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The impact of COVID-19 on Chilean University students: obstacles that impacted their effective online learning

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Abstract
This comprehensive meta-methods research study aimed to investigate the challenges hindering effective remote learning for students at a Chilean university during the COVID-19 pandemic. The study involved 354 participants who completed an online questionnaire. The analysis, using WordStat 8.0.29 topic modeling, identified four challenge themes: Motivation, Time Management, Mental Health, and Learning Challenges. Canonical correlation analysis revealed statistically significant relationships between demographic variables (gender, age, child status, work status) and the emergent challenge themes. Latent class analysis produced three distinct student profiles focused on Time Management, Mental Health, and an interwoven Motivation and Learning Challenges cluster. By deconstructing these themes based on demographic variables, vulnerable subgroups were discerned for each specific challenge. This research provides nuanced insights into the multifaceted barriers faced by students during the pandemic, offering a foundation for tailored interventions and future research. The study's integration of various research approaches contributes to a more comprehensive understanding of the complex interplay between demographic factors and challenges, emphasizing the need for personalized strategies to address the diverse needs of students in a remote learning environment.

Keywords COVID-19 · Chilean university students' psychological well-being · Meta-methods research · Topic modelling · E-learning readiness · Demographic examination

Introduction

The global threat posed by COVID-19 led to widespread disruptions, prompting the modification or cessation of activities worldwide and transforming social, work, and educational paradigms (Lemay et al., 2023). This crisis significantly magnified challenges faced by Higher Education Institutions (HEIs) globally, as seen in the immediate shift to temporary online teaching in Chile and worldwide, with institutions rapidly closing physical doors and adopting virtual education (Purcell & Lumbreras, 2021). HEIs employed learning management systems and platforms like Zoom, Microsoft Teams, and Google Classrooms for synchronous online classes (McClure et al., 2021). Despite the transfer of educational content to the online environment, the shift did not uniformly encompass online teaching methods (Adnan, 2020).

Chilean universities faced disruptions due to the global pandemic leading to a shift from traditional face-to-face to emergency remote teaching and learning (ERTL) (Lemay et al., 2023). However, little is known about the challenges students encountered during this transition. The study focused on a prominent private university in Chile, exploring how undergraduate students adapted to online learning in the 2021 academic year.

Several researchers have investigated the effectiveness of online learning and teaching (Tang et al., 2021), involving students who voluntarily engaged in this approach to education (Lemay et al., 2023). Gherheș et al. (2021) emphasized the key advantage of online classes, eliminating the need to commute, resulting in significant time savings. This coincides with Vlachopoulos's (2020) observation that online classes facilitate location-independent engagement for both students and teachers. Benito et al. (2021) found a unanimous preference for hybrid education, and Darius et al. (2021) highlighted digital collaboration, reviewable

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video lectures, and access to online materials as critical factors in online education success. Despite the global shift to online learning during the pandemic, there is a lack of studies focusing on students' readiness for live online learning when they had no alternative (Tang et al., 2021).

The pandemic marked a significant episode in educational history, particularly in Chilean HEIs, which faced unprecedented challenges in adopting online methodologies due to limited resources and funds, similar to institutions worldwide (Singal et al., 2021). The magnitude of this transition remained unexplored in existing research. This research aims to address this gap by examining the challenges experienced by undergraduate students at a Chilean private university who had to engage abruptly in ERTL during the 2021 academic year. By doing so, we aim to provide valuable insights for future educational strategies and policies, particularly in the context of post-pandemic education. This study's contribution is significant as it sheds light on the specific challenges faced by students during the emergency transition to online learning, thereby informing the development of more effective educational practices and policies to enhance student readiness and support in similar future crises.

Purpose of study and research question

Mailizar et al. (2020) suggest a need for research focusing on students' experiences during the abrupt shift to online learning, examining its impact on their learning and academic success. Recognizing the challenges faced by students in this new reality, the present study replicates investigations conducted in South Africa (Onwuegbuzie et al., 2020). This targeted examination aims to identify challenges undergraduate students faced during the transition, potentially hindering their successful engagement with online learning. More specifically, this study addressed the following central research question:

What are the challenges faced by undergraduate students enrolled at a large HEI in Chile during the COVID-19 global pandemic that impeded their successful online learning experience as a result of having to undergo emergency remote learning?

In our exploration, we utilized Plano Clark and Badiee's (2010) mixed methods research question, following the $1+1=1$ full(er) integration formula. This approach, endorsed by Onwuegbuzie and Hitchcock (2019a), promises more comprehensive answers. As per Plano Clark and Badiee (2010), a comprehensive mixed methods research inquiry incorporates a broad question, integrating both quantitative and qualitative research approaches. A sub-question that we addressed was as follows:

What are the specific challenges faced by undergraduate students enrolled at a large HEI in Chile during the COVID-19 global pandemic that hindered their ability to learn online successfully as a function of selected demographic data?

Thus, we incorporated qualitative and quantitative components throughout the data collection, analysis, and interpretation stages. This fully integrated mixed methods research approach (Onwuegbuzie & Hitchcock, 2019a) allowed us to understand students' challenges and how the pandemic impacted higher education to provide successful interventions, to foster students' learning, and to design future learning online strategies.

Theoretical framework

The present study was driven by Sedlacek's (2004) theory of noncognitive variables. According to this theory, traditional cognitive measures (e.g., standardized test scores) do not capture the full range of factors influencing academic success in higher education). Moreover, this theory posits that noncognitive factors play a pivotal role in predicting academic success. As such, this theory recognizes the importance of noncognitive factors alongside cognitive measures. Therefore, the present study aimed to contribute to the empirical validation of Sedlacek's theory by examining the impact of noncognitive and cognitive variables on academic success, via online learning, within the context of COVID-19 among undergraduate students enrolled at a large HEI in Chile.

To conclude, examining the challenges that could hamper Chilean university students' learning online allowed us to identify and to describe the weaknesses of this sudden transition to online instruction and to anticipate the barriers and threats to online learning during the COVID-19 pandemic and beyond. Hence, the aspiration was that the outcomes of this investigation would contribute to the limited corpus of literature concerning the influence of COVID-19 on students within Chilean higher education institutions.

