

Mobile Devices and Meaningful Learning among University Students in Situations of Vulnerability during Remote Education due to COVID-19

Marco Antonio Toledo Rodriguez^{1*}, Suyai Gallegos Espinoza¹, Olga Sosa Peralta¹, Doris Anyaipoma Hurtado¹, Susan Ambrosio Sevillando¹.

^{1*} Universidad Nacional de Educación "Enrique Guzmán y Valle"

*Autor de principal: mtoledo@une.edu.pe. ORCID: <https://orcid.org/0000-0003-0787-5435>; 07685327@une.edu.pe, <https://orcid.org/0000-0001-8499-7351>; 10112183@une.edu.pe, <https://orcid.org/0009-0006-7803-6582>; 20211313@une.edu.pe, <https://orcid.org/0000-0001-5812-6966>; 20223074@une.edu.pe, <https://orcid.org/0009-0007-3473-7747>.

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The study evaluated whether mobile devices distributed by MINEDU influenced the meaningful learning of vulnerable students from the Faculty of Business Sciences at the National University Enrique Guzmán y Valle during the 2021-II semester. A quantitative, applied research approach was adopted, with a non-experimental, cross-sectional, and correlational design. The probabilistic sample included 125 beneficiary students who took courses in synchronous and asynchronous virtual modalities. Data were collected through a structured questionnaire that measured "effects of portable equipment (mobile devices provided by MINEDU)" and "meaningful learning" across its three dimensions. The analysis employed descriptive and inferential statistics, using Spearman's correlation coefficient. The empirical evidence indicated the absence of statistically significant correlations between mobile devices and meaningful learning, nor between the independent variable and the evaluated dimensions. It is concluded that, under the analyzed conditions, the provision of mobile devices constituted a necessary but not sufficient access condition to improve meaningful learning, highlighting the importance of pedagogical design and teaching mediation.

Keywords: mobile devices, meaningful learning, remote education, vulnerable students, mobile learning, digital divide.

1. Introduction

The appearance of SARS-CoV-2 gave rise to a sequence of the most severe governmental measures in Peru, which began to be used since the middle of March 2020, including the complete isolation of the population. The

continuation of the unfavorable epidemiological situation within a two-year cycle (2020-2021) resulted in the unlimited nature of the closure of physical educational spaces at all stages of the national education system. Such a break of the traditional instructional paradigm impacted the

academic path and educational development of a huge population of students badly.

The international level has also been experiencing a sudden shift in the traditional model of education triggered by the health emergency, which is leading to a timely transition to the virtual mode of instruction carried out in emergency circumstances (Dhawan, 2020; UNESCO, 2020). This case highlighted structural technological inequalities, which manifested in the disparity in access to digital devices and the uneven distribution of skills to successfully use them (Beaunoyer et al., 2020). Within Latin American environments, several surveys found that significant proportions of the student body were not sufficiently technologically endowed to effectively engage in the process of virtualization learning (CEPAL-UNESCO, 2020; Rieble-Aubourg and Viteri, 2020), further widening existing educational inequalities and jeopardizing the continuation of education, especially among the socioeconomically disadvantaged subgroups (Rodicio-García et al., 2020).

As a result of the situation, Peruvian schools had the difficulty of keeping the educational services running under the conditions of severe epidemiological restrictions. Some of the measures embraced were the introduction of virtualised pedagogical strategies and digitally mediated environments. These solutions were however mostly favourable to students who had sufficient financial means, access to computer equipment, good internet connectivity, and favourable home conditions. On the other hand, high population groups that are socioeconomically vulnerable were locked out of these opportunities leading to the increased inequality, school dropouts and the decline in educational attributes as a result of the lack of basic technological infrastructure.

Based on the data published by SIRIES (Higher Education Information Collection System) under the management of the Ministry of Education (MINEDU), the institutions of higher learning showed lower rates of academic

discontinuation of 11.5% in the 2021-I academic term compared to 16.2% in the 2020-II academic term, indicating the effect of institutional-level measures to reduce the impact of the health emergency on higher education. The Ministry of Education was among the measures that gave priority to ways of maintaining academic trajectories by using more digital platforms which enabled it to change the face-to-face paradigms to virtual and hybrid ones. However, this re-organization demonstrated very strong differences among students in terms of technological resources accessibility belonging to various socioeconomic groups.

