Innovations in Classes at Universities: Transitioning from Face-to-Face to Virtual

José Carlos Alvarez Merino, Kazuo Hatakeyama, Elva Castañeda and Ofelia Cernaque

June 27, 2021

Innovations in classes at universities: transitioning from face-to-face to virtual

Jose C. Alvarez, DSc[1], Kazuo Hatakeyama, PhD[2], Elva Castañeda, Dr. [1], and Ofelia Cernaque, Dr. [1]
[1]Engineering Faculty, Universidad Peruana de Ciencias Aplicadas, Peru, pciijalv@upc.edu.ep, pcmaecas@upc.edu.pe, ccernaque@gmail.com
[2]Enterprise Consulting, Salvador, BA, Brazil, khatakeyama@uol.com.br

Abstract–The appearance of the Covid-19 since the beginning of the year 2020 has involved changes in many aspects of daily life in the world. Thus, it has impacted the university in its three dimensions: humanistic, research, and interaction with the company and the community. Particularly in teaching that has varied substantially. In this context, the teaching, and results in courses in some Peruvian universities will be compared during the 2019-2 semesters (eminently face-to-face) and the 2020-1 semester (necessarily virtual). The results and their analysis lead to a proposal of pedagogical innovations in teaching and its extrapolation to the research and interaction of the university with companies and communities.

Keywords—Innovation, virtual education, class at universities, platforms of resources online, post-Covid 19 scenery.

I. INTRODUCTION

Several authors have mentioned about the New Normality after the Covid-19. One of the sectors in which the Covid – 19 to ruled one before and one after is in the learning at school, technical and university levels.

In the case of Peru, it had been regulated that during all the year 2020 the class in the universities must be virtual. This resulted that some universities issuing new academic calendars. Others, however, maintained the program changing only the virtual modality.

In some cases, it has a certain familiarity with the virtual contents including some universities has the specialized unit of the virtualization of courses. However, while the world advances to a digital transformation of the education sector [1] both of its e-learning, b-learning, m-learning, u-learning [2] and its models [3]. In Peru, the digital divide continues to be one of the barriers to access to knowledge, such as training, updating as well as the adoption of technology, since 40.1% of the population has access to the Internet [4], with a penetration rate of 60% at the Latin American level, below the regional average that reaches 64.13% [5], which makes the sector's digital transformation process more difficult, even more so in socio-political contexts of scarce access and participation of Rural populations of Peru.

The irruption of Covid 19 was also an opportunity to verify the adaptation of the university systems to the virtuality.

The challenge consists to find valid forms to substitute the tacit to tacit knowledge transmission by the face-to-face interaction (master-learner) as it was analyzed and highlighted in the previous literature [6],[7]. Recently got ready to carry out surveys to assess the performance of virtual classes.

II. PROBLEM ANALYSIS

The problem consists of identifying the way to go from face-to-face to virtual education due to the covid-19 pandemic.

A. Methodology

Opinion polls will be done to professors that at the university had dictated the same course in the 2019-1 (in the face-to-face form) and in the 2020-1 (in virtual form).

TABLE I
VARIABLES AND DIMENSIONS TO BE INVESTIGATED

Variable	Dimensions
Teaching 2019-2 (live form) 2020-01 (virtual form)	Platforms of resources online
	Didactic strategies
	Formation and training in the enabling programs
	Continuity of the academic activities during the pandemic Covid-19
	Continuity of the academic activities after the pandemic Covid-19
In the context of the pandemic Covid-19 and its impact on the university and its humanistic dimensions of investigation, interaction with the community and the enterprise.	

1) Survey

This empirical survey applied to 63 participants, with the following questions:

About the online platform resources:

What official platform (learning virtual surroundings) is utilized in the management of your classes?

What other virtual platforms use professors?

What tools do you use in your classes online?

What other resources or tools available to professors as the support to the learning process dictated their classes in virtual surroundings?