Method

Participants and data collection procedures

Our study focused on analyzing all undergraduate students who were enrolled in 2021 at a major HEI in Chile. The total number of students registered was 47,149 (50.85% women; 41.16% men; and 7.99% no response). The sampling scheme used represented a convenience sampling because students were selected who were conveniently available and willing to participate in the study (Onwuegbuzie & Collins, 2007). No compensation was provided to participants for

their involvement. Moreover, because all the participants (i.e., respondents) contributed to both the quantitative and qualitative components 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 (Onwuegbuzie & Collins, 2007).

This was a research study conducted using data collected via an online questionnaire. Multiple emails were dispatched to all currently enrolled undergraduate students, inviting their participation in our study. These emails detailed the study's importance and included a link to the participant information sheet, informed consent form, and a 15-minute online questionnaire. The participant information sheet outlined the study, questionnaire details, and confidentiality measures. The aim was to ensure transparency, informed consent, and comprehensive understanding of the study's nature and expectations among potential participants. The informed consent specified non-identifiable publication of results for academic purposes. Clicking the consent button indicated their willingness to participate. The questionnaire could be saved for later completion, within a 2-week deadline.

The first response was on September 28, 2021, and the last was on November 26, 2021. The final sample size for the study was 354 complete responses. In relation to the participants' demographics, most respondents ($n = 221$; 62.4%) were women, followed, respectively, by 122 men (34.5%) and 11 students (3.1%) who preferred not to respond. The majority (72.6%) of respondents were between 18 and 24 years of age, with 17.8% between 25 and 35, 7.6% between 36 and 45, 1.7% between 46 and 55, and 0.3% over the age of 55. Most participants in the study did not have children, with 311 individuals (87.9%) reporting no children, while 43 participants (12.1%) indicated they had one or more children. In terms of employment status, 113 participants (31.9%) were gainfully employed, whereas 241 participants (68.1%) were not gainfully employed. Chile's university landscape consists of three categories: municipal schools, privately subsidized schools, and privately non-subsidized schools. Within the sample, 56.8% hailed from parent- and state-supported private subsidized schools, 22.9% represented state-funded municipal schools, and 20.3% were from privately non-subsidized schools that were financed by parents (see Table 1).

Table 1 Participants' demographics

	Participants' demographics	
Gender	*n*	%
Women	221	62.4
Men	122	34.5
Prefer not to answer	11	3.1
Age		
18-24	257	72.6
25-35	63	17.8
36-45	27	7.6
46-55	6	1.7
over 55	1	.3
Child status		
No children	311	87.9
One or more children	43	12.1
Work status		
Gainfully employed	113	31.9
Not gainfully employed	241	68.1
Types of schools		
Municipal	81	22.9
Private subsidized	72	20.3
Private non-sub	201	56.8
Total	354	100

Research design

In the current study, both qualitative data (via responses to an open-ended item) and quantitative data (e.g., demographic information) were collected via an online questionnaire. The research design underlying this study was a fully mixed concurrent equal status design (Leech & Onwuegbuzie, 2009), which involves mixing quantitative and qualitative research approaches within at least one of the following four elements within a singular research investigation: the research objective, type of data and operational methods, analytical approach, and inferential approach. In this particular study, the qualitative and quantitative stages were mixed concurrently across all of these components, with the priority given to both the quantitative and qualitative components being approximately equally shared. According to Guest (2013), the simplification effort is commendable. Leech and Onwuegbuzie's (2009) eight-design typology clarifies design boundaries, reducing confusion with intuitive and simplified terminology. Additionally, this study involved the use of a meta-methods research approach, a term coined by Onwuegbuzie and Hitchcock (2019b), which involves maximal integration of research methodologies, encompassing both multiple methods research approaches and mixed methods research approaches, all within a single study. Specifically, this meta-methods research approach incorporated what Onwuegbuzie and Combs (2010) referred to as crossover mixed analyses, which represents a methodology whereby analysis approaches associated with one tradition (e.g., qualitative analysis) were utilized to scrutinize data linked to another tradition (e.g., quantitative data) (i.e., full[er] integration). The goal of this approach was to produce meta-inferences, wherein the interpretations from these diverse analysis approaches were seamlessly integrated into a cohesive framework (Tashakkori & Teddlie,

1998), enhancing the robustness and comprehensiveness of the findings.

Instruments

The 15-minute online questionnaire consisted of both closed-ended (i.e., 63 multiple-choice items and 4 demographic items) and open-ended items. The three open-ended items focused on the following topics: (a) perceptions on their current home situation for online learning; (b) personal challenges that could hinder their ability successfully to learn online; and (c) and general comments that might be useful to share. For this article, we considered responses to the demographic items (i.e., gender [men vs. women]; age, child status [No children vs. One or more children]; and work status [gainfully employed vs. not gainfully employed]), background items, and one open-ended item (i.e., "What challenges do you have that could hinder your ability to successfully learn online?").

Fully integrated data analysis

A fully integrated data analysis (FIDA) approach was used to answer the central research question and subquestion. This FIDA analysis involved a series of quantitizing approaches. Broadly speaking, quantitizing entails transforming qualitative data into numerical codes suitable for statistical analysis (Onwuegbuzie & Leech, 2019; Tashakkori & Teddlie, 1998). Onwuegbuzie and Johnson (2021) identified the following four classes of quantitization: descriptive-based quantitizing, exploratory-based quantitizing, measurement-based quantitizing, and inferential-based quantitizing. This investigation utilized exploratory-based quantitizing, descriptive-based quantitizing, and inferential-based quantitizing. As per the authors, exploratory-based quantitizing involves the quantitizing of qualitative data to identify group membership, whereby the groups could be based either on participants or variables (e.g., themes, words). Descriptive-based quantitizing employs descriptive analyses, comprising measures of central tendency, measures of variation/dispersion, measures of position/relative standing, and measures of distributional shape. Finally, inferential-based quantitizing involves quantitizing qualitative data for estimation or prediction purposes (Onwuegbuzie & Johnson, 2021).