In the attempt to curb these inequalities, the Peruvian government introduced Legislative Decree No. 1465, which provided the conditions of ensuring that the educational activities continued to take place in the framework of preventive measures against the spread of SARS- CoV-2 (Ministry of Education of Peru, 2020a). Afterward, MINEDU defined the guidelines and selection criteria of teaching personnel and students who would receive the distribution of computing equipment and technological devices, with the focus on assisting the sectors with higher socioeconomic vulnerability (Ministry of Education of Peru, 2020b).

The modern literature of the educational virtualization and usage of portable devices offers inconsistent results. As a systematic review of technology-mediated learning experiences in the event of crisis conditions, Crompton and colleagues (2021) concluded that the success of mobile learning is highly dependent on the design of pedagogies and teacher support. Equally, in a meta-analysis study on over one hundred research studies, Sung et al. (2016) reported moderate positive effects linked with the integration of mobile devices in the contextualization of learning processes. Regarding the context of higher education, Al-Emran et al. (2020) note that although mobile learning may positively impact the flexibility, access to learning resources, and

the continuity of the teaching process, its success is highly determined by the design of the pedagogue, the digital skills and capabilities of teachers and learners, and the support of the institution.

Taking the case of Latin Americans, in a study on educational virtualization in the context of the health emergency, Méndez (2022) discovered that the implementation of videoconferencing platforms, computer-mediated instructional activities, and accessibility modalities was related to cognitive development processes in the virtual world. In its turn, Espinoza (2021) reported statistically significant associations between technology-mediated remote education and the performance of basic education students. Nevertheless, it is still unrepresentative of empirical data studying the impacts of massive government programs of providing portable equipment to socioeconomically disadvantaged groups, especially when such programs are exclusively focused on providing equipment but do not introduce regular pedagogical support systems.

The current study was supposed to measure the impact of the portable equipment provision (delivery of mobile devices and data packages) to the beneficiary students of the MINEDU program at the Faculty of Business Sciences of the National University of Education Enrique Guzmán y Valle (FACE-UNE). Particularly, it aimed at identifying the level to which this intervention was linked to the meaningful learning attained by these students at the conclusion of the 2021-II school semester, in the framework of distance learning.

The overall aim of the research was to establish whether provision of portable equipment had any impact on meaningful learning among FACE-UNE students at the period of the COVID-19 health crisis. In order to accomplish this goal, quantitative, applied research design was adopted and the design was non-experimental, cross-sectional, correlational design. A set of 125 socioeconomically vulnerable students that were taking virtual

learning in the 2021-II semester was selected using a probabilistic sampling method.

2. Methodology

2.1. Theoretical Framework

The theoretical basis of the methodology used in the study consisted of the theory of meaningful learning proposed by Ausubel (1973) which was subsequently adjusted to the needs of digitalized environments by Mayer (2021) who suggests the necessity to apply the principles of the multimedia design and control of the cognitive load in technology-mediated learning processes. In this interpretive paradigm, being able to gain access to digital equipment does not necessarily lead to deep learning processes, but instead, these processes are predetermined by the pedagogical articulation of such resources and the ability of students to process information in a productive manner (Sweller et al., 2019).

2.2. Research Design

The research was quantitative because the analysis of the role played by mobile technology in the cognitive consolidation processes was operationalized in both descriptive and inferential statistical methods. This methodological orientation has made it possible to test hypothetical propositions based on parameters of objectivity and systematicity and estimate relationships between the independent construct, which are effects of portable equipment, and the dependent construct, which is meaningful learning, in the context of educational virtualization.

A cross-sectional, correlational, and observational research design was carried out. Variables were observed as they are naturally occurring and those were not intentionally manipulated with during data collection taking place within one time frame related to the academic semester of 2021-II. The study was correlational in nature and therefore it was possible to determine the level of association between the variables and the corresponding dimensions.