What other technological resources, you believe are used by professors?

How often, you believe professors use tools for their classes in virtual surroundings?

About the didactic strategies:

The strategies utilized with major frequency in your classes.

The strategies utilized in the laboratory sessions.

The learning evaluation is checked using what type of instruments.

What tools of evaluation online are utilized in your classes?

Professional training in programs empowerment:

According to your opinion, what difficult the implementation of online activities?

Had performed enabling programs, specifically for the classes in virtual surroundings?

Regarding the capabilities, what learning methodology applied to the professors for further application in the class?

Who was in charge of the capabilities, specifically for the actions online during the class in virtual surroundings?

If any courseware has produced for the professor before and during the capabilities program?

Continuity of academic activities during pandemic Covid-19:

After the interruption of the face-to-face classes, how long lasted to start the academic activities online?

The program in the course had a change in the academic calendar.

How to supervise the university institution, the work of professors using online in the virtual surroundings?

According to perceived results, of the implementation of learning methodologies of virtual surroundings online, what do you perceive as a professor?

According to results perceived, of the implementation of learning methodologies online in the virtual surroundings, what do you perceive in the students?

Continuity of academic activities after the pandemic Covid-19:

In your opinion, do you believe that exists the intention to continue with the programs of enabling for online actions, after the return to the normality in the context of university high educational training?

In your opinion, do you believe that should continue with actions in online after the return of face-to-face classes?

In your opinion, according to the results of competency achieved of the course by students, what evidence presented in your portfolio?

In your general opinion, what differences present the students because of the learning with online actions?

B. Results

1) About platform of resources online

The Blackboard collaborate was the preferred resource, that is the resource determined by the university with more teachers participating in the survey.

A WhatsApp group was formed in the course with the participation of the teacher and students, where specific advice was given in relation to the identification of the problem, the determination of the articles for the state of the art and the formulation of the innovative proposal.

Given the virtual nature, the presentations of the research advances, which used to be done in person, were made through an asynchronous video previously recorded by the couple of students specifying the problem, the background and the proposed solution. This video was recorded on YouTube and uploaded to the BBC platform by the students.

Mendeley, as well as Google, were also used in a complementary way. Drive.

TABLE II
RESULTS ABOUT THE USE OF RESOURCES ON LINE

	f	%	Accum. %
Google's class	5	7.9	7.9
BBC	1	1.6	9.5
Runachay	1	1.6	11.1
Moodle	10	15.9	27.0
Open LMS	2	3.2	30.2
Meet	1	1.6	31.7
Own platform	10	15.9	47.6
Canvas	2	3.2	50.8
Blackboard collaborate	30	47.6	98.4
Clementina	1	1.6	100.0
Total	63	100.0	
	f	%	Accum %
WhatsApp	38	60.3	60.3
Facebook	5	7.9	68.3
Videos of YouTube produced by professor	18	28.6	96.8
Arena	1	1.6	98.4
Drive	1	1.6	100.0
Total	63	100.0	

2) About didactic strategies

The majority of cases were through synchronous class by platform that were register for its asynchronous replied.

In real-time classes, teachers present the methodology to be followed by presenting practical cases that serve as a reference.

It also explains how to search for your scientific articles, as well as the determination of the impact of each one according to the quartiles and its relevance in Scimago Journal Ranks.

At this point it is appropriate to highlight that the analyzed course is continued in two subsequent courses until the formulation of the thesis, and the writing of two scientific articles, a short paper for a Congress and a full paper for a journal, both indexed in Scopus.

TABLE III
RESULTS ABOUT DIDACTIC STRATEGIES

	f	%	Accum %
Synchronous classes by platform	55	87.3	87.3
Asynchronous classes	4	6.3	93.7
Publication of video (youtube or platform)	2	3.2	96.8
Published texts	1	1.6	98.4
Google's worksheet	1	1.6	100.0
Total	63	100.0	

	f	%	Accum. %
Experiments performed by WebLab	6	9.5	9.5
Experiments simulated by software	18	28.6	38.1
Experiments simulated in tools online	13	20.6	58.7
Processing of experimental data provided by the professor	18	28.6	87.3
Other	8	12.7	100.0
Total	63	100.0	

3) Formation

After each virtual session a survey is required about the student attendance, incidents, and possible improvement needs.