Stage 1: Exploratory-based quantitizing

Exploratory-based quantitizing involved the use of topic modeling to identify the emergent themes that characterized challenges faced by undergraduate students enrolled at a large HEI in Chile during the COVID-19 global pandemic that impeded their capacity for successful online learning as a result of having to undergo emergency remote learning. Topic modeling is a statistical modeling technique used to discover latent (i.e., hidden) themes, topics, or patterns within a corpus of text. The process of topic modeling involves analyzing the co-occurrence patterns of words within a corpus of text and identifying groups of words that tend to appear together. These groups of words represent topics or themes that frequently occur in the text data. Topic modeling algorithms use probabilistic models to assign probabilities to words and topics, allowing for the estimation of the most likely topics for each corpus. We employed WordStat 8.0.29 (Provalis Research, 2020) to perform topic modeling using a factor analysis, aiming to uncover the primary topics (i.e., themes) from the responses to the open-ended question.

Stage 2: Descriptive-based quantitizing and inferential-based quantitizing

A matrix of themes among respondents (Onwuegbuzie, 2003) was created to capture the students' responses, with each emerging theme being quantitized within it such that if a student's response was associated with a specific emergent theme identified through the topic modeling, they were assigned a score of "1" for that theme; otherwise, a score of "0" was assigned. This process of dichotomization, or binarization, resulted in the creation of an inter-respondent matrix of themes (i.e., Student × Theme Matrix), as proposed by Onwuegbuzie (2003), which consisted only of 0s and 1s. From this matrix, the mean frequency of each theme was calculated, serving as manifest effect sizes (i.e., effect sizes related to observable content; Onwuegbuzie, 2003). The inter-respondent matrix also was used to determine the total number of emergent themes per student participant. The frequency distribution of this total then was ascertained.

Stage 3: Exploratory-based quantitizing

Utilizing the inter-respondent matrix as a foundation, a latent class analysis was undertaken to determine the smallest number of clusters (i.e., latent classes) that could comprehensively explain the relationships among the emergent themes. This analysis was conducted under the premise that the student participants could be grouped into a smaller set of distinct clusters, referred to as latent classes, based on their profiles of these emergent themes. This analysis incorporated what is known as qualitizing (Onwuegbuzie & Leech, 2019), which, as defined by Onwuegbuzie and Leech (2019), involved the transformation of data into qualitative form through "the

full integration of qualitative and quantitative research approaches (i.e., 1 + 1 = 1 integration formula), ultimately leading to a fully integrated analysis" (p. 122).

Stage 4: Inferential-based quantitizing

Furthermore, utilizing the inter-respondent matrix, as outlined by Onwuegbuzie (2022), a canonical correlation analysis was utilized to explore the multivariate relationship between the selected demographic variables and the emergent challenge themes. Broadly speaking, a canonical correlation analysis is used to examine the relationship between two sets of variables in situations when each set contains more than one variable (cf. Onwuegbuzie & Daniel, 2003; Thompson, 1984). The set of emergent themes was employed as the dependent variables, whereas the four demographic variables were used as the independent variables.

Subsequent to the canonical correlation analysis, again, utilizing the inter-respondent matrix, a series of Fisher's Exact Tests was performed to ascertain the association between the emergent themes and the specific demographic variables. The Bonferroni adjustment (Chandler, 1995) was applied to maintain the familywise error rate below 5%.

Finally, the total number of emergent themes per student participant was correlated with the selected demographic variables to examine which of these variables predicted the total number of emergent themes. Due to the limited range of the total number of emergent themes, a set of nonparametric point-biserial correlations, specifically Spearman rs, was employed.

Table 2 Topics extracted from the responses delineating the challenges experienced by students that hinder their ability to successfully learn online during the COVID-19 pandemic ($n = 354$)

No	Topic labels	High probability terms	Coherence	Relative proportion
1	Motivation	Initiative; group; achieving; continue; goals; organized; motivation; studying; lot; learn	0.49	0.11
2	Time Management	Comfortable; time; complicated; studying; organize; study; work; hard; aware; amount	0.32	0.15
3	Mental Health	Attentive; dealing; issues; mental; health; fully; moment; studies; difficult; mental health	0.50	0.53
4	Learning Challenges	Initiative; group; achieving; continue; goals; organized; pandemic; motivation; lack; studying	0.49	0.21

Results

Stage 1: Exploratory-based quantitizing

Topic modeling of responses

Table 2 displays the high-probability terms extracted from the k = 4 topic model solution, representing the four identified topics within the corpus of responses. This table highlights the 10 high-probability terms distinguishing each of the four topics in accordance with topic modeling principles (Provalis Research, 2014). It identifies the specific topics within the corpus:

- Topic 1: Motivation;
- Topic 2: Time Management;
- Topic 3: Mental Health; and.
- Topic 4: Learning Challenges.

Table 2 displays topic coherence scores, indicating semantic clarity, and the proportion of text for each of the four identified topics. The subsequent sections present the bolded topics and their associated terms, with corresponding themes italicized, as derived from the coherence scores and proportions outlined in the table.

Table 2 indicates that **Mental Health** (Topic 3) had, by far, the largest proportion of extracted statements (53.35%), comprising high-probability terms such as *Attentive*, *dealing*, *issues*, *mental*, *health*, *fully*, *moment*, *studies*, *difficult*, *and mental health*. This theme emphasizes the significance of mental health challenges among Chilean university students during the COVID-19 pandemic, hindering their effective engagement in online learning. Addressing emotional needs in the context of emergency remote learning becomes essential. For one student, his mental health issues resulted in panic attacks:

> "Panic attacks when I don't understand something" (Man, 21, no children, did not work, Faculty of Science).

Lockdown directly triggered mental health challenges for some students, as revealed by the following disclosure:

> "Navigating the emotional challenges of current circumstances, involving isolation from friends, severed connections, and sacrificed hobbies, has led

to persistent depression and reduced motivation." (Woman, 20, no children, did not work, Faculty of Science).

