45 age group, who was a part-time, local undergraduate student, representing the Commerce, Law, and Management field)	
"My home is not suitable for online learning because we are too occupied thus making hard to study in a room alone as there's noise and disturbance." (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)	
"It's not completely suitable as there are many disruptions and disturbance at home." (Woman in the 18-24 age group, who was a full-time, local postgraduate (i.e., Honours) student, representing the Humanities field)	
"It is not very suitable, due to poor Internet connection and it is a very concentrated environment so I can't study without any disturbances." (Man in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)	
"It is inconvenient as there are a lot of disturbances at home. Kids and parents always do not respect our right to learn." (Man in the 25-35 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)	
"My current home situation is not suitable for online learning. There is so much disturbance at home. I am a mother of four and a wife so studying at home I very difficult. At school I used to enjoy being in the classroom and exchanging ideas with young innovative students but now I am on my own and have to struggle with new content" (Woman in the 25-35 age group, who was a full-time, local undergraduate student, representing the Humanities field)	
"It's not easy studying at home as there are a lot of disturbances." (Woman in the 18-24 age group, who was a full-time, local postgraduate (i.e., Master's) student, representing the Humanities field)	
"Not ideal. Inevitable disturbances, environment not condusive as would've been at school." (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)	
"Home is not suitable for learning at all, there are so many disturbances and its too dynamic to maintain consistency" (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)	

Although statements related to the disturbances theme tended to be either exclusively negative or, in some cases, exclusively positive, there were two examples wherein the statements were both negative and positive, as follows:

> Good in that I am able to study at my own pace and yet not good in that there are many disturbances as I have to balance studying staying at home environment which I haven't done in a long time. (Man in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)

> I struggle to keep focus because there are so many disturbances (e.g., my little niece). However, the fact that I'm still residing here means I have access to WIFI so at least that's favourable for learning. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Health Sciences field)

A statement that really captures the Non-Academic Home Characteristics metatheme was made by a woman in the 18-24 age group, who was a full-time, local undergraduate student studying a Bachelor's degree representing the Science field:

> It has been difficult to getting used to a new timetable that involves doing *house chores*, helping younger *siblings* with their school work and also fitting in my studies in the day. But I have tried to create a study area in my *room* where I can do my work without much *disturbance* from my younger *siblings*. [emphasis added]

Table 7 presents a selection of negative and positive statements pertaining to the non-academic home characteristics meta-theme in general and disturbances theme in particular.

Cluster 2. Cluster 2 (green color) characterizes ***Current Home Situation*** (i.e., meta-theme) that represents a focus that centers on *environment* (i.e., theme), which is not surprising because the survey question included this phrase. This metatheme included home environment, conducive environment, own space, privacy, Internet access, online, lecturer, and assignment. The slight majority (52.6%) of statements pertaining to this metatheme was negative, with 44% of the statements being positive, and the remaining 3.4% simultaneously being negative and positive.

Several students discussed the problems with online learning that stemmed from their parents, such as the following:

> My current home situation does not allow for full concentration on academics. I can't sit through an online lecture without being disrupted by parents to do something for them in the house. By the time, I am done with chores, I am very tired and end up losing out on the time to keep up to date with my work. I really need to be back at res to be able to cope with online learning, because the people at home refuse to acknowledge that I have plenty of work to do for my studies. Instead they expect me to drop everything I'm doing whenever they want something to be done. At home, my academics come second, and I am worried this could affect my performance. I'm often labelled as selfish and lazy when I speak out against being disturbed while studying by those who live me. (Man in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)

> My current home situation is not suitable for online learning, due to disruption caused by family members when I need to study and submit assignments. Parents do not understand online learning, every time we are sent to do chores, failure to comply by their rules leads to you being punished, where punishment is more chores and less time to do work. (Woman in the 18-24 age group, who was a full-time, local postgraduate (i.e., Master's) student, representing the Science field)

> It's very bad cause in my area that's a lot of noise and my parents don't really understand the importance of this online thing as I need to find balance between chores and online classes and it's stressful cause even when I want to study I get distracted as am in a noisy environment hence my current home situation is not suitable for online learning. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)

Some students expressed concerns that arose from a lack of physical space, such as the following:

> My current home situation really makes it difficult for online learning as I do not even have a table nor a chair to do my work and there's no isolated place where I can do online work without disruption of family members. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Health Sciences field)

> My current home situation is not suitable for online learning considering the fact that I live in an informal settlement and I have no personal space where I can study and think properly. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Science field)

After quantitizing every statement pertaining to the Current Home Situation meta-theme, an analysis of frequency counts revealed that the majority of students who provided statements that were categorized under this theme were women (73.0%), students in the 18-24 age group (81.3%), undergraduate students (80.4%), full-time students (92.0%), students undertaking a Bachelor's degree (80.4%), and local students (98.2%). Further, a

sentiment analysis conducted via a series of Fisher's Exact Tests revealed no statistically significant difference in the proportion of negative statements between the women (i.e., 51.9%) and men (i.e., 63.3%) students, and between 18-24 age group (56.0%) and the 25-35 age group (64.3%). However, the undergraduate students (60.0%) were statistically significantly (p = .02) more likely than were the postgraduate students (33.3%) to provide negative statements about their current home situation. The Cramer's V statistic associated with this difference of .21 represented a small-to-moderate effect size, using Cohen's (1988) criteria. Also, the odds ratio indicated that the undergraduate students were 1.23 (95% confidence interval [CI] = 1.01 to 1.49) times more likely than were the postgraduate students to provide negative statements.

Cluster 3. Cluster 3 (cyan color) characterizes ***Technology*** (i.e., metatheme) that represents a focus that centers on *access* (i.e., theme), including Internet, WiFi, resource, laptop, data, fair, and large extent. With respect to the learning process, the majority (i.e., 70.4%) of the participants reported having access to technology. Interestingly, many of these participants recognized that they were privileged to have such access. For example, a woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Health Sciences field, stated the following: "I believe my current home situation is suitable for online learning. I am fortunate enough to have access to my own studying environment, access to the internet, and access to a laptop." For some students, problems arose from having to share technology with family members:

> It's semi-suitable. It's sometimes hard to work at a timely manner since I don't have access to a laptop the whole day because my father uses it for work. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> We have a capped wireless connection which everyone makes use of and the bundle gets depleted quite fast. This makes it difficult to access online material at times. (Man in the 18-24 age group, who was a full-time, local undergraduate student, representing the Engineering and the Built Environment field)

In contrast, some other students actually sought out family members and friends to *gain* access to technology:

> It's fairly good, I am not at home; I had to move in with my aunt for some time as she has access to the internet, which is beneficial for me. (Woman in the 25-35 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> I live in a remote area therefore it's hard to access the internet from home. I have to travel to friends places to complete my assignments on time, and traveling is hard because of the COVID-19, and traveling is costly. Studying from home is hard because I share a room with a siblings. (Man in the 18-24 age group, who was a full-time, international undergraduate student, representing the Science field)

Some students discussed several challenges that they had relating to access, such as a woman in the 25-35 age group, who was a full-time, local undergraduate student, representing the Commerce, Law and Management field, who declared the following:

> Access to internet and data is expensive as we need things like YouTube to expand on the contents learnt in online classes. I don't have access to a laptop so in general I do not consider my home situation suitable for online learning.