The study was implemented in nature, whereby it sought to test how the implementation of a particular intervention that is the mobile device distribution program of the Ministry of Education can influence the learning experiences of the university students in cases where they are socioeconomically vulnerable.

2.3. Population and Sample

The population was composed of 185 students of the Faculty of Business Sciences (FACE) at the National University of Education Enrique Guzmán y Valle (FACE-UNE), who were beneficiaries of a government intervention aimed at the distribution of portable equipment, internet connectivity services, and data packages in order to participate in virtual classes.

Probabilistic sampling methods and finite population formula helped in arriving at a sample of 125 participants with 95 percent level of confidence, margin of error that is 5 percent and population proportion that is estimated to be 50 percent.

2.4. Instrument

Data were collected using a standardized questionnaire.

- The independent variable, “**effects of portable equipment,**” was divided into two dimensions:

- Connectivity

- Virtual platform

This construct comprised 18 items.

- The dependent variable, “**meaningful learning,**” was structured into three dimensions:

- Activities and perceptions

- Acquisition and integration of knowledge

- Use of meaningful knowledge

This construct comprised 22 items.

2.5. Validity and Reliability

Content validity was established through evaluation by three experts in education and educational technology.

Instrument reliability was assessed using Cronbach’s alpha coefficient with SPSS version 25.

Table 1. Reliability of the Instrument (Cronbach’s Alpha)

Instrument	α -item Range	α -global
Variable 1: Effects of portable equipment	0.970–0.975	0.973
Variable 2: Meaningful learning	0.976–0.979	0.978

Note: Authors’ own elaboration based on SPSS v.25 reliability test.

Both variables demonstrated excellent internal consistency.

2.6. Procedure

The questionnaire was administered via Google Forms. Prior coordination was conducted with selected students, and the survey link was sent to their institutional emails and, when necessary, to personal email accounts. Participation was voluntary, and confidentiality was guaranteed in accordance with ethical principles in educational research.

2.7. Data Analysis

Initial data organization and cleaning were performed using Microsoft Excel (descriptive statistics: frequencies, percentages, and measures of central tendency).

Inferential analysis was conducted using SPSS version 25. The association between variables and dimensions was assessed using Spearman’s rank-order correlation coefficient (ρ), due to the ordinal nature of the items and non-normal data

distribution. The significance level was set at $\alpha = 0.05$.

3. Results

3.1. Sample Characterization

The study included 125 students from the four academic programs of FACE-UNE, all beneficiaries of the MINEDU mobile device distribution program.

3.2. Gender Distribution

Table 2 and figure 1 shows that most of the participants were female as compared to the male students by 20 percentage points. Hence, the sample represented the female students more.

The sample in terms of gender is moderately skewed towards the female gender, although both sexes are sufficiently represented methodologically. The results should also be interpreted with this distribution in mind, especially when it is important that the research is based on the gender differences in the use of technology, engagement, or learning outcomes.

In general, the evidence indicates that the results of the study are mostly based on the experience and perception of female students since they were more prevalent in the sample

Table 2. Distribution of Students by Gender (n = 125)

Gender	Frequency	Percentage (%)
Female	75	60.0
Male	50	40.0
Total	125	100.0

Note: Authors' own elaboration based on survey data collected during the 2021-II semester.