TABLE IV
DIFFICULTIES DETECTED

	f	%	Accum. %
Difficult or lack of access by the students (Lack of equipment, internet,)	31	49.2	49.2
Difficult or lack of access to professors (Lack of equipment, internet,)	5	7.9	57.1
Difficult or lack of infrastructure of the institution	5	7.9	65.1
The resistance of the students	1	1.6	66.7
Difficult or lack of training of professors to deal with the technology	8	12.7	79.4
There were no difficulties	13	20.6	100.0
Total	63	100.0	

III. THE STATE OF THE ART

Arteaga et al. [8] from the analysis of the Project called CR, identified that the start of the virtualization will consist to carry out the present activities to the platform. The following challenge will be to facilitate new learning in the virtual space. For that, recognized the importance to enhance the autonomy of learning and thinking, through the use of territorial references. Project CR, through the support of territorial reference, established a link with reality and in the development of communication skills and solution of conflicts.

Carmona & Rodriguez [9] argue that the virtual space is recognized as one form of participation of the university in the regional context, why so the usability, accessibility, adaptability, and modularity respond to contextual reflections. Thus, the virtual space should be designed in such a way to distribute and share knowledge. Must apply the standardization to establish processes that highlight the coherent dialog of the virtual strategy.

Sanchez & Ariza [10] analyze the impact of the Covid-19 in the training of surgeons in Colombia, who since before the pandemic has had a deficit of practical training hours to complete their learning curve, which exacerbated with the pandemic, as preferred to postpone the surgical interventions. Faced with this scenario and considering that about 20% of the students already knew of virtual tools, proposed the use of simulations for the learning of surgery, while theoretical aspects occur in autonomous form.

Furthermore, Cabrera et al [11] present the mechanisms of adaptation of the virtual education in Colombia for the medical residents. Those authors present a program of virtual education that had started even before the pandemic Covid-19. The publications containing conceptual maps and texts, prepared by the general practitioner and educationalist has appeared. In the second phase, already in the pandemic, Covid-19 resorted to a google.meet with the support of the social networks. This way achieved timely training avoiding risks of Covid-19.

On the other hand, Prensky [12], Melo-Solar & Diaz [13] and Mendoza et al [14] agree on the understanding, adoption and use of technological resources from virtual education, before the pandemic, processes that They have allowed an acceleration in its application with some differences, especially generational. In that sense, Melo-Solar & Diaz [13] warn about the difficulty in the teaching and learning process in these virtual spaces and that they require certain elements so that their adoption represents an improvement and permanence, otherwise they could be elements that motivate the desertion on the one hand, and on the other, they generate adverse reactions to the commitment and conviction that these digital environments require, therefore, the role of the teacher is fundamental above all in their didactic and methodological resources. According to Mendoza et al [14], these elements would make the student feel committed to this new way of learning. It is clear that the digital world also requires new digital profiles, as Prensky [12] warns about availability, the dilemmas that this acceleration brings with it, the advancement of cognitive processes and its implications in the symbiosis of thought and digital wisdom. it would involve a decision of the benefits that the technology brings or the potential harm.

Chancusig [15] presents a model of adoption of information technology in the teaching - learning process in courses at the Technical University of Cotopaxi, showing indicators for collaborative work. The model was validated using statistical software, finding that it was a success. Virtual classrooms were created using the Sakay software that was used in parallel with Moodle.

Rojas et al [16] propose MOOCs as a technological proposal for educational transformation, which, due to the format it presents, could provide a

n alternative to offer services with a greater scope.