According to some of the students, the University was to blame, at least in part, for the access problems that they were experiencing, as exemplified by the following excerpts:

> Above all the University did not do enough with regards to granting us access to the relevant academic sites for articles. (Man in the 25-35 age group, who was a full-time, local postgraduate (i.e., Master's) student, representing the Commerce, Law and Management field)

> The network coverage is really bad and trying to access Journals and articles takes time. I honestly believe that the university should be more lenient on the submission deadlines. Some faculties are very rigid. (Woman in the 36-45 age group, who was a full-time, local postgraduate (i.e., Honours) student, representing the Commerce, Law and Management field)

> It is not suitable as I the university has decided to punch data on the phone that has not applications that are necessary to use data for research and communication. There were no prior consultation regarding the type of phone each student is using. This was simply a top down approach which has resulted in negative implications for accessing of data. In my case, I have highlighted this challenge, but the response I got was that I should contact my network provider which I did to no avail. (Man in the 46-55 age group, who was a full-time, local postgraduate (i.e., Master's) student, representing the Commerce, Law and Management field)

After quantitizing every statement pertaining to the Technology meta-theme, an analysis of frequency counts revealed that the majority of students who reported not having sufficient access to technology were women (69.0%), students in the 18-24 age group (77.0%), undergraduate students (69.0%), full-time students (86.3%), students undertaking a Bachelor's degree (66.4%), and local students (96.9%). Further, Fisher's Exact Tests revealed no statistically significant difference in the proportion of students who do not have sufficient access to technology between students who were full-time (86.3%) and those who were part-time (13.7%). However, in terms of reporting that they do not have sufficient access to technology, men students (37.1%) were statistically significantly (p = .04; Cramer's V = .13; odds ratio = 1.50, 95% CI = 1.01-2.21) more likely than were women (24.4%), the postgraduate students (40.0%) were statistically significantly (p = .01; Cramer's V = .17; odds ratio = 1.69, 95% CI = 1.15-2.47) more likely than were the undergraduate students (23.1%), and the students in the 25-35 age group (38.9%) were statistically significantly (p < .05; Cramer's V = .14; odds ratio = 1.80, 95% CI = 1.01-3.26) more likely than were the students in the 18-24 age group (23.4%).

Cluster 4. Cluster 4 (brown colour) characterizes ***Online Learning*** (i.e., metatheme) that represents a focus that centers on *home situation* (i.e., theme), including current situation, university, everything, and lesser extent. With respect to the online learning process, approximately one half (i.e., 52.2%) of the participants reported that their home was not conducive for online learning. Of those who declared that their home was not conducive for online learning, some of them described the negative emotions that they experienced, such as the following:

> The situation is beyond my control, things are far more difficult and different. This online learning is traumatizing. (Man in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> While I do have the resources to complete online learning. I feel that online learning is more difficult than contact learning. Therefore there is too much of content to cover in a short space of time. The deadlines also increase pressure and anxiety among students further increasing the difficulty of online learning. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Health Sciences field)

Quantitizing every statement pertaining to the Online Learning meta-theme, an analysis of frequency counts revealed that the majority of students who reported that their home was not conducive for online learning were women (64.2%), students in the 18-24 age group (88.1%), undergraduate students (83.8%), full-time students (95.8%), students undertaking a Bachelor's degree (83.5%), and local students (96.5%). Further, Fisher's Exact Tests revealed no statistically significant difference in the proportion of students who reported that their home was not conducive for online learning between women (50.0%) and men (57.5%) and between local students (60.0%) and international students (52.1%). In contrast, with respect to reporting that their home was not conducive for online learning**,** the students in the 18-24 age group (55.7%) were statistically significantly (p = .015; Cramer's V = .11; odds ratio = 1.08, 95% CI = 1.01-1.16) more likely than were the students in the 25-35 age group (39.3%), which represented the next highest proportion; the undergraduate students (56.3%) were statistically significantly (p = .001; Cramer's V = .17; odds ratio = 1.17, 95% CI = 1.06-1.29) more likely than were the postgraduate students (38.5%); and full-time students (54.7%) were statistically significantly (p < .0001; Cramer's V = .17; odds ratio = 3.75, 95% CI = 1.79-7.83) more likely than were the part-time students (24.4%).

Cluster 5. Cluster 5 (blue color) characterizes ***Device*** (i.e., metatheme) that represents a focus that centers on *Internet connection* (i.e., theme), including learning, desk, own room, and conducive. Encouragingly, the overwhelming majority (i.e., 84.2%) of the participants reported that they had the appropriate devices needed. Of those who reported that they did not have appropriate devices they needed, all of them delineated the problems that this lack of devices was causing them. For example, a woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field revealed the following: "I do have space and a quiet environment, however limited access to data or devices that work properly and aren't slow is a problem and significantly adds to stress." Some of these students took the initiative of seeking assistance from the University. Unfortunately, some of them had not received any help from the University:

> I have informed my lecturers, Wits ICAM [the University's Integrated Campus Management responsible for card access into the institution], and Wits Plus [the University's Centre for Part-Time Studies] of my challenges but they have fallen on deaf ears. I am unable to connect from home and I even informed my service provider to no avail. I have also applied for a device from the university but am yet to be responded to. (Man in the 36-45 age group, who was a part-time, local undergraduate student, representing the Humanities field)

However, some students did receive university assistance, as the following comment demonstrates:

> Initially when I was evicted from res and had no device and no data and was contemplating going back home to Eastern Cape, I felt that the university had turned my life upside down and significantly disadvantaged me from my peers … .That was the situation for the 1st month. Moving around with nowhere to live and no access to anything. But since I've gotten a place to live in Joburg and university sent me a device and data things changed, I also got a Rain simcard for unlimited data and am able to access materials. The library databases allow me to access textbooks as I don't have my own. I actually prefer this method of study to contact lessons. I'm still catching with the previous block when I was destabilized but I'm currently up to date with the current block. I'm able to structure my schedule and restructure if I need to, I don't waste time getting ready and traveling to campus and the social aspects as well. We continue group meetings by Zoom and discuss further on WhatsApp. I would be happy if it remained this way or if we were given an option to continue this way even after lockdown has ended. (Man in the 36-45 age group, who was a full-time, local undergraduate student, representing the Health Sciences field)

In contrast to access to devices, the majority (56.5%) of students reported that they did not have adequate Internet connectivity. These students discussed how disruptive this lack of connectivity was. For example, a woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field revealed the following:

> My situation at home had affected my studies negatively and has resulted in failure for some of the assessment that I had to do. The internet connection is also bad and I struggle to get access to the university emails and sites unless someone with a better network coverage hotspots me.

