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Periods of Technological Change in Higher Education

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This article was not written with the assistance of any Artificial Intelligence (AI) technology, including ChatGPT or other support technologies.

Abstract

This study identifies three fundamental historical moments related to the incorporation of information and communication technologies in higher education. To explore these phases, we acknowledge an initial period defined by the massive use of computers, mostly for accounting and office automation; a second period during which highly specialized software emerges and expands its coverage in academic disciplines; and a third period characterized by a widespread use of Learning Management Systems and communication software during the COVID-19 pandemic.

Keywords: Higher education, Information and Communication Technologies (ICT), pandemic, specialized software, Learning Management Systems, Mexico

Resumen

El capítulo propone un ensayo de periodización que ubica tres momentos históricos fundamentales que se asocian con prácticas de uso de las TIC en las universidades: un periodo inicial que impulsa el uso masivo de las computadoras y se basa principalmente en el software para la contabilidad y para labores de oficina; un periodo más, representado por la explosión del software especializado; y un tercer momento de desarrollo caracterizado por la utilización generalizada de las plataformas de enseñanza y de comunicación durante la pandemia de la COVID-19.

Palabras clave: educación superior, México, plataformas de enseñanza, pandemia, plataformas de enseñanza software especializado, TIC

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Introduction

The technological change associated with the incorporation of information and communication technologies (ICT) in higher education (HE) has not been a continuous process nor is it made up of the same elements. We identify three

historical moments in which ICT has been incorporated by colleges and universities for educational purposes. We recognize an initial period that was defined by a massive use of computers, mainly for accounting and office automation; a second period during which highly specialized software emerges and expands to penetrate practically all academic disciplines; and a final period that was characterized by the widespread use of learning management systems (LMS) and communication software during the COVID-19 pandemic.

The evolution of technology among higher education institutions (HEI) has been studied from a historical point of view (Casillas & Ramirez, 2014) and currently research examines elements of technological change and the digital culture (Casillas & Ramirez, 2021). The evolution process includes the acquisition and massive use of computers and all sorts of digital devices that have not only become more accessible and multifunctional but have also been adapted for many professions. Technological change generated an enormous use of computers, smartphones, mobile applications, networks, information systems, and highly specialized software. In a digital culture, mobile devices lead the way when it comes to portability, ubiquity, and accessibility to information. A new digital culture also flourished within this technological change. This includes new ways of thinking about technology uses, practices, attitudes, social representations, and values that scholars promote around cyberspace, as well as the use of computers and the evolution of the workplace to digital environments.

Technological change moves across all social spheres. For instance, all economic processes and their branches have incorporated computers and the Internet into their workplace, transforming their operations, duties, and professions and denoting a wide domain of technological practices. Moreover, fundamental references for humankind have been modified in which ICT accelerates time, resizes the world, and expands reality to simulated experiences known as virtual and augmented reality. Additionally, the substantial use of social media establishes new consumption practices and domination of globally standardized ideologies and social dynamics. Therefore, human communication, access to information and everyday interactions have been altered and diversified (Castells, 1996; 2013).

It is precisely in educational environments where this modern digital culture unfolds leading to significant changes. For example, new strategies for reading, writing, teaching, and learning, or producing and distributing new knowledge are disclosed and schools, educational processes, student-educators' roles, and bureaucratic procedures have evolved. Old traditions have been overtaken by new practices. Online student-teacher interactions changed, assignments are turned in digitally, there is massive production and consumption of digital materials about different topics, documents are done collaboratively through the cloud, and academic discussions take place in virtual forums and face-to-face meetings have been relocated to virtual spaces. But above all one of the most radical changes is the open access to cultural goods that were previously only accessible to certain people (Cobo, 2016; Rama, 2021a; 2021b).

However, these changes also yield unequal distribution of academic resources. There are differences in access, use, and appropriation of ICT between social classes. For instance, during the Covid-19 pandemic, when academic activities migrated to digital spaces, socially excluded communities were affected in many ways. Teachers and students with poor Internet quality, computers, or an inappropriate workplace at home for online classes were left behind. The online learning for them was not as effective as for those with stable access to ICT. These educational inequalities end up separating those who have from those who are dispossessed of technological capital (Casillas & Ramirez, 2014).