The online learning environment exacerbated mental health challenges for some students, as illustrated by the following statement:

"Struggles with concentration, disorganization, procrastination, and the depressive episode affected my academic performance." (Woman, 22, no children, did not work, Faculty of Rehabilitation Science).

Some students discussed coping mechanisms that they used to address their mental health challenges:

"I frequently experience frustration when plans go awry, often becoming emotional and tearful over minor issues. Despite valuing emotional expression, I struggle with control, occasionally feeling overwhelmed and requiring a break." (Woman, 21, no children, did not work, Faculty of Education and Social Sciences).

The Mental Health theme is followed by the **Learning Challenges** topic (Topic 4), encompassing 20.49% of the extracted statements, featuring high-probability terms like *Initiative*, *group*, *achieving*, *continue*, *goals*, *organized*, *pandemic*, *motivation*, *lack*, *and studying*. This topic highlights the challenges that made it (more) difficult for them to learn successfully. One very common learning challenge was a lack of adequate focus, as exemplified by the following statement:

"Concentrating in online classes is challenging due to the lack of in-person interaction, making focus maintenance more difficult." (Woman, 21, no children, did not work, Faculty of Education and Social Sciences).

For another student, their learning challenges stemmed from "insecurities and difficulties in maintaining focus" (Man, 22, no children, did not work, Faculty of Medicine). Several reasons for learning challenges were provided as follows:

"Online classes disrupt my concentration with constant device use, and the lack of hands-on labs frustrates my learning style." (Man, 20, no children, did not work, Faculty of Life Sciences).

Another reason cited was the lack of a suitable study space:

"I lack a dedicated study space and a structured approach to studying." (Woman, 20, no children, did not work, Faculty of Education and Social Sciences).

Noise that resulted from having to learn at home also was cited as a factor:

"I face multiple distractions, including noise from neighbors and construction, hindering my ability to focus effectively during online classes." (Woman, 24, no children, did not work, Faculty of Education and Social Sciences).

One of the more compelling account came from a 30-year-old woman representing the Faculty of Education and Social Sciences, who had a child and who worked:

As a single mother to a young daughter, I face challenges balancing her care, professional responsibilities, and household tasks, making it difficult to manage academic workload.

The subsequent prominent topic among students (15.42% of the extracted statements) centered on **Time Management** (Topic 2), showcasing high-probability terms encompassing *Comfortable*, *time*, *complicated*, *studying*, *organize*, *study*, *work*, *hard*, *aware*, *and amount*. This theme emphasizes the crucial role of time management in the challenges experienced by these students during the COVID-19 pandemic. Many faced difficulties balancing home and academic responsibilities, a shift exacerbated by the transition to online learning. This is evident in the following anecdotes:

"Juggling family care and study time is a constant challenge, leaving limited time for academic pursuits." (Woman, 24, no children, did not work, Faculty of Nursing).
"Balancing study, work, family, and social life, while ensuring adequate time for each aspect, proves challenging for me." (Man, 39, one child, worked, Faculty of Engineering).

A particularly compelling extract that illustrates the juggling act that many students had to undergo is as follows:

"Balancing household chores and studying has been a significant challenge for me. There have been occasions where I've had to multitask, such as folding clothes during class or cooking while trying to focus on my studies. This juggling act has proven to be quite complicated, and I believe that being physically present on campus would greatly alleviate these time

> constraints and allow me to dedicate more time to my university responsibilities." (Woman, 20, no children, did not work, Faculty of Education and Social Sciences).

One student implicated her professors and university staff as contributing to her time management challenges, as follows:

> "The lack of flexibility from professors and university staff in recognizing the unique challenges of studying from home, where the assumption is that students have unlimited time available, hampers my ability to manage my academic responsibilities effectively." (Woman, 20, no children, did not work, Faculty of Nursing).

The concluding theme (10.75% of the extracted statements) pertains to **Motivation** (i.e., Topic 1), featuring high-probability terms such as *Initiative*, *group*, *achieving*, *continue*, *goals*, *organized*, *motivation*, *studying*, *lot*, *and learn*. This topic indicates that motivation was an important challenge. For some students, their lack of motivation was debilitative, as the following account illustrates:

> "I experience a significant lack of motivation, particularly during morning classes, making it challenging to sustain focus and attention." (Man, 19, no children, did not work, Faculty of Education and Social Sciences).

Several students directly linked their lack of motivation to the online learning environment, as exemplified by the following statement:

> "Despite my efforts in studying, reading, and reviewing online classes, I haven't found them as effective for my learning as face-to-face classes, leading to a loss of motivation in my chosen career." (Woman, 20, no children, did not work, Faculty of Law).

Finally, two students mentioned a lack of motivation not only to engage in online learning but also to engage in other activities:

> "I lack motivation for activities, including attending classes, seeing learning more as an obligation than a pleasure." (Prefer not to answer, 19, no children, did not work, Faculty of Education and Social Sciences).
> "I face a notable lack of motivation, affecting both academic pursuits and overall life, leading to neglect and falling behind." (Woman, 20, no children, did not work, Faculty of Education and Social Sciences).

Table 3 Manifest effect size and standard deviation of each emergent theme

Theme	Mean frequency (i.e., Manifest effect size)	Standard deviation
Motivation	0.234	0.42
Time Management	0.226	0.42
Mental Health	0.285	0.45
Learning Challenges	0.243	0.43

Stage 2: Descriptive-based quantitizing and inferential-based quantitizing

Prevalence rates

Table 3 presents manifest effect sizes (i.e., effect sizes that pertain to observable content; Onwuegbuzie, 2003) that were computed from the inter-respondent matrix (Onwuegbuzie, 2003) of themes. These manifest sizes reveal a prominent prevalence of the Mental Health theme, with almost one third (29%) of responses reflecting challenges falling within this category. This theme was followed by Learning Challenges, with a 24% prevalence rate, followed, closely by both Motivation (23%) and Time Management (23%).