An analysis of frequency counts pertaining to this Internet connection theme revealed that the majority of students who reported that they did not have adequate Internet connectivity were marginally women (52.1%), students in the 18-24 age group (91.7%), undergraduate students (89.6%), full-time students (95.8%), students undertaking a Bachelor's degree (77.1%), and local students (97.9%). Additionally, Fisher's Exact Tests revealed no statistically significant difference in the proportion of students who reported that they did not have adequate Internet connectivity between women (51.0%) and men (62.9%), between the postgraduate students (50.0%) and the undergraduate students (57.3%), and between the full-time students (57.5%) and the part-time students (50.0%). Indeed, none of the demographic variables were statistically significant.

Cluster 6. Cluster 6 (purple color) characterizes ***Network*** (i.e., metatheme) that represents a focus that centers on *electricity* (i.e., theme), including test and bit. Of those who mentioned network availability, there was almost unanimity (i.e., 98.8%) regarding how inadequate their network was. The majority of students who reported that they did not have adequate network connectivity were women (67.6%), students in the 18-24 age group (80.6%), undergraduate students (82.4%), full-time students (89.4%), students undertaking a Bachelor's degree (77.1%), and local students (98.8%). Disturbingly, for many students, issues with network availability led to various negative emotions, such as frustration, fear, and feelings of an inability to cope, as the following extracts exemplify:

> … even though I have devices such as a smart phone and a laptop, we struggle with electricity which keeps on switching on and off in our neighborhood. This is Scary because sometimes we might have an online test and there is load shedding. We won't have network and therefore won't partake in the online test or assessments. So far every day we have load shedding and it is scary. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> It is at a remote area where network is a problem, most of the time I struggle logging in. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> My current situation is not conducive for studying or doing the work effectively online. While I take steps to ensure that I access online learning at all material times, unavoidable situations like every day consistent power cut in my hometown and lack of water affects my progress in a great deal. While I find means to work through these situations, the back to back submissions and multiple submissions of work on the same day also affects my ability to be comfortable with online learning. In simple terms, online learning was a great initiative but how it is conducted and the amount of work given in a short space of time creates panic and stress for me personally as a student. (Man in the 25-35 age group, who was a full-time, local undergraduate student, representing the Commerce, Law and Management field)

> If I didn't have lots of assignments to do, studying would have been productive even at home. Being in a remote area with poor network coverage, accessing material to do assignments takes long and thus the process tedious. (Woman in the 25-35 age group, who was a part-time, local undergraduate student, representing the Health Sciences field)

> My home situation not suitable or feasible at all I use cell phone which I sometimes struggle with network during classes of online I lose lots of time and that creates frustration which results in disruption for my studies. (Woman in the 25-35 age group, who was a part-time, local undergraduate student, representing the Humanities field)

Even among some students who were generally satisfied with online learning from their homes, they mentioned having issues with network connectivity. For example, a woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Commerce, Law and Management field, stated the following: "I am fortunate in that regard, to have a very suitable home for online learning. The only unsuitable thing is poor network connection." As another example, a woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Science field, stated the following: "The biggest problem is beyond my power because it has to deal with network connectivity, for past few days network has been my biggest problem."

With respect to the issue of electricity, perhaps not surprisingly, the overwhelming majority (95.7%) discussed it in negative terms. The majority of students who reported that they did not have adequate network connectivity were women (68.2%), students in the 18-24 age group (90.9%), undergraduate students (77.3%), full-time students (95.6%), students undertaking a Bachelor's degree (79.5%), and local students (93.2%). Interestingly, their descriptions of electricity represented some of the most powerful discussions, as the following extracts exemplify:

> My situation at home is not suitable for online learning at all. I live in an area that is in close proximity to a squatter camp and since its winter, people from these informal settlements steal electricity from the formal settlement areas and our community then finds itself with no electricity because of electricity theft. There was no electricity for the past twelve days because of this, as a result, all my gadgets were low on battery, making it hard for me to participate in online learning. My situation at home is resulting in me being silently excluded in Education. This is why I opted for residence in the first place. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> We also have electricity problems. The past two days it has been going off in the morning until 10 in the evening. Therefore my home is not that friendly or suitable for online learning. It is hard to cope. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> … my home situation doesn't allow me to do online learning, because first there's no electricity we are still using candles, and other thing there's no network when I want network I need to go somewhere which is far from home just to get network. (Woman in the 18-24 age group, who was a full-time, international undergraduate student, representing the Humanities field)

> It's not appropriate for online learning, I do not have a proper place to study and sometimes we don't have electricity for days. This makes it very hard to participate with online learning. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

> I live in a township that has high levels of crime - Just after midnight our electricity cable was stolen and I assume this was done before 3am because I was up before that time and the power was gone. (Woman in the 18-24 age group, who was a full-time, local undergraduate student, representing the Humanities field)

Analysis of the co-word map of responses shows that non-academic home characteristics, with a focus on *disturbance* that includes chores, responsibility, children, persons, everyone, noise, room, school work, and night, mostly occupy the left hand side of the map (cf. Figure 4). Current home situation and conducive environment, with a focus on online learning, electricity, network, assignments, tests, occupy the central region of the map. Finally, *technology* with an emphasis on *access* to resources, devices, a laptop, the Internet, WiFi, data, and own space, mostly occupy the right hand side of the map. As such, from left to right, this maps reflects a logical sequence of the COVID-19 learning process, wherein for many students—especially those with families—the non-academic functions of the home turn into *disruptions* during the transition of the home into a full-time place of academic learning, which, in turn, because of the need for *online learning*, systems such as *electricity* and *networks* are even more essential for completing assignments, tests, and the like, which are moderated or mediated by *access* to resources, devices, a laptop, the Internet, WiFi, and data—access needed that is in addition to what the remainder of the household members have.