Mora et al [17] propose a digital theoretical model for education applying Business Process Management (BPM) mediated by Robotic Process Automation (RPA).

IV. Innovative proposal

It is applied in a research seminar course, which belongs to the Faculty of Engineering of one of the surveyed universities, the same one that the BBC uses corporately, and is aimed at students of various engineering (industrial, mechatronics, software, civil, among others).

The innovative proposal consists of the integration of knowledge management, asynchronous methods and multilevel communication in the course in question.

The course seeks for students to advance their undergraduate thesis in engineering, in particular to define the research problem, its background and an innovative proposal.

A. About the problem analysis

To define the research problem, they resort to tools such as the Ishikawa diagram, TRIZ methodology and the Vester matrix. Although the proposal is novel, since it escapes the regular rule of finishing the courses to start the research process, when it is transversal. This challenge will allow students to tackle the investigation as soon as they have their question ready and are willing to continue investigating. The key-words of the research are defined.

B. Background formulation

To identify antecedents, a search for papers is used in SCOPUS and other databases, as well as the preparation of summaries of the identified articles. The antecedents are compiled in a document on the state of the art, which includes typologies to classify the articles found. For the determination of the typologies, the use of a conceptual map of the topic that is being investigated by each student couple is suggested.

To facilitate the convergence of the antecedents, a matrix key-words vs. papers, where in the rows the key-words that appear in the papers found are placed and grouped, while in the columns the papers numbered as they will appear in the references, then marked with an "X" where the intersection between key corresponds -words and papers, so the "X" that appear will give us an idea of the convergence and relevance of the state of the art papers, as can be seen in the following table 5, around a state of the art on prototypes and tests of adsorption cooling systems with the silica gel / water pair and powered by solar energy.

C. About the proposal

The proposal, where two or three techniques are generally integrated, is accompanied by an infographic of it.

V. Validation

The determination of the problem was carried out through synchronous virtual classes and asynchronous activities, which are reviewed by a thematic advisor and a methodological one. A whasaap group was also formed through which groups of students presented their research problem.

TABLE V
MATRIX: KEY-WORDS VS. PAPERS

Key-words	1	2	3	4	5	6	7	8	9	10
Adsorption chillers	X									x
Coefficient of performance; COP	X		x							
Low-grade thermal energy	x									
Coated adsorption beds	x									
Adsorbent (s)	x	X						x		
Adsorption		x		x	x	x	x	x		
Refrigeration		x			x	x				
Adsorbate		x						x		
adsorption, Adsorption refrigeration			x				x			
Solar energy; Solar heat; solar refrigeration; solar cooling			x	x	x				x	x
Silica gel - water			x							
Renewable energy				x						
Air-conditioning				x	x					
Heat source temperature				x						
Absorption					x		x			
Chiller						x				
Ejector systems							x			
Refrigerating equipment							x			
Heat storage							x			
Silica gel										x
Economic analysis										x

A document is prepared that consolidates the analysis of the problem, the state of the art and the innovative proposal that will be the graduation work of the student groups.

In relation to the results of the course, interviewed students (2020-2) state:

E1: "The achievement of our theme, which is the improvement of an inventory system in a logistics operator, was possible thanks to the tools that the academic research seminar course has provided us. Among these tools we have the virtual consultancies with the methodological and thematic advisers who gave us feedback on our project, the platforms and workshops to search for papers or scientific articles for the creation of the state of the art, the workshops to carry out the definition of the topic and the theoretical framework, among many more".

E2: "Thanks to what my colleague mentions, we have been able to propose solutions that allow us to contribute to the company, through our knowledge and guidance

from the advisors; also, this research gives us broader ideas about the reality of the career courses".

E3: "My topic is about the reduction of costs generated by poor procurement and supply management in the maintenance of a freight forwarding company. First, the methodological consultancies helped us to focus on the maintenance issue, since most of the purchases were made for truck parts and the topics about the investigation of the Papers and the techniques to apply for the improvement. Research resources such as Scopus and Mendeley also helped us with the search for papers and books to inquire about our topic. Likewise, both consultants supported us with the definition of our problem tree and our research proposal".