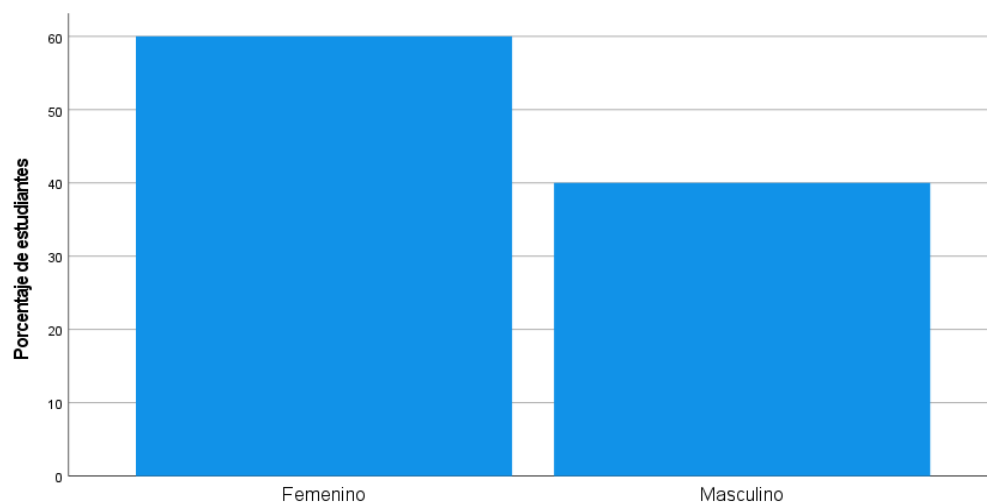


Figure 1. Distribution of Students by Gender (n = 125)

(Female: 60%; Male: 40%)

3.3. Distribution by Academic Program

Table 3 and figure 2 indicate that there is quite an equal representation in the four academic programs. The highest percentage is Business Administration (28%), but it is not clear why the difference between it and International Business Administration (27.2) is so negligible. The large proportion share (24.8%) by Tourism and Hospitality as well as Gastronomy share the least participation (20%).

In general, there is no single academic program that dominates the sample significantly, which indicates that the study results indicate the views of the students representing a wide range of disciplinary backgrounds in the faculty. This equal representation enhances the transferability of the findings to the general population at the Faculty of Business Sciences because the findings are not unduly affected by a concrete program.

Table 3. Distribution of Students by Academic Program (n = 125)

Academic Program	Frequency	Percentage (%)
Business Administration	35	28.0
International Business Administration	34	27.2
Tourism and Hospitality	31	24.8
Gastronomy	25	20.0
Total	125	100.0

Note: Authors' own elaboration based on survey data collected during the 2021-II semester.

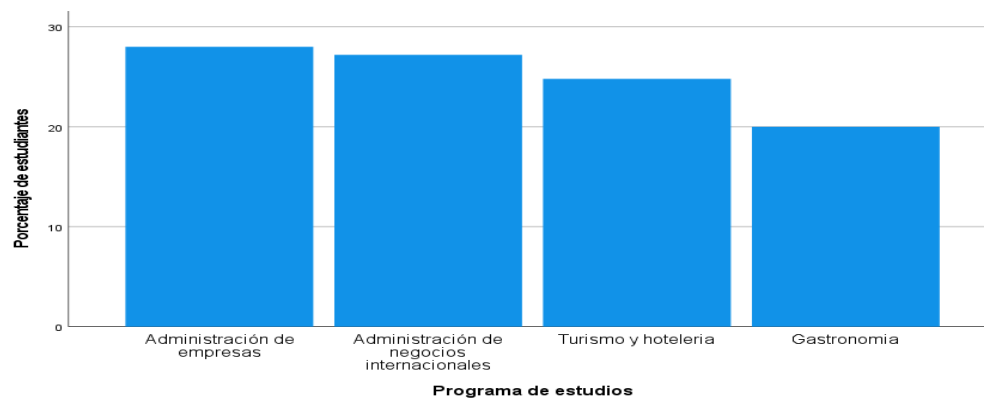


Figure 2. Distribution of Students by Academic Program (n = 125)