Crossover mixed analyses. A series of Mann-Whitney's *U* tests, using the Bonferroni adjustment (i.e., adjusted $\alpha = .05/3 = .017$), was used to determine the relationship between attitudes towards COVID-19 and its impact on higher education and each of the metathemes and select themes. More specifically, for each metatheme and theme, scores representing the two subscales and full scale were compared between those who expressed a

negative sentiment and those who expressed a positive sentiment. The findings are presented in Table 8. This table indicates no statistically significant difference with respect to the three attitudinal measures between the negative sentimentalists and the positive sentimentalists that represented the Non-Academic Home Characteristics metatheme, the Network metatheme, and the Electricity theme of the Network metatheme. In contrast, a statistically significant difference emerged between the negative sentimentalists and the positive sentimentalists (a) for the Current Home Situation metatheme, with regard to the SSTCHE subscale (positive sentimentalists were higher) and the ATTLACBHE subscale (negative sentimentalists were higher); (b) for the Technology metatheme, with respect to ASTCIHE scale (positive sentimentalists were higher) and the SSTCHE subscale (positive sentimentalists were higher); (c) for the Online Learning meta-theme, in terms of ASTCIHE scale (positive sentimentalists were higher), the SSTCHE subscale (positive sentimentalists were higher), and the ATTLACBHE subscale (negative sentimentalists were higher); (d) for the Device metatheme, in terms of the ATTLACBHE subscale (positive sentimentalists were higher); and (e) for the Internet connection theme of the Device metatheme, with respect to SSTCHE subscale (positive sentimentalists were higher).

Table 8. Follow-up Mann-Whitney *U* values (and non-parametric effect sizes) comparing groups providing negative and positive sentiments with respect to scores on the Full ASTCIHE Scale, the SSTCHE Subscale, and the ATTLACBHE Subscale, for each of the six metathemes and two themes.

	ASTCIHE Scale			SSTCHE Subscale			ATTLACBHE Subscale		
	- *M* (*SD*)	+ *M* (*SD*)	*U* (Effect size)	- *M* (*SD*)	+ *M* (*SD*)	*U* (Effect size)	- *M* (*SD*)	+ *M* (*SD*)	*U* (Effect size)
M1	32.35 (4.79)	35.67 (2.73)	46.50 (0.40)	19.19 (3.30)	22.17 (2.64)	37.00 (0.53)	13.15 (2.53)	13.50 (1.76)	76.50 (0.02)
M2	32.23 (4.63)	33.94 (3.01)	1283.00 (0.18)	18.18 (4.32)	21.75 (2.32)	728.00* (0.53^{L})	14.05 (1.33)	12.20 (2.42)	803.00* (0.48^{L})
M3	31.41 (5.54)	34.06 (3.30)	3620.50* (0.30^{M})	18.42 (4.34)	20.93 (3.14)	3321.00* (0.36^{M})	12.98 (3.02)	13.13 (2.24)	4891.00 (0.06)
M4	31.45 (4.98)	33.84 (3.87)	21189.00* (0.32^{M})	18.06 (4.08)	21.42 (2.96)	15100.00* (0.51^{L})	13.39 (2.54)	12.42 (2.85)	23506.00* (0.24^{S-M})
M5	29.92 (5.52)	33.77 (4.87)	185.00 (0.52)	19.08 (3.75)	20.94 (3.42)	256.50 (0.33^{M})	10.83 (3.41)	12.83 (2.74)	239.50* (0.38^{M})
M5_T	31.81 (4.73)	34.00 (3.97)	629.00 (0.29)	18.23 (3.85)	21.14 (2.42)	459.50* (0.48^{L})	13.58 (1.81)	12.86 (2.86)	815.00 (0.08)
M6	31.46 (5.30)	35.00 (4.24)	101.00 (0.41)	18.37 (4.25)	21.50 (2.12)	93.00 (0.45)	13.09 (2.66)	13.50 (2.12)	168.00 (0.01)
M6_T	30.86 (4.98)	37.50 (2.12)	7.50 (0.83)	18.14 (3.89)	22.50 (2.12)	12.00 (0.73)	12.73 (2.85)	15.00 (0.01)	17.00 (0.61)

Note: - = Negative sentiment; + = Positive sentiment; *M* = Mean; *SD* = Standard Deviation; *U* = Mann-Whitney's *U*; *$p < .001$; $^{S-M}$Small-to-medium effect size; ^{M}Small-to-medium effect size; ^{L}Small-to-medium effect size; M1 = Metatheme for Cluster 1: Non-Academic Home Characteristics; M2 = Metatheme for Cluster 2: Current Home Situation; M3 = Metatheme for Cluster 3: Technology; M4 = Metatheme for Cluster 4: Online Learning; M5 = Metatheme for Cluster 5: Device; M5_T = Metatheme for Cluster 5 Theme: Internet connection; M6 = Metatheme for Cluster 6: Network; M6_T = Metatheme for Cluster 6 Theme: Electricity.

Topic modeling of open-ended question. Table 9 presents the high-probability terms from the k = 5 topic model for each of five topics in the corpus of responses. For each topic, as recommended by topic modelists (e.g., O'Callaghan, Greene, Carthy, & Cunningham, 2015; Provalis Research, 2014; Wang, Bowers, & Fikis, 2017), this table lists the 10 high-probability terms that best distinguish the topics from one another. Overall, the following five topics emerged from the corpus: Home Chores/Study Area, Online Learning/Home Situation, Internet connection access, School work family, and Network coverage. Also, in Table 9 is the topic coherence, which is the semantic interpretability of the terms used to describe a particular topic, and the relative proportion pertaining to documents underlying these five topics. In what follows, the topics and themes extracted from Table 9 are presented, wherein the topics and terms are presented in boldface text and the theme[s] derived from these topics are presented in italics.

Table 9. Topics extracted from the responses delineating the extent that the students considered their current home situations suitable for online learning (*n* = 4,419).

No	Topic Labels	High Probability Terms	Coherence	Relative Proportion
1	Home Chores/Study Area	House, study, live, siblings, night, house chores, study area, place to study, small house, study at home	.43	13.25
2	Online Learning/Home Situation	Online, learning, situation, home, current, online learning, home situation, suitable for online learning, current learning situation, learning situation	.42	58.44
3	Internet connection access	Internet, access, devices, connection, Internet connection, Internet access, access to the Internet, stable Internet connection, stable, connection access	.36	12.14
4	School work family	Work, family, school, school work, house work, members, time, household, family members, understand	.30	9.82
5	Network coverage	Network, coverage, poor, connection, network coverage, network connection, poor network, network connectivity, area, connectivity	.29	6.35

It can be seen from Table 9 that **Online Learning/Home Situation** (Topic 2) had the highest relative proportion of documents, with high-probability terms including *online*, *learning*, *situation*, *home*, *current*, *online learning*, and *home situation*. This topic indicates that online learning in the home situation is the major focus of the students, as opposed to other types of learning. The Online Learning/Home Situation topic is followed by the **Home Chores/Study Area** topic (Topic 1), with high-probability terms such as *house*, *study*, *live*, *siblings*, *night*, *house chores*, *study area*, and *place to study*. This topic indicates that online learning must take place in the context of home chores and that locating a study area is important for the success of the online learning experience. The next most frequent topic for the students was **Internet connection access** (Topic 3), with high-probability terms that include *Internet*, *access*, *devices*, *connection*, *Internet connection*, and *Internet access*. This topic demonstrates that access to the Internet and other technological devices is central to the online learning process for these students. Representing a significant proportion (i.e., 9.82%) of the set of topic labels is the **School work family** topic (i.e., Topic 4), with high-probability terms that include *work*, *family*, *school*, and *school work*. This topic illustrates a unique intertwining of work, university, home, and family during a pandemic. The final topic is **Network coverage** (i.e., Topic 5), with high-probability terms that include *network*, *coverage*, *poor*, *connection*, *network coverage*, *network connection*, and *poor network*. Bearing in mind the importance of network coverage for transmitting signals, this topic has logical appeal.