The inter-respondent further unveiled a diversity in the number of themes per participant, spanning from 0 to 3 (M = 1.01, SD = 0.82). The largest subset of participants exhibited contributions to a single theme ($n = 154$). Subsequently, 77 participants were associated with two themes, and 14 participants were associated with three themes.

Stage 3: Exploratory-based quantitizing

Latent class analysis

The latent class analysis of the four emergent themes revealed a three-cluster solution (L2 = 1.80, df = 1, $p = .18$, Bootstrap $p = .73$). These clusters consist of the following proportions: Cluster 1 (45.21%), Cluster 2 (34.81%), and Cluster 3 (19.98%). The profiles of these three clusters are outlined below:

- Cluster 1: Students within this cluster exhibit comparatively lower levels in terms of the Motivation, Mental Health, and Learning Challenges themes, but relatively high in terms of the Time Management theme. Therefore, this cluster can be labeled as students who represent the Time Management cluster.
- Cluster 2: Students in this cluster demonstrate relatively diminished levels of the Motivation, Time Management, and Learning Challenges themes but relatively high in

terms of the Mental Health theme. Hence, this cluster can be identified as students who represent the Mental Health cluster.

- Cluster 3: Students in this cluster exhibit relatively lower levels with regard to Time Management and Mental Health themes but extremely high in terms of the Motivation and Learning Challenges themes. Therefore, this cluster can be identified as students embodying the Motivation and Learning Challenges cluster.

Following a multiple methods approach, a twostep cluster analysis also was performed to determine the optimal number of clusters related to the four emergent themes. This twostep cluster analysis similarly resulted in the identification of three clusters, thereby affirming the validity of the three-cluster solution derived from the latent class analysis.

Table 4 Canonical correlation analysis: Canonical solution for the two statistically significant functions: Relationship between the four demographic variables and the four most prevalent challenge themes

	Function 1[a]		Function 2[b]	
	Standardized coefficient	Structure coefficient	Standardized coefficient	Structure coefficient
Demographic Variables:				
Gender	0.65*	0.70*	0.69*	0.65*
Age	-0.36*	−0.66*	-0.17	0.34*
Child status	-0.34*	−0.67*	0.52*	0.50*
Work status	-0.20	−0.44*	0.56*	0.64*
Challenge Themes:				
Motivation	0.06	0.30*	-0.22	−0.45*
Time Management	-0.36*	−0.57*	0.74*	0.65*
Mental Health	0.82*	0.82*	0.65*	0.53*
Learning Challenges	0.40*	0.27	-0.19	−0.44*

*Practically significant coefficients with the effect sizes greater than 0.3 (Lambert & Durand, 1975)

Variables that are italicized but not bolded have either a standardized coefficient or a structure coefficient on one or more canonical functions that is practically significant

Variables that are bolded have both a standardized coefficient and a structure coefficient on one canonical function that are practically significant

Variables that are bolded and italicized have both a standardized coefficient and a structure coefficient on both canonical functions that are practically significant

Variables that are neither bolded nor italicized (i.e., normal font) have a non-practically significant standardized coefficient and a non-practically significant structure coefficient on both canonical functions

[a] $R_{c1} = 0.36$; $R_{c1}^2 = 12.60\%$ (Eigenvalue = 0.14; Wilk = 0.82; $F = 3.88$, $p < .001$)

[b] $R_{c2} = 0.22$; $R_{c2}^2 = 4.62\%$ (Eigenvalue = 0.05; Wilk = 0.94; $F = 2.13$, $p = .025$)

Stage 4: Inferential-based quantitizing

Canonical correlation analysis

A canonical correlation analysis was employed to investigate the multivariate relationship between the four demographic variables (i.e., gender [men vs. women]; age, child status [No children vs. One or more children]; and work status [gainfully employed vs. not gainfully employed]) and the four central challenge themes (i.e., Motivation, Time Management, Mental Health, Learning Challenges). This form of analysis produces one or more canonical functions, which are determined by the size of the smaller variable set (Thompson, 1984). Hence, because the canonical correlation analysis involved the correlation between four challenge themes and four demographic variables, four canonical functions were produced. Each function was evaluated for both statistical significance (i.e., p value) and practical significance (i.e., effect size). Each canonical function is characterized by both the standardized coefficients and the structure coefficients pertaining to each variable. In the present study, each statistically significant canonical coefficient was analyzed, along with their standardized coefficients and structure coefficients, aiding practical significance assessment (Onwuegbuzie & Daniel, 2003).

The canonical correlation analysis indicated that the four canonical correlations as a set were statistically significant ($p < .001$). Further, when the first canonical root was removed, the remaining three canonical roots were statistically significant ($p < .001$; Canonical Rc1 = 0.36). This suggests that the first canonical function was statistically significant and, thus, should be interpreted. Likewise, upon exclusion of the first two canonical roots, the remaining two canonical roots demonstrated statistical significance ($p < .025$; Canonical Rc2 = 0.22). In contrast, excluding the first three canonical roots rendered the remaining canonical root as statistically non-significant ($p = .36$). Furthermore, the fourth canonical root also lacked statistical significance ($p = .86$). These findings, collectively, led to the conclusion that, although the first two canonical functions were both statistically and practically significant (Cohen, 1988), the latter two roots lacked statistical significance. As a result, only the first two canonical functions were interpreted.

Table 4 displays the results of canonical correlation analysis for the initial canonical root. This table presents the standardized coefficients (i.e., canonical function coefficients), as well as the structure coefficients for this function. Applying the cutoff coefficient of 0.3, as suggested by Lambert and Durand (1975), the standardized coefficients highlighted the significant contributions of gender, age, and child to the set of independent variables—with gender by far making the greatest contribution. Regarding the array of

dependent variables, significant contributions were observed from time management, mental health, and learning strategies, with mental health yielding the most substantial contribution. Further, the structure coefficients linked to the first canonical function unveiled that all four demographic variables significantly contributed to the first canonical variate, with gender, again, making the largest contribution, followed closely by child status and age. With respect to the set of challenge themes, motivation, time management, and mental health played significant roles, with mental health once more emerging as the dominant contributor to its corresponding set.

