Informatizing the Universities: Reflections on One Cuban Experience

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Abstract

This article explores the current situation of Cuban universities as they face the challenges caused by the informatization of society. The discussion begins with the Cuban context and the primary obstacles to this transformation that exist in Cuban society. Although Cuban universities began to join the digital world from a relatively early date for a country from the Global South, many obstacles, both objective and subjective, have slowed progress in this race. At this time the penetration of information and communication technologies (ICT) in higher education is insufficient. The article discusses the experience at the University of Havana and asks, What are the primary obstacles that block informatization in Cuban society, and what can universities do to overcome them and make progress toward digital transformation?

Literature Review and Research Question

The world has changed in recent decades due to the introduction and dissemination, at an unprecedented tempo, of information and communications technologies (ICT). Whether we are discussing the information society of Castells (1996) or the advent of the Fourth Industrial Revolution (Schwab 2016), we live in a period characterized by a new confluence of physical, digital, and biological technologies. Some examples include big data (the analysis of massive amounts of data); the internet of things (with the expectation that 20 trillion objects will be connected to the internet via sensors by the year 2020); cloud computing (internet storage); 3-D printing (custom design and modeling solutions); robotics; nanotechnology; artificial intelligence; augmented reality; biotechnology; and more.

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This massive transformation impacts every aspect of human life, including universities. The development of these technologies is of particular significance in higher education because these institutions, aggregated, form a complex organization designed essentially to generate a high volume of information and knowledge, both in constant change (Silvio 2000).

Until a few years ago, the impact of ICT on universities was most obvious in two areas (Baelo and Cantón Mayo 2009). First, the introduction and use of ICT in teaching and learning and in the administration of higher education have involved an institutional transformation focused on responding to a growing number of constituents. Second, ICT has influenced all education-related fields, facilitating the transformation and optimization of most administrative processes, the development of innovative methods for teaching and learning, and access to higher-level training for new groups of individuals, as well as an incipient transformation in the organizational structure of universities.

Several authors have emphasized the need for prior integration of ICT to all university processes. Ottaviani, Tancredi, and Salmerón emphasize, for example, "It is appropriate for ICT to be not just an instrumental component, but also a framework for organizational dynamics, which will open new vistas and approaches to the construction of institutional policies related to the university context" (2007, 2).

Day by day even this vision is becoming obsolete. It is no longer possible to understand the transformation of universities through the paradigm of gradual digital assimilation mediated by a vision, whether more boldly innovative or more conservative, of university and government administration. Urgent responses are needed. The traditional university model is at risk of failure.

Ángel González (2018) analyzes the interesting case of training engineers to design driverless vehicles, the capacity for which does not exist in the vast majority of universities although demand in the advanced automotive industry is high and growing. No traditional college or university can respond to this demand; yet the online platform Udacity has used Mercedes Benz engineers to teach five million student visitors to the site. Verdegay Galdeano (2018) warns: "Transformation to the digital university is not an option, it is a question of survival, a challenge we must meet. And although this has been repeated frequently, it is important to repeat it. We face the dilemma of digitize or die."

How easy will this transformation be? The Digital Transformation Institute states in its Report Number 10 (2017) that the primary obstacle to digital transformation is a cultural one. The task at hand is to "change the organization and, above all, the mentality and culture of those persons who are reticent to change, especially many professors who still see computerization as a threat to their teaching methods, their knowledge, and their leadership" (Verdegay Galdeano 2018). If the societies of the Global

South, especially our universities, as centers of the most advanced thinking and producers of future national leaders, do not transform, the technology gap separating the poorest countries from the developed world will widen, and it will become an additional source of cultural, economic, and political colonization (Ruíz Jhones y Vidal Larramendi 2016).

In this article we refer to informatization of the university as "a strategic institutional project of technological innovation for electronic governance" (Piñero Martín, Carrillo Vásquez, y García García 2007, 8). Computerization is sometimes the English translation of the Spanish *informatización* ("Informatización de la Sociedad" 2014). The more technical word *informatization* has been advanced by Castells (1996) and others to signify the emergence of the information society with all the complex practical activity that entails, as this article will demonstrate.