Qualitizing of the SSTCHE and ATTLACBHE subscales: Research Question 8: To what extent are there identifiable attitudes towards COVID-19 and its impact on higher education that attract similar students within each group? The twostep cluster analysis led to the identification of four clusters. Figure 5 illustrates a comparison of these four clusters as a function of the SSTCHE and ATTLACBHE subscales. Combining the two figures in Figure 5 led to the following attitudinal-based characterization of the four clusters:

- Cluster 1 contained students who, on average, had the least positive self-regulation towards COVID-19-based higher education and the least positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education (i.e., *LOW-LOW students*).

- Cluster 2 contained students who, on average, reported the least positive self-regulation towards COVID-19-based higher education and reported positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education (i.e., *LOW-HIGH students*).
- Cluster 3 contained students who, on average, reported the most positive self-regulation towards COVID-19-based higher education and reported moderate positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education (i.e., *HIGH-MODERATE students*).
- Cluster 4 contained students who, on average, reported the most positive self-regulation towards COVID-19-based higher education and reported the most positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education (i.e., *HIGH-HIGH students*).

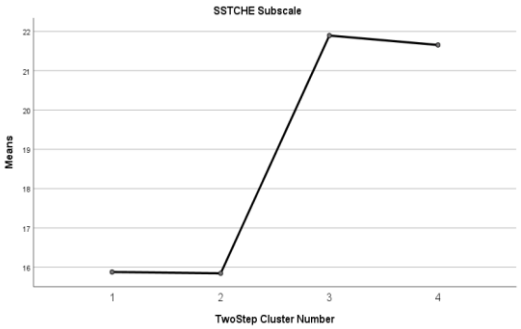

Figure 5a. SSTCHE subscale means as a function of the four qualitized clusters.

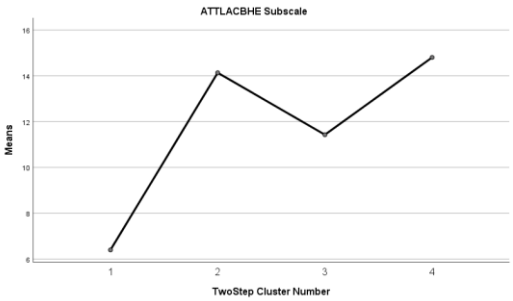

Figure 5b. ATTLACBHE subscale means as a function of the four qualitized clusters.

Figure 5. SSTCHE and ATTLACBHE subscale means as a function of the four qualitized clusters.

Correlating the Qualitized Clusters with the Quantitative Demographic Variables and of the SSTCHE and ATTLACBHE subscales. A series of chi-square analyses, using the Bonferroni adjustment (α = .01 = .05/5 demographic variables), revealed statistically significant differences among the four qualitized clusters with respect to age group ($X^2[9] = 89.28$, $p < .0001$, Cramer's $V = 0.14$), level of student, ($X^2[3] = 54.84$, $p < .0001$, Cramer's $V = 0.11$), and full-time status ($X^2[3] = 56.69$, $p < .0001$, Cramer's $V = 0.11$). No statistically significant difference among the four qualitized clusters emerged with respect to gender ($X^2[6] = 13.14$, $p = .04$, Cramer's V = 0.03) and origin ($X^2[3] = 7.29$, $p = .06$, Cramer's $V = 0.04$).

With respect to the quantitized variables (i.e., the 6 metathemes and 2 select themes), a series of chi-square analyses, using the Bonferroni adjustment (α = .006 = .05/8 methathemes/themes), revealed statistically significant differences among the four qualitized clusters with regard to the Current Home Situation metatheme ($X^2[3] = 35.01$, $p < .0001$, Cramer's $V = 0.56$), the Technology metatheme ($X^2[3] = 18.50$, $p < .0001$, Cramer's $V = 0.29$), the Online Learning metatheme ($X^2[3] = 67.42$, $p < .0001$, Cramer's $V = 0.37$), and the Internet connection theme of the Device metatheme ($X^2[3] = 14.96$, $p < .002$, Cramer's $V = 0.42$). Contrastingly, no statistically significant difference among the four qualitized clusters emerged with respect to the Non-Academic Home Characteristics metatheme ($X^2[3] = 2.92$, $p = .41$, Cramer's $V = 0.30$), the Device metatheme ($X^2[3] = 8.04$, $p = .05$, Cramer's $V = 0.33$), the Network metatheme ($X^2[3] = 1.85$, $p = .60$, Cramer's $V = 0.10$), and the Electricity theme of the Network metatheme ($X^2[3] = 5.31$, $p = .15$, Cramer's $V = 0.34$).

Moreover, an examination of the cell proportions pertaining to the statistically significant demographic variables and metathemes/themes led to the construction of comparative profiles. These profiles were obtained by comparing one cluster to the other clusters to identify similarities and differences among them (Onwuegbuzie & Leech, 2019). The comparative profile narratives are presented in the final subsection of the Results section.

Comparative narrative profiles. As presented previously, the 4,419 students who participated in this study were found to be clustered into four groups based on their reported attitudes toward COVID-19 and its impact on higher education in general and their self-regulation towards COVID-19-based higher education and attitudes toward teaching, learning, and assessment in COVID-19-based higher education in particular. And comparing

these four groups with respect to the cell proportions pertaining to the three statistically significant demographic variables (i.e., age group, level of students, and full-time status), three statistically significant metathemes (Current Home Situation, Technology, and Online Learning, Device), and one statistically significant theme (i.e., Internet connection), led to the following comparative narrative profiles.