Upon comparing the standardized coefficients and structure coefficients presented for the first initial canonical function in Table 4, it is apparent that both work status and motivation exhibit signs of multicollinearity, as evidenced by the fact that the structure coefficients linked to these variables (i.e., 0.44, 0.30, respectively; both ≥ 0.30) were relatively large, whereas the corresponding standardized coefficients (i.e., 0.20, 0.06, respectively; both < 0.30) were relatively small (Onwuegbuzie & Daniel, 2003). Further, it is worth noting that learning challenges played a role as a suppressor variable. This is evident from the fact that the standardized coefficient attributed to this variable (i.e., $0.40 > 0.30$) was relatively large, whereas the corresponding structured coefficient (i.e., $0.27 < 0.30$) was relatively small (Onwuegbuzie & Daniel, 2003). As explained by Onwuegbuzie and Daniel (2003), suppressor variables enhance the prediction of dependent variables, thereby amplifying the effect size. This enhancement stems from their association with one or more independent variables. In essence, suppressor variables improve the predictive power of the other independent variables in the model by inhibiting variance that does not contribute to this prediction. This is achieved through the suppressor variable's relationship with the other independent variables.

In summary, the first canonical root revealed that the multivariate relationship between the demographic variables and the challenge themes was primarily driven by the association between gender, age, and child status from the set of independent variables, and mental health and time management from the dependent set. Both work status and motivation played a collinear role, whereas learning challenges served as a suppressor variable. Specifically, the first canonical root revealed the following:

- Women, the youngest students without children, and those not gainfully employed tended to report the most challenges related to motivation.
- Women, the youngest students without children, and those not gainfully employed tended to report the most challenges related to mental health.
- Women, the youngest students without children, and those not gainfully employed tended to report the most learning challenges.
- Men, the oldest students, students who had at least one child, and students who were gainfully employed tended to indicate the most challenges associated with time management.

Table 4 also provides information concerning the other canonical root that was both statistically and practically significant—specifically, the second canonical root. The standardized canonical function coefficients pertaining to this second canonical root revealed that gender, child status, and work status played significant roles in predicting the challenge themes, with gender exhibiting the most substantial influence. With regard to the challenge themes, time management and mental health demonstrated significant contributions, each making considerable contributions in their own right. The structure coefficients associated with the second canonical function highlighted significant contributions of all four demographic variables to their respective sets, with gender and work status making the most significant contribution. On the other side of the equation, all four challenge themes made significant contributions, with time management and mental health each emerging as the primary contributors.

Comparing the standardized and structure coefficients suggested that age was collinear. Further, the following two challenge themes were collinear: motivation and learning challenges. In summary, the second canonical root led to the conclusion that the multivariate association between the demographic variables and the challenge themes was chiefly defined by the relationship between gender, child status, and work status on the one hand, and time management and mental health on the other hand. Additionally, age, motivation, and learning challenges contributed to the multivariate relationship. Specifically, the second canonical root unveiled the subsequent findings:

- Women, students who had at least one child, students who were gainfully employed, and the youngest students tended to indicate the most challenges associated with time management.
- Women, students who had at least one child, students who were gainfully employed, and the youngest students tended to indicate the most challenges associated with mental health.
- Men, students with no children, students who were not gainfully employed, and the oldest students tended to indicate the most challenges associated with motivation.

- Men, students with no children, students who were not gainfully employed, and the oldest students tended to indicate the most learning challenges.

Fisher's Exact Tests

Following the canonical correlation analysis, a series of Fisher's Exact Tests was performed to explore the association between the four emergent themes and the select demographic variables. The Bonferroni adjustment (Chandler, 1995) was applied to ensure that the familywise error rate did not exceed 5% (i.e., adjusted $\alpha = 0.05/4$ themes $= 0.0125$). Table 5 displays the demographic variables that are statistically significant predictors of each theme.

In summary, Table 5 reveals the following:

- The Motivation theme was predicted by work status.
- The Time Management theme was predicted by child status and work status.
- The Mental Health theme was predicted by child status and work status.
- The Learning Challenges theme was predicted by child status and work status.

Table 5 Demographic variables statistically significant predictors of each theme

Theme	Mean frequency (i.e., Manifest effect size)
Motivation	WORK STATUS: Non-working students were 2.17 times (95% confidence interval [CI] = 1.31, 3.58) more likely than their working counterparts to report issues related to motivation.
Time Management	CHILD STATUS: Students with one or more children were 4.90 times (95% CI = 1.94, 12.32) more likely than those without children to report issues related to time management. WORK STATUS: Working students were 2.63 times (95% CI = 1.57, 4.40) more likely than non-working students to report issues related to time management.
Mental Health	GENDER: Women students were 4.09 times (95% CI = 2.23, 7.49) more likely than male students to report issues related to mental health. CHILD STATUS: Students without children were 8.41 times (95% CI = 1.15, 61.81) more likely than those with one or more children to report issues related to mental health.
Learning Challenges	CHILD STATUS: Students without children were 6.75 times (95% CI = 0.92, 49.68) more likely than those with one or more children to report issues related to learning challenges. WORK STATUS: Non-working students were 1.78 times (95% CI = 1.13, 2.81) more likely than working students to report issues related to learning challenges.

Nonparametric point-biserial correlations

Due to the limited range of emergent themes (ranging from 0 to 3), a series of nonparametric point-biserial correlations, specifically Spearman rs, was computed. The goal of this analysis was to examine the relationship between the select demographic variables and the total number of themes. To mitigate the risk of Type I error, the Bonferroni adjustment was employed. Following this adjustment, the set of nonparametric point-biserial correlations revealed no statistically significant relationship between the number of themes and gender ($rs = 0.11$, $p = .045$), child status ($rs = -0.07$, $p = .19$), and work status ($rs = -0.08$, $p = .12$). Contrastingly, participants who generated a statistically significant higher number of themes tended to be younger ($rs = 0.19$, $p < .001$), with this correlation representing a small-to-moderate effect size. That is, to a small-to-moderate degree, the youngest students appeared to face the greatest number of challenges.