E4: "Practically, the use of the information center tools such as the search for articles in indexed journals that we were taught in the course were key to the development of the topic and presentations of each deliverable. In addition, it was much easier to make the bibliographic references through the Mendeley extension, make the presentations of the papers in the workshops to receive feedback and improve the analysis of the next article analysis, have the means such as WhatsApp or email to any question that was generated to obtain a quick response".

E5: "The development of our research proposal, which is an inventory management model that we proposed with my colleague, was possible thanks to virtual resources such as books, online magazines, since with them it was possible to evaluate which tools and to be able to select the best of The same way for the writing and approach of our problem were possible thanks to the weekly advice provided by the methodological and thematic and finally with respect to the Mendeley this resource allowed us to have a better control of our articles".

E6: "Through the tools provided (SCOPUS, Web of Science, Mendeley, etc.) they helped with the collection of information and knowledge about the procedures for curing and treating natural fibers. The methodology was complemented by putting this information into a document taking into account the APA format".

E7: "The consultancies by the methodological and thematic, through the blackboard and zoom platform, since throughout the cycle they guided and advised us how our research topic should be directed. Make us realize if some aspect of our work is wrong or if it is right. In addition, to give us advice for the development of the course with his extensive experience in the field of engineering"

E8: "In my opinion, the search tools for papers are the ones that are most helpful in achieving a serious, valid and sustained investigation. Likewise, place ourselves in the context and know the possible solutions that other authors have had for the problem. In addition, the consultancies with our advisors are important in the path of the investigation since they help us with their experience to make the study more nurturing us".

Additionally, in anonymous survey filled by the course students was asked that:

TABLE VI
QUESTIONS IN THE ANONYMOUS SURVEY

The teacher clearly explained the competence (s) that I must develop in the course.
The methodology used by the teacher allows me to achieve the learning achievement of the course.
The teacher promotes an environment of respect during class sessions.
The teacher motivates my interest in learning in the course.
The teacher dominates the topics of the course.
The teacher develops activities that allow me to learn by myself.
The teacher uses strategies (dynamics, activities, exercises, etc.) that facilitate my learning.
The teacher develops activities that allow me to apply in practice what I am learning in the course.
The teacher encourages my autonomous learning.

VI. DISCUSSION

The differential majority of teachers showed adaptation to the implementation of online educational services. A small part of this average also stated that they obtained significant progress and better response from the student. A minority percentage of teachers had problems with online classes and all web teaching services.

Teachers who performed well also showed positive changes in students. These represent 70-90% of the range of teachers surveyed out of 80% of the total of teachers who stated that they had no problems regarding the adaptation of synchronous classes.

In addition, with respect to teachers who reported obtaining opportunity, skills and provision from their students, 27% do not have competent services (better equipment, software-hardware). However, 88% of those surveyed recognized the implementation of academic assistance teams (WhatsApp-fb-etc).

On the other hand, the topics are based on real problems in companies, for which an improvement proposal is made based on state-of-the-art research.

VII. CONCLUSIONS

The main conclusions of this study are that the Covid-19 pandemic has modified attitudes in different fields, one of them being virtual education, forcing the use of ICTs and simulations to comply with learning.

That prior preparation in educational institutions, teachers and students have favored the rapid response of academic activities through the use of platforms and other ICTs.

Although the pandemic brought an acceleration in the use of these virtual platforms, in the Peruvian case there are still access gaps, however, it has allowed finding in these educational services a space to improve the teaching and learning processes.

There is resistance on the part of both groups towards the use of virtual environments, however, they are being incorporated naturally more in young people than in adults, which implies a challenge in this adoption process.