We focus primarily on the transformation of university administration with ICT as a basic step toward transformation into a digital university. So we pose the fundamental research questions: What are the main difficulties encountered today in the process of informatizing Cuban universities, what obstacles are slowing things down at the social and institutional levels, and what can be done to move forward?

Cuban Universities and ICT

When the revolution triumphed in 1959, the Cuban university system consisted of three public universities: Havana (one of the oldest in the Americas, founded in 1728), Central de las Villas, and Oriente. The last two were founded in the middle of the last century. Currently, Cuba has fifty institutions of higher education and 126 municipal university centers associated with larger universities (similar to satellite classroom locations in the United States). Higher education in Cuba is completely free and has graduated almost 1.5 million professionals since 1959. In Cuba 12 percent of the population and 22 percent of all workers are university educated (Saborido Loidi 2018). In 2016 higher education enrollment included 218,643 undergraduate students and 526,445 graduate students (ONEI 2017a).

The University of Havana, with its 290 years of history, is the alma mater of Cuban universities. Located in the country's capital, it offers degrees in natural and exact sciences, economics and accounting, social and human studies, and design. It currently has 14,214 undergraduate students; 4,145 graduate students (master's and doctoral); and 1,273 full-time professors, 61 percent of whom hold doctorates in science (La Universidad de la Habana, n.d.).

Computer use at Cuban universities began relatively early. The University of Havana played a particularly important role in the creation of the first Cuban computer in 1970 (Blanco Encinosa 2015). Cuban universities' access to the internet began with the University of Havana in 1996, the same year that the country itself got connected (Recio 2013). At the

present time, centralized investments are still being made to improve network quality, connectivity, and hardware at universities (Baluja 2016).

The use of ICT as support tools for teaching and learning is perhaps the aspect that has received the most attention in Cuban institutions of higher learning. A broad national community exists in higher education, reaching almost all universities using the Moodle platform for distance learning.

Another area of university work with ICT is in the management of scientific and technical information. González Santos (2013) identifies the 1990s through today as a period of technological development based on two fundamental conditions: shrinking funds for traditional library services and the continuing delivery of computer equipment to Cuban universities (Sánchez Vignau 2000). In roughly 2005, libraries began to adopt the Belgian ABCD library administration system. The Cuban university network REDUNIV, which is managed by the Cuban Ministry of Higher Education, is another example of using ICT to share services and content (Bermello Crespo 2004).

Less organized and promoted has been the informatization of university management, understood, as we said above, as its electronic government project. An early example in this direction was the late 1990s implementation of ASSETS, a human resources, accounting, and financial management system, in all universities under the administration of the Ministry of Higher Education. (Additional medical and military universities are under either the army or the Ministries of Public Health or the Interior.) The turn of the century saw the development and implementation of the New University Management System (Sistema de Gestión de la Nueva Universidad [SIGENU]) for registration management and student transcripts. This project falls under the purview of the Ministry of Higher Education and is led by the José Antonio Echeverría Technological University of Havana, known by its former acronym CUJAE. Within each university, interesting computerization initiatives have taken place, for example at CUJAE, the Marta Abreu Central University of Las Villas, and the University of Informatics Sciences (UCI).

However, administration informatization is far from what it should be for a modern university system, given current needs and possibilities. And so confronting this transformation is an urgent challenge. In the next sections we examine the main factors responsible for this situation and that present obstacles to its resolution. We also propose principles and possible action steps for a path toward the definitive digital transformation of our universities.

Methods

The reflections shared here are primarily the result of the experiences of the authors over more than ten years of leading the informatization pro-

cess of the University of Havana. The participant observation method has been fundamental. We also reviewed documents, especially around twenty reports about ICT use at the University of Havana. These reports were provided to the administrative departments of the institution and the Ministry of Higher Education during this time period.

Moreover, eight years of teaching ICT in public administration management at the Higher School for State and Government Cadres has enabled us to observe insufficient initial acceptance followed by application of the course content by more than four hundred directors of central administration departments in Cuban national and regional governments. Data from a survey of students in the same school developed by the Informatics for Business group of the Technological University of Havana (CUJAE) was collected and analyzed. The topic was the ICT strategic plan for the Cuban national business environment (Ruiz Jhones et al. 2018).