Before technological change, universities were closed spaces for centuries. Their academic departments, even with some curricular flexibility, not only had definite processes of disciplinary affiliation, without an interdisciplinary perspective, but also a trend to be homogenous without recognizing students´ learning pace or the cultural differences that distinguish them. HE has long been using a rote learning approach in which professors are the main authorities and truth and knowledge bearers while the exams are the main assessment method. Nonetheless, the incorporation of ICT into HE represents the most important change in the progression of university systems since they appeared in the 12th century. Modern communication channels, the use of specialized software in academic disciplines and appropriation of LMS for academic continuity are creating unprecedented changes on this educational level (Gobierno de España, 2023).

Some clear changes are seen in the management of HEI, administration processes, their governance and in other institutional activities. Luckily, a boost is happening in the production of cultural and educational resources, information, research and in the development and use of diverse digital platforms including LMS and other means to share and access knowledge (EDUCASE, 2022).

Nevertheless, our research indicates that the incorporation of ICT has happened randomly without planning and needs assessment or well-designed policies based on the experienced. With few exceptions, spontaneity has prevailed as well as a poor critical reflection on behalf of educational institutions and policy makers. We have not even been able to determine what scholars should know about ICT in every academic discipline, nor have we agreed on what needs to be taught. HEI have not defined the digital knowledge set a students' needs to possess at graduation. Uncertainty prevails, and the disciplinary approach of ICT use is still pending. With the lack of clear and effective ICT policies to ensure quality and excellence in HEI strategies for incorporating ICT in disciplinary fashions a proper update of students' preparation will be out of hand (Bruner, 2003; Brunner, 2017; Brunner, 2022; Brunner & Tedesco, 2003; Rama, 2021a).

Literature Review

The Initial Incorporation of ICT into HE

The initial phase of incorporation of ICT in HEI started at the end of the 20th century and made its course until the dawn of the 21st. century. It began with a massive use of office automation software like Microsoft Word, MS Excel, and MS PowerPoint. At that time, electronic devices were not interconnected, the Internet was being developed and social media was nowhere in sight. Furthermore, computers and digital devices were high-maintenance, inaccessible and, to some extent, unaffordable.

It is fair to say that computers, software, and programming language have evolved since the 1950s, and since then programming computers and being proficient using information systems, has been considered as sophisticated knowledge. The dawn of desktop computers in different spheres of society brought out a different meaning to the use of computer software. Accounting and management areas received prominent attention since their work-related activities could benefit from the use of computers. The software for that area was widely used even before the graphic user interfaces (GUI) were adopted.

Computer sciences, accounting and management have enormously expanded. They are the reference for using software for special purposes with the greatest impact on the global economy and growth. Aside from military purposes and computing itself, another area of expansion was office automation by means of systems software suites. Microsoft software became the leading solution for modern office procedures. The accounting spreadsheet, a word processor that provided office workers with editorial functions, and a graphic presentation program, were sufficient elements to allow Microsoft to launch the first versions of Office, from the early versions of Windows Operating System, revolutionizing in the 1990 the users of computers.

The popularization of Office allowed new possibilities of computational usage and eventually it had an important impact in the curriculum design across all educational levels. Novel users, from elementary schools to college institutions, not only acquired knowledge for office software rooms, but also for operating desktop computers and their peripheral devices. Over the years, software for office automation was seen as the standard of computer usage, until specialized software for academic disciplines emerged and developed profusely. The HE user needed to expand their digital knowledge on office suites, to the digital process of medical images, computer-aided architectural design, virtual science lab simulation or employment of geographic information systems (GIS), as well as the use information ecosystem for the online education necessities made more evident during the coronavirus lockdown.

Microsoft Excel represents the legacy of the accounting software movement initiated in the 1970s that users who were neither computer scientists nor accountants had to learn. Besides this type of disciplinary software soon emerged other computers that required both basic proficient computer users and a given disciplinary knowledge.