3.4. Perception of the Effects of Portable Equipment in Remote Education

3.4.1. Acceptance of the Device Received

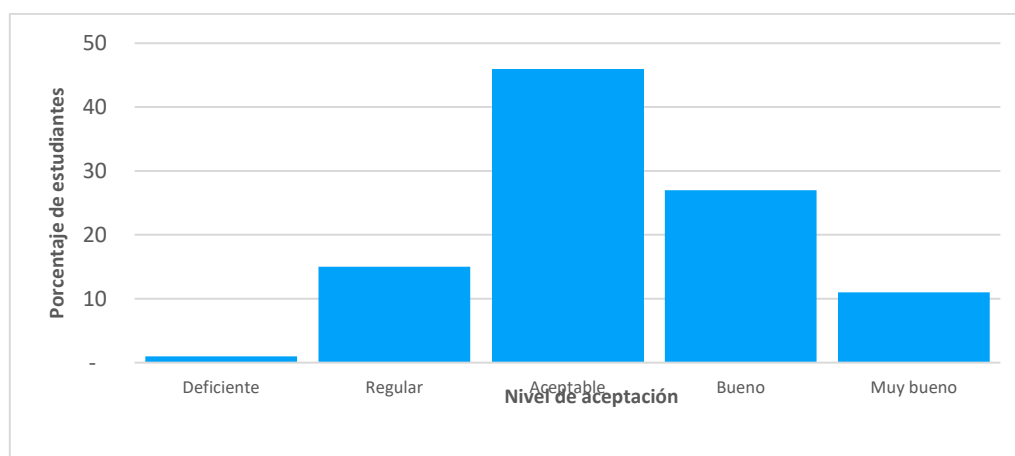


Figure 3. Level of Acceptance of Portable Equipment (n = 125)

- Acceptable: 46%

- Good: 27%
- Very good: 11%
- Regular: 15%
- Poor: 1%

Overall, 84% of students rated the device from moderate to high acceptance levels, while only 1% expressed negative evaluations.

3.4.2. *Perceived Usefulness for Meaningful Learning*

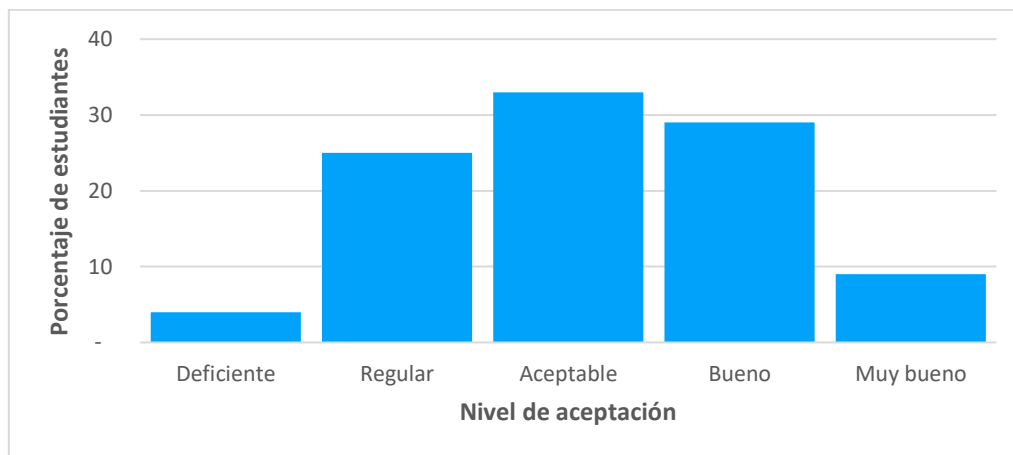


Figure 4. Acceptance of Mobile Device Use in Meaningful Learning

- Acceptable: 33%
- Good: 29%
- Very good: 9%
- Regular: 25%
- Poor: 4%

In total, 71% of participants rated usefulness from moderate to high levels, while 29% expressed regular or poor perceptions, suggesting room for pedagogical optimization.

3.5. *Normality Testing and Selection of Correlation Coefficient*

Normality as shown in **Table 4**, was tested using Kolmogorov–Smirnov and Shapiro–Wilk tests. Several variables and dimensions showed significance values below 0.05, indicating violation of the normality assumption. Therefore, Spearman’s correlation coefficient (ρ) was applied.

Table 4. Normality Tests

Variable	K-S Sig.	S-W Sig.
Effects of portable equipment	0.079	0.021
Connectivity	0.022	0.016
Virtual platform	0.006	0.011
Meaningful learning	0.009	0.015

Activities and perceptions	0.000	0.004
Acquisition and integration	0.000	0.001
Use of meaningful knowledge	0.000	0.001

Since multiple variables violated normality ($p < 0.05$), non-parametric analysis was justified.