Finally, we participated in a focus group to discuss the obstacles that were slowing down informatization in the country. Participants included ICT specialists from several universities located in the capital (the University of Havana, the Technology University of Havana, and the University of Informatics Sciences). Other participants came from scientific groups and departments in the Ministry of Communication; the Ministry of Culture; and the Ministry of Science, Technology and the Environment, as well as businesses from the computer and telecommunications sector. From the analysis of this focus group (Ruiz Jhones y Vidal Larramendi 2017), topics have been selected and are discussed below.

Problems and Obstacles to ICT Use in Cuban Universities

International barriers and the limited financial and material resources that exist for these purposes nationwide are well known (Elizalde 2013; Recio 2013). The US embargo imposed on Cuba since 1961 means the nation is unable to access financing sources such as the International Monetary Fund and the World Bank. In addition, Cuba cannot import equipment from the United States or products produced by US firms, even through a third country. This results in available commercial credit being provided under very unfavorable terms (MINREX 2017). According to the International Telecommunications Union, Cuba appears in the next-to-last position in Latin America in connectivity. Internet users comprise 38 percent of the population, and 7.5 percent of homes are connected to the internet (International Telecommunication Union 2017). The telephone-line density of the country in 2016 was only 47.4 lines per one hundred inhabitants, and this figure includes mobile phones (ONEI 2017b). That same year, the entire nation's international bandwidth was only 8 GB per second (Figueredo, Doimeadios, y Pérez 2017). A considerable national effort is now underway to expand the mobile phone network, which in-

cludes 5 million lines connecting a population of slightly more than 11 million inhabitants (ETECSA, n.d.). This is in addition to more than 1.152 million personal computers (ONEI 2017b), a figure that includes computers at home, school, work, and public access spots. There is also a very large number of other digital devices across the island. However, there is still room to deploy more technologies to answer strong popular demand for digital communication services.

National policies have prioritized public access to these technologies on the one hand and their use in sectors such as education, health, and industry on the other, which has both benefited and challenged higher education. However, the situation described above impacts the universities as well. We see five types of problems—by which we mean shortcomings or deficiencies—as the most significant: infrastructure, computer systems, information security, ICT support for teaching and learning, and human resources. These are detailed in table 1 below. This has resulted in universities not achieving the standard requirements of ICT utilization in administrative development and management as compared to other countries, including other poor countries.

What are the key obstacles standing in the way of solutions to these problems? To answer this question, we will focus on personal communication (Ruiz Jhones y Vidal Larramendi 2017):

- The social environment. There is insufficient appreciation of the potential of connectivity and information technology in economic and social development.
- Economics and finance. Access to international financing is limited. In addition, foreign investment in telecommunications and computers is lacking, with insufficient domestic financing and no access to external funding sources such as the International Monetary Fund and the World Bank. ICT investment is regarded as a cost, not as an investment for the future (MINCEX 2014, 2016).
- Technology. Cuba is taking the same steps that were taken elsewhere in the world, yet we are not advancing quickly enough to reach the level of the rest of the world.
- Cross-sector institutional leadership (what Cuba referred to as cadres). Most people in these positions are not digital natives, and they tend to leave ICT decisions to specialists. So ICT strategies are not in line with development strategies.
- Technical personnel. The lack of mid- and high-level technical personnel is becoming more noticeable every day. There are two reasons for this. Some of these people are emigrating to more-developed countries. And here on the island, they are migrating from the public sector (health, education, public administration), which is subject to budgetary restrictions, to other sectors where salaries are higher. Plus, Cuba permits pri-

Table 1. The Most Significant Problems Relating to Informatizing Higher Education in Cuba

Infrastructure:
1. Insufficient equipment or a significant level of obsolescence of the existing equipment
2. Insufficient speed of the wired networks connecting equipment
3. Insufficient wi-fi network speeds
4. Insufficient national and international bandwidth
Computer systems:
5. Few computer systems automating university administration
6. At the university level, only two software systems used by all universities: ERP ASSETS for accounting and human resources management and SIGENU for registration management
7. No state approval for any small or midsize private businesses in this field
Information security:
8. The lack of Public Key Infrastructure (PKI) in the country
ICT use to support teaching and learning:
9. Lack of generalized systemization of the production of educational projects on an ICT framework
10. Insufficient take-up of online learning platforms and the nonexistence of sufficiently accessible and up-to-date archives
Human resources:
11. Insufficient personnel directly associated with the development and use of ICT in universities, with frequent changes in the existing personnel
12. A very significant proportion of the university faculty members who are not digital natives
13. Lack of existence in all universities of an administrative structure that coordinates and encourages the use and development of ICT

vate developers to do flexible light manufacturing in the computer and telecommunications sectors, but not private enterprises, which would work at larger scale.