With the development of personal computers, Office became more popular, and schools needed to design academic routes to promote their teaching and learning. A variety of courses appeared specifically to teach how to use personal computers and their office suites. Its practical use for authoring essays, processing information, and making graphic presentations in class became daily practices. Gradually, learning office automation software became the minimum requirement in the educational system and soon extended to other social areas. Although it is not officially evaluated at admissions to HEI, we have reason to believe that students nowadays start college with a considerable set of digital knowledge (Casillas & Ramirez, 2020). Academic texts, research reports and other pieces of text are created within a word

processor. Usually enhanced with images, references, hyperlinks, and tables, users create documents either locally or collaboratively.

An Era of Specialized Software

Once the use of office automation software in higher education became common and the use of computers and digital devices were accepted at colleges and universities, new challenges occurred. Specialized software became known, along with modern devices and sources of information that were specific to every profession or field of study. The technological change and digital culture not only imply a challenge for HEI but for the stakeholders of each academic discipline who need to adapt on various aspects such as knowledge production, disciplinary practices, digital rich interactions, and communication among academic communities. Academic disciplines in universities have a dominant position in science (Bourdieu, 1994) and the technological rapport of their members is high and changes rapidly (Casillas et al, 2016).

Without proper educational guidance or policies, most HEI have improvised on the incorporation of ICT into their educational practices, relying on engineers, computer experts or administrators who decide what needs to be done. This chain of command, although common and quick, leaves out academia, educational needs, and real opportunities to incorporate ICT into the fundamental functions of the educational institution. HEI should assume the responsibility to provide guidance for their technological decisions from an academic perspective, understanding the inherent differences in academic work (Clark, 1978; 1987; 1991). Academic disciplines are communities structured by epistemological differences (Becher, 2001) and social configurations where faculty members bring together social practices (Grediaga, 1999), and generate the academic stakeholders' identities (Biglan, 1973; Dubar, 2002). Academic disciplines form scientific fields (Bourdieu, 1994; 2000) and attempt to improve their positions to obtain social benefits and rewards.

The integration of ICT in all academic disciplines has not been so far a homogenous process, because of the nature of the tasks and activities needed to be performed (Clark, 1987), the multiple fields of study and professions found in HEI.

Some academic disciplines rely heavily on technology, while others show various degrees of technological appropriation. However, we would like to emphasize the considerable proportion in which electronic devices, specialized software, applications, resources, and appropriation of cyberspace is growing within academic disciplines. We have verified that the proposed indicators, in line with Becher (2001), are relevant to recognize the nature of work and examples of how different the incorporation of ICT is done in HE (Casillas, Ramirez, Luna and Marini, 2017; Ramirez and Casillas, 2015).

Academic disciplines are social systems with interactions, practices, and endeavors. By integrating their professionals, they generate an identity and define specific behaviors. Members of a scientific discipline establish an ethos around legitimate values and forms of action (Merton, 1938; 1942). In terms of Bourdieu (1980; 1994; 2000), academic disciplines in specific fields of study create a particular habitus that makes physicians, for example, think, act and value social situations different from what engineers or sociologists would do. As academic disciplines and professions intersect technological change, we can speak of a digital habitus (Casillas & Ramirez, 2018, 2019).

In HEI and the professional world, the digital habitus looks at how teachers and other professionals are using ICT in their line of work. Digital Proficiency mastering office suites, the expansion of websites, digital libraries, software programs, digital content, and blogs reinforce the idea of how deep information has specialized in line with disciplines, professions, and jobs. We identified this matter as the social dimension of academic disciplines (Morales & Ramirez, 2015; Morales et al., 2015; Ramirez et al., 2014). HEI teachers and other professionals play a position in the digital cultural system as consumers, producers, or administrators of digital content (Lévy, 2007).