3.6. Correlation Between Portable Equipment and Meaningful Learning

Spearman's rho was used to assess associations between the independent and dependent variables and their dimensions.

Table 5. Spearman Correlation Results (n = 125)

Relationship	ρ	p-value
Portable equipment – Activities & perceptions	-0.004	0.968
Portable equipment – Acquisition & integration	0.024	0.793
Portable equipment – Use of meaningful knowledge	-0.025	0.780
Portable equipment – Meaningful learning (overall)	0.005	0.958

All correlations were extremely low and statistically non-significant ($p > 0.05$).

For the general hypothesis, the association between portable equipment effects and meaningful learning yielded $p = 0.958$, exceeding the significance threshold ($\alpha = 0.05$), indicating no statistically significant relationship.

Similarly, specific hypotheses examining relationships with each dimension were also non-significant ($p = 0.968$; $p = 0.793$; $p = 0.780$).

4. Discussion

The purpose of this research was to determine the relationship between the effects of portable equipment (mobile devices offered by MINEDU) and meaningful learning of students of FACE-UNE during remote learning with the conditions of COVID-19. However, the fact that access to synchronous classes and asynchronous activities can be provided with the portable equipment in place, along with the results, makes the futuristic vision of distributing devices automatically benefiting the learning outcomes a bit more realistic.

In terms of the overall purpose, which is to understand whether the effects of portable equipment were positively associated with meaningful learning among FACE-UNE students during semester 2 of the 2021 academic

year, the correlation analysis will result in the value of $p = 0.958$ (> 0.05), which does not suggest a statistically significant relationship between two variables. That is, in the sample under study, there was no correlation between the use of portable equipment and the increased levels of meaningful learning.

This observation contradicts a significant body of the global research on mobile learning. Specifically, it was compared to the findings of Hinojo-Lucena et al. (2018), which revealed in their analysis of doctoral dissertations on mobile learning in Spain positive impacts of mobile devices in many aspects of learning, such as the development of spatial skills and the enhancement of student engagement. The difference implies that the presence of the devices is a necessary but not a sufficient set of meaningful learning and that the relationships between technology and learning outcome are moderated by the pedagogical design, instructional mediation and effective conditions of connectivity in the FACE-UNE context.

These findings are much more in line with critical assessments of technology-equipment policies carried out by Warschauer and Matuchniak (2010), who have recorded that simple access to

digital devices do not necessarily result in an improvement of education without a conscious curricular integration and the implementation of digital skills in teachers and students. On the same note, it is possible to explain the lack of a significant relationship in this study in the context of the work of Beaunoyer et al. (2020), who stated that digital divides during the pandemic were not only about physical access to the devices but also more complex aspects such as the ability to operate them, the quality of connectivity, and the technological cultural capital of students.

As far as the first particular goal is concerned, which is to consider whether the effects of portable equipment were dependent on activities and perceptions, the obtained value ($p = 0.968 > 0.05$) shows that there is no statistical significance of its correlation. Practically, there were no significant differences in the affective disposition of students and perceptions about the learning process when using the mobile devices offered by MINEDU. Such findings contradict those of Chuquisana (2021), who found that there is a small yet significant correlation between the use of mobile devices and learning in secondary school students. This contradiction supports the idea that the effects of mobile learning are not uniform and that they will be related to the level of education, the environment of a specific institution, and the extent to which technology is integrated into the pedagogical process.

On the second specific objective which was to determine the positive relationship between portable equipment effects and the acquisition and integration of knowledge, also the result ($p = 0.793 > 0.05$) was not significant. A positive relationship was not established between portable equipment and this aspect of meaningful learning. This is contrary to the results of Calderón and Sánchez (2021), whose review stated that more than 70 percent of the studies had the reported positive effects of mobile device on learning, with more or less 20 percent displaying the neutral effects and less than 10 percent of the studies reported negative effects. The difference indicates the significance of contextual variables and implies that the reported

gains in different contexts may not be directly transferred to the context of technological integration when the latter involves equipping only with equipment without organised pedagogical teaching.