What has been expressed above regarding administrators' insufficient understanding of the potential of ICT to drive development is clearly explained in a research project developed by colleagues from the Informatics for Business research group of CUJAE. They designed a diagnostic instrument that identifies existing gaps in the minimum understanding that administrators need to move their organizations forward using ICT.

A sample of 262 individuals operating or working for fifty-six entities in seventeen sectors of the economy completed this instrument. Of these, 83 percent worked in businesses and 15 percent in some central office of the state. Out of the total number of participants, 92 percent were managers and 46 percent had ICT-related functions. The instrument presented a set of proposals that concerned either aligning ICT with the strategic objectives of an organization or simply the transformative capacity of ICT. The results showed that 91 percent of the proposals were not being acted on by

the participants. This reinforces the idea expressed above: managers are unlikely both to understand the transformative effect of these technologies and to use them for that purpose (Ruiz Jhones et al. 2018).

Any path proposed for bringing about the digital transformation of Cuban universities must attempt to overcome the obstacles discussed above. A strategy must be designed to attack the problem simultaneously from various sides. In addition, it will be essential to be prepared from the outset for criticism and a lack of understanding. The proposed solutions detailed below emerge from our experience over nearly a decade as we designed and directed the informatization process at the University of Havana.

Principles and Best Practices

In 2009 the University of Havana's University Council decided to move forward energetically with a university-wide informatization strategy. This created the Office of Informatization (Dirección Docente de Informatización [DDI-UH]) to coordinate and implement the initiative. Vidal Larramendi and Ruiz Jhones (2014; Ruiz Jhones y Vidal Larramendi 2016) have detailed the problems and the progress made; a few interesting data points are listed here:

- Increased internet connectivity from a single 1-Mbps channel in 2010 to two channels, 34-Mbps and 10-Mbps, in 2017
- Improvement in the internal telecommunications network from a network of more than sixty access points over low-speed telephone lines in 2010 to an extensive and modern university-owned fiber-optic network encompassing more than 80 percent of the units of the University of Havana—a network that is still growing
- Implementation of a systems and services platform that includes all main university processes, including more than ten high-impact systems, such as those for handling research information or postgraduate course information
- Use of proprietary PKI for user authentication currently being implemented
- Purge of computing device inventory, with the percentage of broken or obsolete items dropping from 23 percent in 2013 to less than 13 percent in 2016

What is most important has been the change in the university community. In the past, people only used ICT to connect to the internet and for electronic messaging. Nowadays, they use all the systems in the platform, and some important moments in University life are not possible without them, such as the annual accounting for scientific activity.

Along these lines, one important obstacle has been the great variety of ways things have been done at the University of Havana. There was no standardization of procedures, and each area clung to its own way of working.

Another obstacle to be overcome has been a general resistance to change in the university community, something that has been observed most particularly at the time of implementation of new information and management systems. Workshops, courses, online help, and other types of assistance for end users have not yet managed to break down this resistance. Our experience indicates that, to a significant degree, implementation of a new, automated management system needs to be imposed by the university administration in its early phases. This of course involves a high level of commitment to the computerization process at the highest administrative levels of the University of Havana. When this was lacking, significant backward steps occurred.

One factor that has worked against acceptance of these systems by the university community has been the lack of adequate infrastructure in terms of equipment and connectivity. Various strategies to mitigate this have proved useful, such as web-based systems and better-quality equipment, especially in the functional areas responsible for the workflows being automated.

Another important lesson is that systems should be introduced little by little, not all at once. The community cannot tolerate massive change. In addition, the user must experience personal benefits to using the system.