REFERENCES

[1] Ramirez-Montoya, M.S. (2000) "Transformación digital e innovación educativa en Latinoamerica en el marco del Covid-19". Campus Virtuales, 9(2), 123—139

[2] Quitian-Bernal, S.P. and Gonzalez-Martinez, J. (2020) "El diseño de ambientes blended-learning: retos y oportunidades". Educación y Educadores, 23(4), 659-682

[3] Cuadra-Martinez, D. & Castro-Carrasco, P. (2018) "Cambio educativo: propuesta de un modelo de trasnformación de teorías subjetivas". Liberabit, 24 (1), 147-164

[4] Instituto Nacional de Estadística e Informática. (2020) El 40.1% de los hogares del país tuvo acceso a Internet en el primer trimestre del 2020. Avaiable in: http://m.inei.gob.pe/prensa/noticias/el-401-de-los-hogares-del-pais-tuvo-acceso-a-internet-en-el-primer-trimestre-del-2020-12272/

[5] Burgueño, E. (2021) "America Latina y Caribe: Uso de internet por pais 2021", Statista. Avaiable in: http://es.statista.com/estadisticas/1136646/tasa-penetracion-mas-altas-internte-america-latina-caribe/

[6] I. Nonaka and H. Takeuchi. The knowledge creating company: how Japanese companies create the dynamics of innovation, New York: Oxford University Press, p. 284, ISBN 978-0-19-509269-1, 1995.

[7] T. E. Davenport and L. Prusak. Working Knowledge: How Organizations Manage What They Know, Publisher: Harvard Business School Press, 1998. DOI: 10.1145/348772.348775.

[8] C. Arteaga, N. Enriquez and J.L. Chuquimia. "Methodological Challenge in Virtual Education. Approximation of the complexities of the virtual learning and the rescue of the value of the social contact". Fides et Ratio, v. 10, pp. 99-114, 2015.

[9] E.J. Carmona and E. Rodríguez. "Best practices in virtual higher education from the specifications of stands e- Learning". Sophia, 13(1): pp. 13-26, 2017

[10] S.S. Sanchez and A. Ariza. (2020) "Surgical education in Colombia in the era of the COVID–19". Rev. Colomb Cir [online], vol.35, n.2, pp.250-255, 2020. ISSN 2011-7582.

[11] L. Cabrera, C. Luna and M. Pedraza. (2020) "Adaptation of the general surgery residence in Colombia for the pandemic COVID-19: virtual program of surgical learning". Bogotá, Rev. colomb. cir ; 35(2): pp. 257-264, 2020.

[12] M. Prensky. "Homo Sapiens Digital: From digital immigrants and digital natives to digital wisdom", Miami, Innovate: Journal of Online Education, v5 n3 Feb-Mar 2009.

[13] D. Melo-Solar and P. Diaz. (2018) "The Affective Learning and the Gamification in Virtual Education Scenary". Información Tecnológica, 29 (3), pp. 237-248, 2018.

[14] H. H. Mendoza, V. M. Burbano and M. A. Valdivieso. "The role of the mathematics professors in virtual university education. A study in the Pedagogy and Technology University in Colombia". Tunja, Formación Universitaria, 12 (5), pp. 51-60, 2019.

[15] [J.C. Chancusig. (2021) Implementación de un Modelo de Adopción de la Tecnología de Información y Comunicación para el proceso de Enseñanza –Aprendizaje en la Universidad Técnica de Cotopaxi. DSc Thesis, Lima: UNMSM

[16] Rojas, O.A.C., Villa, C.F.H., Arango, D.A.C., Zapata, J.A.S., Fernández, J.E.V., Montoya, E.M.H. & Grisales, M.A.B. (2020). Moocs and other technological proposals in the transformation of education. Iberian Conference on Information Systems and Technologies, CISTI, June.

[17] Mora, H.L. & Sanchez, P.P. (2020). Digital transformation in higher education institutions with business process management: Robotic process automation mediation model. Iberian Conference on Information Systems and Technologies, CISTI, June.