Discussion

The current inquiry replicates studies conducted in South Africa examining the challenges faced by university students during COVID-19 that impeded their successful online learning experience as a result of having to undergo emergency remote learning (i.e., Onwuegbuzie et al., 2020), except that the present study involved undergraduate students enrolled at a large HEI in Chile. Conducted as a meta-methods research study, the present inquiry yielded notable findings. The open-ended responses exposed numerous challenges faced by students at a Chilean University during the COVID-19 era, identified through topic modeling analysis that revealed the following four themes: Motivation, Time Management, Mental Health, and Learning Challenges. It should be noted that motivation, time management, and mental health represent noncognitive variables, and that learning challenges represent both cognitive and noncognitive variables. The four themes support Sedlacek's (2004) theory of noncognitive variables inasmuch as it demonstrates that both cognitive and noncognitive factors played an important role in impacting the online learning process of undergraduate students enrolled at a large HEI in Chile within the context of COVID-19.

Employing Cohen's (1988, pp. 180–183) non-linear arcsine transformation and Cohen's d criteria, Onwuegbuzie (in press) established thresholds of 1% endorsement to indicate a small effect size, 7% endorsement for a medium effect size, and 16% endorsement for a large effect size. Using these cut-points, all four themes—which ranged from 23 to 29% (see Table 3)—represent large effect sizes.

Among the four emergent themes, the one with the highest prevalence—signifying the theme with the gravest potential repercussions and, consequently, requiring immediate attention—is the mental health needs of students. Disturbingly, the 29% effect size found in the present study for the mental health theme is significantly larger than the 9.5% effect size associated with mental health challenges reported by Onwuegbuzie and Ojo (2021) in a study of undergraduate and graduate students at a South African University ($n=4,419$), as well as the 12.3% reported by Onwuegbuzie et al. (2020) among undergraduate and graduate students enrolled in another South African University ($n=1,932$) and the 7.4% reported by McClure et al. (2021) among 254 undergraduate and graduate students enrolled at a university in New York City. As concluded by Onwuegbuzie et al. (2020), this Mental Health theme urgently needs to be addressed. According to Onwuegbuzie et al. (2020) and Onwuegbuzie and Ojo (2021), mental health issues can lead to suicidal thoughts and, more alarmingly, actual suicide attempts. Interestingly, as can be seen from the odds ratios in Table 5, women students were more than four times more inclined to report issues related to mental health compared to their men counterparts. This odds ratio is much larger than is the odds ratio of 1.83 reported by Onwuegbuzie et al. (2020) and 1.70 reported by Onwuegbuzie and Ojo (2021). The odds ratio of 4.09 in this study not only aligns with pre-COVID-19 findings indicating higher rates of factors associated with mental health disorders among women (Scott-Young et al., 2020), but also confirms that this gender difference has prevailed, if not increased, within this COVID-19 context. Qualitative responses from women students reveal that the overall impact of the pandemic, particularly the lockdown, intensified mental health challenges. In the same vein, Duarte and Jiménez-Molina (2022) further support the significant link between being female and experiencing psychological distress over time. Their study and the present study suggest that this gender difference is more pronounced among Chilean students compared to South African counterparts, highlighting potential generalizability across Chilean universities.

Mental health issues are highly prevalent among Chilean university students, exceeding rates in the general population, and are frequently associated with self-harm; and academic stress with being female has been identified as a significant contributing factor (Vinet et al., 2022). Women in Chilean society have faced burdens during the pandemic, taking on increased responsibilities in domestic oversight, family care, and supporting children's or younger siblings education (García et al., 2022), exacerbating the difficulties in sustaining livelihoods and ensuring well-being (Riecher-Rössler, 2022). The substantial demands on women likely exacerbate the pandemic's impacts, suggesting a gender-related influence on susceptibility to mental health challenges.

A surprising discovery emerged as students without children were more than eight times more likely than were those with children to indicate mental health problems. However, although parenthood can lead to increased stress, sleep deprivation, and financial pressures, which, in turn, might contribute to mental health problems, parenthood can provide a sense of purpose, meaning, and fulfillment, which can contribute to overall well-being (Nelson et al., 2013). Studies like Novoa et al. (2021) suggest that Chileans with children exhibit higher well-being and reduced mental health issues. Additionally, research by Carrillo et al. (2016) in Brazil, Mexico, and Chile indicates a positive association between parenthood and life satisfaction, aligning with findings of lower depression and higher happiness levels among parents. Then, parenthood appears positively to influence mental well-being during COVID-19. Further research is recommended to explore and to validate this finding within the pandemic context.

The next most prevalent theme was Learning Challenges (24%). Surprisingly, students with no children were nearly 6.75 times more likely than were students with one or more children to indicate problems associated with learning challenges. Nikiforidou and Holmes (2022) suggest that the lower likelihood of mental health problems among student parents during the pandemic might stem from increased family time fostering organization and proactivity. Despite lockdown challenges, the study reveals that student parents effectively balanced parenting and academics through communication and negotiation, reducing feelings of alienation and learning challenges. The ability to navigate conflicting roles during the day and night contributed to their overall well-being and successful management of multiple responsibilities.

The literature lacks research on the higher prevalence of learning challenges among Chilean students without children compared to student parents. Inference suggests that students without children might face different distractions hindering effective handling of learning challenges. Novoa et al. (2021) explored well-being indicators among Chilean adults, considering those with and without children, providing insights into potential disparities in challenges faced by these groups. These authors highlight parenthood's potential for immense fulfillment through continuous learning and embracing new roles. This suggests that parents, equipped with such experiences, might be better prepared to tackle learning challenges compared to those without children.