All these experiences led us to formulate a set of operating principles that will contribute to an ICT-based transformation of colleges and universities. The seven principles are as follows:

- One, a strategic and cross-domain process. Informatization of the university is a transformative process that reaches all activities and all actors. Therefore, understanding its strategic character is fundamental.
- Two, commitment by the highest levels of university administration. Because it is a strategic process, the highest level of university administration must provide leadership. No one else can. Administrators at the highest level must use the systems themselves.
- Three, an executive team. Beyond strategic leadership at the highest institutional levels, informatization requires a group that leads and implements the work.
- Four, organized workgroups within the university. Chaos cannot be computerized. Processes must be carefully organized if they are to be automated.
- Five, because informatization implies transformation, which is to say a cultural change, it cannot be accomplished all at once. It must occur gradually, but without pause. Once informatization has begun, it must continue.
- Six, creation of consensus. Even when mandatory changes may ultimately be required to facilitate the adoption of a particular system, the construction of consensus regarding a transformative process like this one is essential for its success.

- Last of all, security management. Security is a fundamental requirement in everything related to ICT, but it must be managed with a broad view of risks versus progress. Security cannot raise a barrier that impedes development.

Armed with these principles, a set of best practices, or actions, can be used to begin the informatization of an institution of higher learning with a high probability of success. These are based very much on lessons learned during informatizing the University of Havana.

Action 1
Create a working group at the highest administrative level to design the general strategy for beginning work. The startup strategy is just that, a way to get started. It should start with a diagnostic analysis of the situation at each university and set general long-term and short-term goals.

Action 2
Discuss and approve the strategy within the administrative departments of the university. The digital transformation strategy must be articulated with the university's overall development plan.

Action 3
Create an executive entity to take responsibility for the process. It should answer directly to the highest administrative level of the university. Its functions could include the following: long-term planning for the digital transformation project; administration of the production, acquisition, implementation, and maintenance of computer products; development of professional development and postgraduate activities and courses; and administration of remote services and the telecommunications network. Computer security is best located outside of its purview because the team should not be the judge of its own results in this area. Remote platform administration should be the central focus of this department.

Action 4
Create a vision for the university transformation project. The fundamental objective of all this effort is a comprehensive transformation of the university. Systems should function on a common platform so as to ensure interoperability.

Action 5
Define systems-development architecture. From the start, the department must select the tools and platforms to be used in systems development. Preferably, the solutions developed should be open source.

Action 6
Make alliances. The department must make alliances with the university departments that are responsible for the processes to be computerized.

Building on what others have already accomplished is also advisable. Some universities have already been down this path, and it is possible to make use of their systems.

Action 7
Focus on the end user. Along these lines, user-interface standardization is something that must be dealt with. The elimination of bureaucratic processes that require a physical presence and a significant reduction in the use of paper should be among the primary objectives of the transformation.

Action 8
Set up an ICT training program at all levels and from all perspectives. The ICT department must be established as an entity capable of teaching both professional development and postgraduate courses.

Action 9
Manage the university's understanding of ICT. Given the relative instability of specialized ICT initiatives, systemization, conservation, and transmission of knowledge by the new specialists is essential. Among other measures, the following are needed: appropriate documentation of the systems to be developed and used, as well as procedural outlines for version control and safeguarding of prior versions of all the software used by the university.

Conclusions

The informatization of administrative functions is an essential step in preparing a university for the world of today and its demands. In this area, the University of Havana has had unquestionable successes in the last decade but has a ways to go. Lessons explained here aim at helping others travel a shorter and smoother road.

Digital transformation is manifested as an institutional cultural revolution. It should be treated as such, with a full understanding of the challenges involved. It is impossible to effect this transformation without a fully thought-out, collective strategy, without a centralized team directing the process, and without the strong and constant support of the highest levels of the administration. Once the process has begun, it cannot be stopped. The infrastructure, systems, and personnel will always be growing, and the project will grow too.

Real-world resources will be required, but it is unreasonable to expect to have all of them in place at the early stages of this process of transformation. The creation of a shared culture is what takes the most time. In this process, everyone counts; the understanding, education, decisiveness, and firm will to overcome the difficulties that present themselves will require everyone to move forward together.

The digital divide between the Global South and the more-advanced countries is particularly acute in Cuba, which means that significant effort and creativity will be required to resolve it. The task is urgent and demands that universities be leaders throughout the course of the process. The ideas expressed in this article may serve as a guide in these efforts.

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