The digital habitus, as a set of incorporated provisions, refers to the cognitive dimension of the digital knowledge set (theoretically and experientially) that represents a certain degree of knowledge beyond basic computer skills (Ramirez & Casillas 2015; Casillas et al., 2014). In a practical sense, the digital habitus includes knowing how to interact and use digital devices, and information in a practical way. Therefore, the digital habitus is a practical knowledge because it provides a sense of knowing how to use ICT efficiently and it is part of the digital culture because it includes attitudinal and behavioral dimensions for online environments, which in our terms we tend to study as digital citizenship and digital literacy (Casillas & Ramirez, 2019). Every academic discipline has a particular culture, which is a set of notions, practices, theoretical and methodological foundations that Kuhn conceived as scientific paradigms (Gonzalez, 2019; Remedi & Ramirez, 2016). Each academic discipline established sees itself as different from others by a particular set of uses and attitudes towards software

programs and digital devices. Those differences can be observed in the word clouds we have created for the six academic discipline areas that operate at Universidad Veracruzana.

The research hypothesis of the intervention is that we are experiencing a transition era characterized by an expansion of specialized software. The word clouds created with the information gathered from professors at Universidad Veracruzana demonstrate a prominent fluctuation of software. A deeper look at the information let us determine the most frequently used software and how big the variation of usage is. Furthermore, the data analysis also shows that Microsoft Office Suite is still a popular option among teachers even when its degree of specialization is shallow. The presence of Microsoft software in the disciplinary software clouds allows us to see whether the academic disciplines have evolved towards a more diverse incorporation of software, or they remain in a basic stage of Microsoft general purpose software usage.

When teachers were asked to provide the name of the specialized software they use frequently in their field of expertise, their answers revealed a considerable confusion about web pages, devices, applications, and general-purpose software. The initial inquiries allowed us to determine the type of software, web pages and mobile applications commonly used among all academic disciplines. This also helps explain how ICT have been incorporated in Mexico, particularly at Universidad Veracruzana, where teachers keep relying strongly on Microsoft software, now present by a campus agreement of using Office 365. Other popular family of information services were those of Google such as generic and academic search engines, translation services, email exchanging and the cloud-based office suite. Finally, Eminus, the institutional LMS at Universidad Veracruzana also appeared in the clouds due to its mandatory character for all university courses at the institution.

Distance Education Era

We are now experiencing a new phase of technological change, caused in part by the health measures applied during the COVID-19 lockdown. Specialized software is still being refined and expanding there is no doubt, but the dynamics of HEI changed when all activities were entirely suspended, and face-to-face learning was dramatically interrupted. The situation granted the opportunity to use video conferencing, LMS, and social media to enhance the learning experience for those participating remotely, but it also forced teachers and students to acquire computer equipment and gain access to Internet by their own means.

The steps taken to face the pandemic favored the use of ICT not only for academic purposes, but also for social and commercial ones. Digital enabled communication became essential to both relationships and businesses, so people needed to remotely stay in touch with family members, friends, colleagues, customers, partners, and even employees. The synchronous and asynchronous interactions enabled applications for productivity and communication to become popular, facilitating live streaming, online class recordings, personalized learning environments, a fast distribution of digital content through instant messaging and Internet-based chatrooms, thus enhancing learning processes, student engagement and collaborative work. What seemed impossible at the end of 2019 was quickly implemented during the lockdown. All students and teachers were forced to appeal to distance education as the only means possible to advance with school activities, especially instruction. Governments and educational authorities were slow to deal with the pandemic situation in a quick manner. Their first response involved closing schools' spaces and reducing teachers' and students´ mobility. Later, LMS were profusely used as well as software and applications for productivity, and synchronous and asynchronous communication such as Goggle Meet, Zoom, MS Teams.

HEI that, prior to the pandemic, had any type of LMS, were able to continue with instruction and learning processes, followed their own guidelines, and used whatever digital resources they had available. But those educational institutions that did not have any sort of LMS, had to react in many ways. In some cases, HEI improvised with some LMS, in others, educators used whichever platform they felt comfortable with and in other situations, it was social networking platforms or instant messaging services that were used for communication, teaching and learning.

It is worth acknowledging that difficulties resulting from the shutdown of campuses and face-to-face activities did not stop educational processes. Classes continued online on a regular basis, and students were able to advance in their learning. Although most educators were not ready for online education, they succeeded in providing instruction at home following their own intuitions and using whichever technologies they had previously employed, even on a smaller scale. We observed that during the coronavirus lockdown, online classes embraced four types of teaching strategies.

- Use of video conferencing applications for synchronous learning.