Also surprisingly, students who did not work were 1.78 times more prone than were their employed peers to signal issues connected to learning challenges. Engaging in work to a reasonable extent does not appear to hinder students' academic advancement (Douglas & Attewell, 2019). Student parents, known for enhanced organization and structure

(Nikiforidou & Holmes, 2022), might navigate learning challenges positively. Research indicates that students working alongside studies often possess skills contributing to effective addressing of learning challenges, compared to non-working counterparts (Scott-Clayton & Minaya, 2016). This suggests that work experience can equip students with valuable skills for academic success.

The third most prevalent theme was Motivation (23%). Interestingly, students who did not work were 2.17 times more inclined than were students who were employed to point out issues linked with motivation. Although specific research on the relationship between work status and motivation among Chilean students is lacking, insights from similar contexts provide relevance. For instance, Hermawan and Astuti (2021) found that Indonesian university students, though facing challenges in balancing work and studies, displayed strong motivation driven by intrinsic and extrinsic factors. They sought relevant knowledge for future employment and financial stability, distinguishing themselves from non-working peers. Similarly, Malaysian university students in Tumin et al.'s (2020) study demonstrated high motivation despite juggling work and studies, attributing employment experiences to personal growth and essential skill development for improved employment prospects.

The final theme was Time Management (prevalence rate = 23%). Interestingly, students with one or more children were 4.90 times more prone than were students without children to highlight challenges related to time management. This finding, which has intuitive appeal, is consistent with the literature. Sicam et al. (2021) emphasized time management as a significant challenge for student mothers. Nikiforidou and Holmes (2022) noted that, according to student parents, the main difficulties revolve around time management, particularly allocating limited time to family commitments over personal pursuits. Lucchini-Raies et al. (2018) reported similar challenges among student parents at a Chilean private university, attributing time management difficulties to their primary responsibility of caring for children, limiting availability for academic studies and other commitments.

Not surprisingly, students who worked were 2.63 times more likely than were students who did not work to signal issues connected with time management. Although specific research on Chilean students regarding the link between work status and time management is lacking, insights from other contexts, such as Hermawan and Astuti's (2021) findings on Indonesian students, highlight the importance of effective time management in balancing academic obligations, work responsibilities, personal development, and overall well-being. Similarly, Malaysian working students face time limitations, emphasizing the need for a balance between work and academic commitments (Tumin et al., 2020).

Lastly, the intriguing finding that younger students, to a small-to-moderate degree, tend to face more difficulties merits deeper exploration. This observation implies that the challenges impeding successful online learning during the COVID-19 pandemic for students at the Chilean University might be influenced by their age.

Finally, the present research was rooted in a critical dialectical pluralistic perspective, as outlined by Onwuegbuzie and Frels (2013), which operates under the belief that societal inequalities are embedded within broader contexts. Guided by this perspective, a central aim of the study was to furnish students, educators, and administrators in Chilean universities with insightful data, enabling them adeptly to navigate students' learning experiences during potential future scenarios requiring emergency remote teaching and learning.

Summary and conclusions

Significantly, the multidimensional nature of challenges, comprising both cognitive and noncognitive variables—consistent with Sedlacek's (2004) theory—and influenced by demographic variables, is a key finding. Canonical correlation analysis confirms a multivariate relationship between demographics and emergent challenge themes. Examining subgroups vulnerable to specific challenges empowers administrators to design tailored interventions. This approach, utilizing targeted strategies, such as adaptive learning systems, addresses the unique needs of each subgroup, avoiding a generalized approach for all students (Firat & Bozkurt, 2020). As these interventions are being formulated, it is crucial to assess their effectiveness and impact through rigorous research and evaluation methods (Ardiyanto et al., 2021). This will help identify and document the interventions that are most effective and beneficial, aiming to enhance the online learning experiences for a wide range of students (Onwuegbuzie & Ojo, 2021).

Limitations

Constraints to generalizing study results beyond Chilean university students include the limited number of variables used to describe the respondents. For instance, focusing solely on the challenges faced by Chilean university students in online learning, without considering their strengths, might restrict the applicability of the findings to students who did not struggle with the rapid transition to online learning.

Implications and recommendations

This study holds promise for shaping future research, informing decision-making, and inspiring initiatives led by institutional leaders. The lessons learned provide enduring insights applicable in the post-pandemic era, valuable for similar institutions committed to enhancing the well-being aspects of teaching and learning. Based on the findings pertaining to mental health, a recommendation is to promote the formation of social networks including virtual social groups among students during lockdown and post-pandemic contexts to build supportive communities that can facilitate peer interactions, reducing feelings of isolation. These groups could offer mutual support and assistance, as well as foster solidarity-based networks. Besides, it is recommended to implement targeted educational interventions aimed at providing significant support for mental health and promoting resilience among students. These targeted educational interventions could include, counselling services, mental health workshops, academic support services such as tutoring, study groups, and peer support groups, specifically designed to address the unique needs of students. In addition, implementing adaptive learning technologies can provide personalized learning experiences for students. These systems can adjust the content and pace of learning based on individual student performance, helping to address the varying challenges students face and improving overall learning outcomes. It is crucial to evaluate continuously the effectiveness of these interventions through rigorous research and assessment. Regular feedback from students and faculty should be incorporated to refine and to improve support services, ensuring they meet the evolving needs of the student population. Considering the non-cognitive challenges related to time management and work-life balance, universities should explore flexible scheduling options and workload management support. This might include offering more asynchronous learning opportunities, flexible deadlines, and workshops on time management skills.

These recommendations are grounded in the study's findings and aim to create a more supportive and effective educational environment for all students. By implementing these targeted strategies, universities can better support their students, particularly those facing significant challenges in their transition to online learning. Finally, the Chilean Government should carefully evaluate the allocation of increased funding to universities to tackle mental health challenges effectively. This would strengthen university support centres, such as counselling services, designed to offer necessary interventions aimed at improving student well-being and academic success.

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Data Availability The datasets generated and/or analysed during the current study are not available to anyone at any time due to the sensitive nature of the data.

Declarations

Informed consent Was obtained from all individual participants included in the study.

Competing interests On behalf of all authors, the corresponding author states that there is no conflict of interest.

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