- Cluster 1: *LOW-LOW students* (*n* = 312): Representing by far the smallest group, these students tended to contain students whose distribution of ages was very similar to the distribution of ages in the total sample, respectively, as follows: 18-24 (74.4% vs. 77.0%), 25-35 (17.9% vs. 15.5%), 36-45 (6.7% vs. 4.6%), and 46-55 (1.0% vs. 2.1%). Similarly, the distribution of level of education was very similar to the distribution in the total sample, respectively, as follows: undergraduate students (71.6% vs. 74.9%) and postgraduate students (28.4% vs. 24.4%). Also, the distribution of full-time status was very similar to the distribution in the total sample, respectively, as follows: full-time students (86.3% vs. 87.8) and part-time students (13.7 vs. 11.8). Therefore, Cluster 1 contained students who appeared to be representative of the total sample. However, compared to the total sample, this group contained (a) a significantly smaller proportion of students who expressed a negative sentiment about the extent to which they consider their current home situation to be suitable for online learning (i.e., 54.5% vs. 40.0%), (b) a significantly larger proportion of students who expressed a negative sentiment about their access to technology (28.3% vs. 50.0%), (c) an almost identical proportion of students who expressed a negative sentiment about online learning (52.2% vs. 51.4%), and (d) a significantly smaller proportion of students who expressed a negative sentiment about their Internet connectivity (i.e., 56.5% vs. 42.9%).
- Cluster 2: *LOW-HIGH students* (*n* = 1,381): Representing marginally the second largest cluster, compared to the total sample, this cluster contained a higher proportion of students in the 18-24 age group (77.0% vs. 83.9%). In fact, this group contained the highest proportion of students in the 18-24 age group. Also, compared to the total sample, this cluster comprised a larger proportion of undergraduate students (i.e., 74.9% vs. 81.4%) and full-time students (87.8% vs. 92.9). Therefore, in summary, this cluster was characterized by a higher proportion of students in the 18-24 age group, undergraduate students, and full-time students. Further, compared to the total sample, this group contained (a) a significantly larger proportion of students who expressed a negative sentiment about the extent to which they consider their current home situation to be suitable for online learning (i.e., 54.5% vs. 87.9%), (b) a significantly larger proportion of students who expressed a negative sentiment about their access to technology (28.3% vs. 45.8%), (c) a significantly larger proportion of students who expressed a negative sentiment about online learning (52.2% vs. 78.0%), and (d) a significantly larger proportion of students who expressed a negative sentiment about their Internet connectivity (i.e., 56.5% vs. 83.9%).
- Cluster 3: *HIGH-MODERATE students* (*n* = 1,287): Representing the third largest cluster, like Cluster 1, these students tended to contain students whose distribution of ages was very similar to the distribution of ages in the total sample, respectively, as follows: 18-24 (71.6% vs. 77.0%), 25-35 (17.6% vs. 15.5%), 36-45 (7.2% vs. 4.6%), and 46-55 (3.6% vs. 2.1%). Also, compared to the total sample, this cluster contained a similar proportion of undergraduate students (i.e., 74.9% vs. 69.4%). Further, compared to the total sample, the proportion of full-time status was similar (87.8 vs. 83.6%). Therefore, like Cluster 1, Cluster 3 contained students who appeared to be representative of the total sample. Further, compared to the total sample, this group contained (a) a significantly smaller proportion of students who expressed a negative sentiment about the extent to which they consider their current home situation to be suitable for online learning (i.e., 54.5% vs. 18.9%), (b) a significantly smaller proportion of students who expressed a negative sentiment about their access to technology (28.3% vs. 16.4%), (c) a significantly smaller proportion of students who expressed a negative sentiment about online learning (52.2% vs. 31.9%), and (d) a significantly smaller proportion of students who expressed a negative sentiment about their Internet connectivity (i.e., 56.5% vs. 42.1%).
- Cluster 4: *HIGH-HIGH students* (*n* = 1,396): Representing marginally the largest cluster, like Cluster 1 and Cluster 3, these students tended to contain students whose distribution of ages was very similar to the distribution of ages in the total sample, respectively, as follows: 18-24 (78.1% vs. 77.0%), 25-35 (15.9% vs. 15.5%), 36-45 (4.1% vs. 4.6%), and 46-55 (1.9% vs. 2.1%). In fact, these proportions were almost identical. Also, compared to the total sample, this cluster contained a similar proportion of undergraduate students (i.e., 74.9% vs. 76.1%). Further, compared to the total sample, the proportion of full-time status was almost identical (87.8 vs. 88.0%). Therefore, like Cluster 1 and Cluster 3, Cluster 4 contained students who appeared to be representative of the general population. Further, compared to the total sample, this group contained (a) a significantly larger proportion of students who expressed a negative sentiment about the extent to which they consider their current home situation to be suitable for online learning (i.e., 54.5% vs. 62.2%), (b) a significantly smaller proportion of students who expressed a negative sentiment about their access to technology (28.3% vs. 22.5%), (c) a similar proportion of students who expressed a negative sentiment about online learning (52.2% vs. 48.3%),

and (d) a significantly smaller proportion of students who expressed a negative sentiment about their Internet connectivity (i.e., 56.5% vs. 39.3%).

Discussion

The present study is unique in at least four ways. First, the present study appears to be the first explicitly to involve use of a multi-mixed methods research approach, wherein multiple methods research approaches and mixed methods research approaches are partially integrated within the same investigation. Second, this study also appears to be the first to involve use of a meta-methods research approach, wherein multiple methods research approaches and mixed methods research approaches are fully integrated within the same inquiry. Third, and most importantly, it is one of the first studies worldwide to involve examination of the effect of COVID-19 on the online learning process of university students, and is likely the first study of this type conducted in the continent of Africa. Fourth, a comprehensive review of the literature suggests that it is likely the first study to involve a comparison of subgroups within a university population with respect to the online learning process during the initial stages of the COVID-19 pandemic.

The principal components analysis of the Attitude of Students Towards COVID-19 and its Impact on Higher Education (ASTCIHE) scale revealed two subscales, namely, Students' Self-regulation Towards COVID-19-Based Higher Education (SSTCHE) and Attitudes Toward Teaching, Learning, and Assessment in COVID-19-Based Higher Education (ATTLACBHE)—both of which were shown to have excellent psychometric properties. Using the full scale and subscale revealed that men students were statistically significantly more likely to believe that the COVID-19 learning context is significantly different from the Pre-COVID-19 learning context than did the women students, although the effect size was small. This gender difference in attitudes is consistent with Rovai and Baker (2005), who documented that women who enrolled in online graduate education courses believed that their online learning experiences were more aligned to their educational values and goals and that they learned more than did their men counterparts. Similarly, McSporran and Young (2001) reported that, with respect to online learning, compared to the men students, the women study participants appeared to be more motivated, better at communicating online, and more adept at scheduling their learning. Contrastingly, the men participants in this study needed the discipline that classroom sessions afforded them. Also, Anderson and Haddad (2005) reported that women in their study experienced greater perceived deep learning in their online courses than in their face-to-face courses, with the expression of voice appearing to contribute to this observation. Moreover, this gender difference suggests that these attitudes have a gender context to some degree. Indeed, based on their findings, Ashong and Commander (2012) concluded that gender influences students' perceptions of online learning. Therefore, future researchers should strive to unpack these gender differences more in the context of university preparedness (cf. Combs et al., 2010) in general and online learning in particular during this pandemic era.