- Use of LMS for asynchronous learning and distribution of materials.
- Collaboration and communication fostering through various channels.
- Instruction through remote guided reading.

Videoconferencing aided teaching worked well for those students and instructors who had a proper space at home, high-speed Internet access, and electronic devices that supported video conferencing applications. Sessions were to be conducted synchronously, respecting schedules, as much as possible, and simple outlines, or agreements regarding the correct use of microphones or cameras were established for those attending. In online classes students had to listen to the teachers´ instruction conveyed through applications like Zoom, Microsoft Teams, or Google Meet. Regardless of the video conferencing system implemented, operating system or types of devices used, school activities were mostly accomplished on mobile apps or in LMS. Google Classroom, Microsoft Teams, Moodle, Eminus (at Universidad Veracruzana) and others, provided the space for the administration, automation and delivery of materials, videos, links, images, and all sorts of digital content. LMS permitted instructors to assign tasks, conduct assessments, and interact with students or colleagues in forums and chatrooms. Although LMS existed in the country and were moderately used before the pandemic started, they turned out to be the most beneficial resource for knowledge management and interactions in distance learning practices.

Opening proper communication channels for academic and other informational purposes was particularly useful during the pandemic. Academic communities appropriated social media or instant messaging applications which helped them to continue their academic activities. For instance, WhatsApp allowed teachers in all educational levels to continue working remotely by sending instructions, texts, audios, attachments, and monitoring students' questions. In some cases, WhatsApp was even used for socializing and entertaining teachers and students. Apps for instant messaging played a significant role during the lockdown.

Instruction through remote guided reading in HEI was as common as online classes through video conferencing. Reading assignments were established, and the materials were uploaded to LMS or shared through instant messaging, usually in a PDF format. Also, e-reading became accepted and common, and was just as efficient and dynamic as instruction through videoconferencing, although it is necessary to mention that this strategy is not a full representation of what online education is all about.

Theoretical Framework

We recognize that there is a digital divide that includes access, use and appropriation of technologies. To measure this multifactor phenomenon, we borrow from Pierre Bourdieu´s theory of Cultural Capital and brought it to the technological field. The Technological Capital has three states: the institutional, the objectified, and the embodied capital. The institutional state is given by diplomas and certifications, while the objectified capital can be observed on the brands and devices the users have got. The embodied technological capital is seen as a digital knowledge set.

To measure what academic stakeholders know about digital technology we developed and used a conceptual model called the digital knowledge set. The interviews, focus groups and the empirical result, for this text and other research findings have been previously discussed and published in other spaces (Casillas & Ramirez, 2015b; 2021a; 2021b; Casillas et al., 2014; 2016; Ramirez, 2012; Ramirez & Casillas, 2016, 2017b; 2021a; 2021b; Ramirez et al., 2014; Ramirez et al., 2015). What the HE stakeholders need to know with regards to ICT is organized in ten categories: digital files, digital devices, software and databases, text, data sets and multimedia, communication in digital platforms, collaboration in digital environments, digital citizenship, and digital literature. These ten sections describe what academic stakeholders should know about digital matters considering their disciplines and leave behind the general view of computer use for office automation purposes. Data analysis was handled in a database that is accessible at https://gat.aexiuv.com. It holds over 500 records of faculty members at Universidad Veracruzana in Mexico that participated in this series of interventions between January 2018 and May 2019. Data were filtered by academic disciplines through a data-mining processes considering the six areas the university considers: Arts, Humanities, Economic and Business Administration, Engineering, Biology and agrobusiness, and Health Sciences.

Methodology

Prior to this intervention, we developed and applied a focus group-based methodology to study academic communities that have similar uses of technology. Qualitative research allows us to voice stakeholders by asking them about

their values, preferences, and strategies when using digital technology. We arranged the findings as a set of digital knowledge with levels of digital fluency. The differences are evident among group given practices as well as the similarities within. That is, the use of digital technology from architects, for instance, is similar among them, and different to those of philosophers or physicians. The focus groups, analysis of discourses, the systematization of responses and the general opinions allow us to observe discussions, tensions, and trends.