The third precise goal was the study of whether there was a connection between connectivity and virtual platforms on the meaningful use of knowledge. The finding ($p = 0.780 > 0.05$) once again proved the lack of statistically significant relationship. Therefore, in the studied situation, portable equipment failed to reveal a direct correlation with the capacity of students to apply or transfer meaningful knowledge. This result is a clear contradiction to Espinoza (2021) who found the correlation between mobile-mediated distance education and academic performance among secondary education students as very significant. The divergence implies the effects of mobile devices on meaningful use of knowledge depend on context and that it might differ depending on the level of education, the quality of instruction design, and the degree to which teachers provide guidance - especially in situations involving socioeconomically vulnerable groups.

Put collectively, the results suggest that under the given terms of implementation of the MINEDU mobile device distribution initiative at FACE-UNE, mobile devices failed to be a variable that facilitates meaningful learning, either on a global level or on its dimensions (activities and perceptions, acquisition and integration of knowledge, and meaningful use of knowledge). The inconsistencies with the past help to highlight that intervening factors, including teacher training in mobile learning, the quality of instructional design, and the reliability of connectivity and the structured support of vulnerable learners should be considered before attributing the generalized positive or negative outcomes to the usage of mobile devices in the higher education settings.

These results should be put in the context of the wider issue of higher education in Latin America during the pandemic. The reports by UNESCO (2020) and CEPAL-UNESCO (2020) identified

several problems that were observed at the same time at higher education institutions in the region: the lack of technological infrastructure, an unpreparedness of the faculty in the learning process online, and a severe lack of heterogeneity in the conditions of access to higher education among students. In this context, the distribution of devices programs like the one that was introduced by MINEDU were a necessary yet inadequate reaction to the complexity of the educational crisis that arose due to the health crisis.

Considering the distance education frame, these results support the thesis statement that technological access, despite its importance, does not alone result in the creation of meaningful learning. To make this possible, the portable devices need to be incorporated into deliberate didactic suggestions that are driven towards analysis, problem solving, and active knowledge building.

5. Absence of a Significant Influence

These results indicate that the outcomes of portable equipment (mobile devices provided by MINEDU) among vulnerable students at FACE-UNE were not statistically significantly linked with meaningful learning, both at the global level of level and in its dimensions: activities and perceptions, acquisition and integration of knowledge, and meaningful use of knowledge. It means that in the context of study, the availability of portable equipment per se was not a defining feature in the enhancement of the process of learning.

Given that the learning effects are controlled by learning the method and learning the content, the difference in subjective valuation and learning effects is given.

Even though most of the students showed positive attitude towards the mobile devices and

their role during the distant learning (medium to high levels of acceptance), the same positive attitude was not reflected in the actual impact on the real learning. The difference between the subjective perception of the technological resource and its actual contribution to the learning process implies that interest or satisfaction with the device has not been enough to guarantee more profound learning results.

6. Technological Access A Necessary but Not Sufficient Condition.

The results confirm the idea that the supply of portable devices and connectivity is a significant access requirement to engage in distance learning; it, nonetheless, does not ensure the synthesis of the significant learning on its own. The quality of instructional design, teacher mediation, systematic support of vulnerable students, the effectiveness of teaching and learning experiences in general are important factors in turning the technological access into real learning opportunities.

7. Implementation in future research.

On the educational policy level, the evidence brings to the fore the fact that higher education technological equipment programs should be stated with specific mobile learning strategies, teacher training in the area of the pedagogical application of portable devices, as well as the systematic control of student learning, especially with such vulnerable groups.

Future studies might be mixed-methods or longitudinal designs, take direct measures of academic performance, and address the role of intervening variables such as student engagement, digital self-efficacy, and teaching strategies to comprehend the circumstances in which portable equipment can be used, or not, to make significant learning in a distance education environment on university level.

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