With respect to age, K. J. Kim and Frick (2011) documented that this variable was one of the best predictors of motivation to begin self-directed e-learning, alongside perceived relevance, and reported technology competence. In the present investigation, age group differences emerged with respect to the full scale and two subscales—with 11 out of the 18 pairwise comparisons being statistically significant (see Table 6). Even more significantly, three trends emerged from this analysis of age groups. Firstly, a linear tend emerged for attitudes towards COVID-19 and its impact on higher education, wherein these attitudes increased monotonically as a function of age group, with the oldest students reporting the most positive attitudes (see Figure 1). Secondly, a linear trend emerged for self-regulation towards COVID-19-based higher education, wherein these attitudes increased monotonically as a function of age group, with the oldest students reporting the most positive attitudes (see Figure 2). Thirdly, a cubic trend emerged for attitudes toward teaching, learning, and assessment in COVID-19-based higher education, wherein these attitudes decreased from the 18-24 group to the 25-35 group, then decreasing more sharply from the 25-35 group to the 36-45 group, before increasing from the 36-45 group to the 46-55 group (see Figure 3). These trends provide compelling evidence that these attitudes have a strong age context. These findings, in turn, suggest that university administrators consider designing age-specific interventions for addressing negative attitudes.

Another important finding was that compared to undergraduate students, postgraduate students reported statistically significantly more positive attitudes towards COVID-19 and its impact on higher education and more positive self-regulation towards COVID-19-based higher education than did the undergraduate students. These findings have intuitive appeal because self-regulation concerns a student's intrinsic ability to engage with oneself to persevere to achieve their learning goals. Postgraduate students tend to be more independent and are able to manage better the pressure of their studies, as compared to undergraduate students. This appears to be

consistent with previous findings discussed by Onwuegbuzie and Jiao (2000). These authors presented the finding that a higher proportion of undergraduate students (i.e., approximately 95%) engage in frequent procrastination—which represents the purposeful delay in beginning and/or completing academic tasks—as compared to graduate students (i.e., approximately 60%).

In contrast, the undergraduate students reported statistically significantly more positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education than did the postgraduate students. This finding also has logical appeal because of the decision of the university administrators to direct the faculty to replace their face-to-face assessments with other forms of assessment during the emergency remote teaching. Specifically, the Office of the University's Registrar issued a statement that

> during this period, no formal face-to-face, in person or sit-down assessments will take place. Assessments will take the form of a project and/or take-home assessment and/or an open book assessment and/or a Multiple-Choice Questionnaire (MCQ) and/or any other form of remote assessment, as determined by faculties. (Official university communication, 29 May 2020)

This cancellation of face-to-face assessments likely would have been especially well received by the undergraduate students, thereby generating more positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education, relative to their postgraduate counterparts. Consistent with this conclusion, some researchers (e.g., Benson, 1989) have observed that undergraduate students report higher levels of general test anxiety than do graduate students (see also, Onwuegbuzie, 2000).

Another interesting finding is that the international students reported statistically significantly more positive self-regulation towards COVID-19-based higher education than did the local students. This is another finding that has logical appeal because international students have been found to be able to adapt psychologically (Shafaei, Nejati, & Abd Razak, 2018) and to have more resilience (Glass & Gesing, 2018; Y. K. Kim & Cronley, 2020) than do local students.

With regard to the registration status of students, compared to full-time students, part-time students reported statistically significantly more positive attitudes towards COVID-19 and its impact on higher education and more positive self-regulation towards COVID-19-based higher education. This finding might have arisen because part-time students tend to adopt a "workplace attitude" to their studies, which "often includes a clear understanding of the career benefits of gaining a degree, and therefore a link between study ambitions and work ambitions" (Davies, 2008, p. 6). Contrastingly, the full-time students reported more positive attitudes toward teaching, learning, and assessment in COVID-19-based higher education than did the part-time students. This finding might reflect the fact that time management is a much more important mediator for part-time students than for full-time students (MacCann, Fogarty, & Roberts, 2012), likely because part-time students, at least those who are engaged in full-time employment, tend to have more demands on their study time. Therefore, university administrators might consider designing different interventions for addressing negative attitudes for full-time and part-time students.

Analysis of the open-ended responses yielded numerous findings. Most notably, the VOSviewer 1.6.14 text mining software program led to the identification of six co-word clusters that yielded the following six metathemes: Non-Academic Home Characteristics, Current Home Situation, Technology, Online Learning, Device, and Network. Similarly, the WordStat 8.0.29 topic modeling yielded the following five topics (i.e., metathemes) that emerged from the same corpus: Home Chores/Study Area, Online Learning/Home Situation, Internet connection access, School work family, and Network coverage. As can be seen from Table 10, wherein these two sets of themes are mapped onto each other, these two sets of findings are very consistent. That is, they have triangulated each other, providing incremental validity for these findings. These metathemes indicate what students believe to be the most important issues related to online learning in general and the negative experiences of students related to online learning in particular, which, in turn, should provide useful information or administrators to design and to implement interventions to help students at Wits University and beyond to negotiate successfully their online learning experiences.

Table 10. A comparison of the metathemes extracted from the VOSviewer 1.6.14 text mining and WordStat 8.0.29 topic modeling.

VOSviewer 1.6.14 text mining	WordStat 8.0.29 topic modeling
Cluster	Topic
Non-Academic Home Characteristics	Home Chores/Study Area
	School work family
Current Home Situation	Online Learning/Home Situation
Online Learning	Online Learning/Home Situation
Technology	Internet connection access
Device	Internet connection access
Network	Network coverage

The sentiment analysis extracted from the VOSviewer 1.6.14 text mining revealed that the following three metathemes statistically significantly discriminated subgroups for one or more of the demographic variables: Current Home Situation, Technology, and Online Learning. Table 11 presents these statistically significant findings. These statistically significant negative sentiments not only reveal the biggest challenges for students but, even more importantly, reveal the characteristics of students who experience the biggest challenges. Therefore, these findings should help university administrators to target their interventions to the subgroups that most need them.

Table 11. Summary of sentiment analysis findings pertaining to the metathemes and select themes extracted from the VOSviewer 1.6.14 text mining.