In this study we present the results of a study we conducted between January 2018 and July 2019, in which we defined the digital knowledge set that academic communities have by means of the analyses of the academic discourses elicited in good 60 focus groups. With the idea that the use of digital solutions in HE is permeated by the culture of a given academic profession (Lund et al., 2021) we proceeded to explore what teachers and practitioners use with regards to specialized software and databases.

The main objective of the intervention was to help college departments define the digital knowledge set for their specific undergraduate degrees. The results allowed us to picture how different the digital knowledge sets are across academic disciplines in HE. We also observed an outbreak term in which the use of computer programs and access to specialized information from a wide variety of sources increase. This suggests a disciplinary culture linked to the appropriation of technology (Casillas and Ramirez 2021a, 2021b; Ramirez and Casillas 2021a, 2021b).

Participants

To explore the complex relationships between academic life and software use we organized 60 focus groups with about 500 University professors, from 60 different HE programs. The focus groups were held in 6 different appointments organized from January 2018 to July 2019. In each focus group the teachers discussed the software and databases that are commonly used in their discipline.

Findings

In this part we present the evolution of ICT adoption in HE, in six different sections. The way we have divided the views of the informants respond to the institutional organization of the University we intervened. Each of the six sections correspond to the academic division of the university. They are Arts, Humanities, Economics and Business Administration, Sciences Technology Engineering and Math Academic, Biology and Agrobusiness, and Health Sciences.

The Arts Academic Department

In this academic area formed by disciplines in music, contemporary dance, plastic arts, and theater there is a huge diversity of software programs, devices, and digital sources of information, whereas the use of office automation software such as Office 365 is less common. Sibelius, Transcribe, Finale, Audacity, Metronome and Garage Band were some of the most common programs mentioned by this community.

Figure 1

Word cloud of the software used in the arts academic department

The Humanities Academic Department

This academic area gathers undergraduate programs in sociology, anthropology, history, social work, philosophy, linguistics and languages, education, and law. The word cloud of this academic area shows an interesting diversity and dispersion of software being used. It is an area with the experimentation of software, but without an institutional agreement on what to use. Microsoft office suites is present in the cloud. Word and PowerPoint were indicated as extremely common among teachers in these disciplines. Part of the software mentioned by teachers in these disciplines are Atlas.ti, Babel, Bonjour de France, Cambridge & Oxford dictionaries, Cuadernia, Edmodo, Educaplay, Evernote, ExeLearning, Hot potatoes, Jclic, Kahoot, MaxQDA, Mendeley, Moodle, Padlet, SPSS, Statistica and Sways.

Figure 2

Word cloud of the software used in the humanities academic department

The Economics and Business Administration Academic Department

Universidad Veracruzana offers in this academic department degrees in economics, geography, statistics, accounting, and other business administration options. These disciplines use specialized software extensively such as Aspel, COI, NOI, SAE, SPSS, Geogebra and R. Although Word, Excel and PowerPoint also appeared.

Figure 3

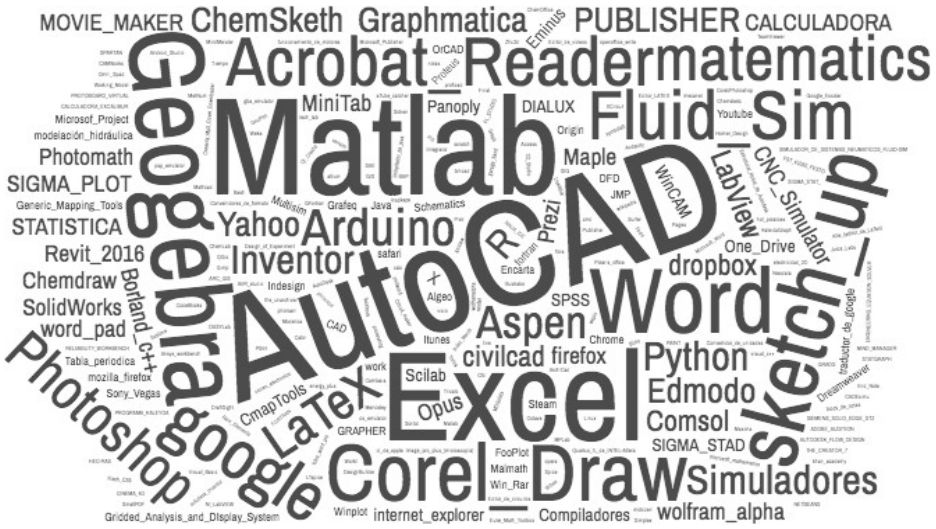
Word cloud of the software used in economics and business administration academic department