Metatheme/Theme	Groups that were statistically significantly more likely to provide negative statements
Metatheme 1: *Non-Academic Home Characteristics*	No statistically significant findings
Metatheme 2: *Current Home Situation*	Undergraduate students (60.0%) were 1.23 times more likely than were the postgraduate students (33.3%)
Metatheme 3: *Technology*	Men students (37.1%) were 1.50 times more likely than were women (24.4%)
	The postgraduate students (40.0%) were 1.69 times more likely than were the undergraduate students (23.1%)
	Students in the 25-35 age group (38.9%) were 1.80 times more likely than were the students in the 18-24 age group (23.4%)
Metatheme 4: *Online Learning*	Students in the 18-24 age group (55.7%) were 1.08 times more likely than were the students in the 25-35 age group (39.3%)
	The undergraduate students (56.3%) were 1.17 times more likely than were the postgraduate students
	Full-time students (54.7%) were 3.75 times more likely than were the part-time students (24.4%)
Metatheme 5: *Device*	No statistically significant findings
Internet connection Theme of the Device Metatheme	No statistically significant findings
Metatheme 6: *Network*	No statistically significant findings
Electricity Theme of the Network Metatheme	No statistically significant findings

Statistically significant differences emerged in attitudes (as measured by the full scale and/or one or both of the two subscales) between the negative sentimentalists and the positive sentimentalists with respect to the Current Home Situation metatheme, the Technology metatheme, the Online Learning meta-theme, the Device metatheme, and the Internet connection theme of the Device metatheme. These findings suggest that students' attitudes are related to their experiences with online learning (cf. Jiao & Onwuegbuzie, 2004; Onwuegbuzie & Jiao, 1998, 2004). Thus, to the extent that this relationship is causal, future researchers should investigate this causal link further. In particular, researchers should study the causal direction. Specifically, do students' experiences with online learning affect their attitudes? Or do their attitudes affect their experiences? Or is there a bi-directional relationship? Or are there one or more variables that mediate or moderate the relationship between students' attitudes and their experiences with online learning?

Finally, the cluster analysis, combined with the series of chi-square analyses, led to the identification of four clusters of students who differed with respect to their attitudes, as measured by the two attitude subscale measures. In building comparative narrative profiles, it was determined that the students' online experiences were much more important than were the demographic variables in discriminating the four attitudinal clusters of students. These clusters provide important information about which negative experiences are most likely to co-exist, again, informing the development of interventions.

Limitations

Like all studies, the present investigation has some limitations. First and foremost, although the sample size was large, it is likely that some, if not many, of the non-respondents were students who did not have (sufficient) online access to the survey. Therefore, findings pertaining to lack of access (e.g., Internet access, WiFi access, Internet connectivity, access to resources, access to laptops) in this study likely represent a lower bound. Second, due to oversight, information about race/ethnicity had not been included in the survey. This variable very likely would have provided valuable information. Therefore, future researchers conducting research in this area in South Africa should examine the role of race/ethnicity in the online learning context. Another variable that is worthy of attention is some measure of socioeconomic status. Other useful demographic variables include marital status, location of home, number of household members, forms of employment, type of disability (if any), and ICT experience.

Finally, the ensuing metathemes and themes stemming from the open-ended responses were interpretive in nature. Therefore, despite using a team approach to analyzing and interpreting, it is possible that other researchers would have arrived at different interpretations of the same data. However, the analytical rigor involved in using two analytical approaches (i.e., co-word analysis via co-occurrence maps and topic modeling)—which represented multiple methods—and the consistency in findings that these two approaches yielded, help to establish trustworthiness.

Implications of the Findings

The size and representativeness of the sample justifies generalizing the array of findings to the university where the study took place and might even justify making generalizations to other South African universities, especially those that are most similar to Wits University in terms of student demographics. Therefore, based on the numerous findings documented in the present investigation, and using our critical dialectical pluralistic stance (Onwuegbuzie & Frels, 2013), the following recommendations are made. These recommendations are made at two levels: at a *macro-level* broadly for South African higher education and at a *micro-level*, specifically targeting what individual institutions might consider implementing.

A few universities, mostly Historically White Universities (HWUs), were swift to engage their faculty and implement remote teaching, irrespective of the limitations that the COVID-19 lockdown placed on staff and students. Historically Black Universities (HBUs), on the other hand, have not been able to adapt and to adjust, and this has negatively impacted their ability to engage in teaching and learning online. As such, COVID-19 has brought back memories of the past, namely, the legacy of segregation (Zulu, 2020). This is a watershed moment in the history of higher education in South Africa, post-1994. The need to rethink the future of South Africa's higher education is more urgent particularly due to the cut in higher education funding by R10 billion (Department of National Treasury, Republic of South Africa, 2020).

This is the time to reconsider the argument by Habib (2015, 2016) for a differentiated higher education in South Africa especially after the Department of National Treasury, Republic of South Africa's (2020) Supplementary Budget Review. According to Habib (2016),

> a differentiated higher education system enables responsiveness to the diverse and multiple needs of an economy and a society. In South Africa, it would allow some universities to play a bigger role in the teaching of undergraduate students and the production of professionals, which is necessary if the economy is to become more productive and competitive. But it would also allow other universities to focus on postgraduate students and undertake high-level research, which are equally essential if the country is to develop a knowledge-based economy of the 21st century. (p. 43)

A differentiated South African higher education encourages more sharing of resources and collaboration to achieve national imperatives of growth and competitiveness. The opportunity for staff and student exchange nationally allows for a cross-fertilisation of ideas and expertise (human resources) such that less-resourced HBUs are able to be supported to grow by their HWUs.

COVID-19 has hastened South Africa's transition to the Fourth Industrial Revolution (4IR) and the Internet is an important resource in making this transition. Indeed, it is a critical resource in support of education and educational research (Silva & Cartwright, 2017). It might be worth considering a similar project as the Canadian Network for the Advancement of Research, Industry, and Education (CANARIE) for South Africa. The CANARIE project has impacted positively on the Canadian education sector, including higher education (Plumer & Marchioro, 1998; Silva & Cartwright, 2017).

As demonstrated by the richness of findings presented in this editorial, the online survey used in generating the data for this study has been extremely useful in identifying the challenges that university students experience in an attempt to cope with online learning at home. University administrators should consider using such a data collection strategy not only to identify the most at-risk students but also to assist them to the greatest extent possible.

At the time of writing, numerous countries are gradually relaxing the lockdown, including South Africa. Despite the fact that some form of normality is gradually returning, the scare of a second wave of the COVID-19 virus (Maphanga, 2020a), including a recent surge of COVID-19 cases in South Africa (Maphanga, 2020b), shows that South Africans are far from returning to full normalcy. In view of this. South African universities have to rethink higher education teaching and learning, to move from an emergency remote teaching approach to a more formalized, properly thought-through blended and hybrid teaching approach to replace the dominant traditional, face-to-face classroom teaching practice. We close with a very timely quotation by Rose (2020):

> While in the midst of this COVID-19 crisis, it is crucial that the academic educational community learns from the experience and prioritizes a forward-thinking and scholarly approach as practical solutions are implemented. Reflection and evaluation must follow … Students and educators can help document and analyze the effects of current changes to learn and apply new principles and practices to the future. (p. 2132)

With these words in mind, we encourage other researchers to replicate and to extend our current work.

Note

1. Tables have been created that provide examples of statements for all the metathemes and themes. However, because of the space constraints, only the table that provides examples of statements related to this theme of disturbance (i.e., Table 7) have been presented. However, the other tables can be provided upon request to the authors.

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