The Sciences Technology Engineering and Math Academic Department

The STEM academic department includes some formal and applied sciences programs such as chemical, civil, electrical, materials science, mechanical, architecture, chemical sciences, atmospheric sciences, electronic instrumentation, mathematics, and physics. These disciplines are strongly associated with the use of formal languages and mathematics. Even when the teachers of this department use a vast number of software programs such as Matlab, Geogebra, Statistica, ChemSketch, SigmaPlo, R and Python, MSExcel and MS Word still appeared in the word cloud.

Figure 4

Word cloud of the software used in the sciences academic department



The Biology and Agrobusiness Academic Department

In this academic area, Universidad Veracruzana offers degrees in biology, agronomy, agricultural economics, agricultural engineering and veterinary. The use of specialized software is less frequent than in other disciplines while the use of Microsoft Office suites like Office 365 is more common. Part of the software teachers mentioned are MS Excel, MSPowerPoint, MS Word, Google Chrome, Explorer, Mozilla, WinRAR, Opera, Moviemaker, Corel Draw, Photoshop,MacAfee, Arc view, and others.

Figure 5

Word cloud of the software used in the biology and agrobusiness academic department

The Health Sciences Academic Department

In this academic area Universidad Veracruzana offers degrees in medicine, nursing, dentistry, nutrition, laboratory medicine, psychology, and physical education. There is a big dispersion in the use of software in these academic disciplines and multiple specialized software is being used. Part of that software is: Atlas, Astra Seneca, AutoCAD 360, Clinical Chemistry Control, ChemSketch, Clinical Lab QC, Epidat, Pharmacology, pharmacopoeia, GeoGebra, JMP, Latex, Matlab, Mendeley, Minitab, NeuroScan, Numbers, OmniGraff, OneNote, R, SuperLab, Tesi, Visible Body Atlas Anatomy, VisualStudio.

Figure 6

Word cloud of the software used in the health sciences academic department

Discussion

There are two essential aspects that the research identifies. Firstly, we are past the days of early onboarding and office software usage. Secondly, we are now installed in an era in which software is being developed for each disciplinary field. Specialized software tends to be diverse and accompanies the specialization of disciplines in an ongoing trend where there is no end in sight. Many HEIs have been oblivious to this process resulting in zero policies addressing purchase, usage, integration, and incorporation of technology in the classrooms. Also, didactic principles have not been established to attend a progression and a systematic approach for its teaching, although we must acknowledge that little discussion in HEI has been done on how this process needs to be addressed.

The Generative Artificial Intelligence (GenAI), because of machine learning development provides a new horizon of changes and technological innovations that still needs to be discussed in depth. Therefore, every institution must lay out important discussions and reach agreements on the use of software, specialized databases, and other technological issues. By not doing so, they are opening the door for new conditions of distinction, segmentation, and inequality among HEI.

There are two primary elements of the study: (1) We are past the time of initial onboarding and office software and (2) We are now in an era in which software is developed for each disciplinary field. Specialized software tends to diversify and accompanies the specialization of disciplines. This is a continuing trend.

There is a continuity towards the future and there is no end in sight.

a. The HEIs have not noticed this process. Until now this has been invisible to the HEI and there are no policies for incorporation, purchase, use, regulation in the classroom, integration.
b. Nor have teaching mechanisms been established that provide for a progression and a systematic approach to teaching.
c. Finally, we must recognize that there has not been a transversal discussion in the HEIs to give order to this process.
d. With the development of the Generative Artificial Intelligence, a new horizon is opened to change and differential usage that we still need to treat and discuss deeply.
e. It seems unavoidable that each institution holds a discussion and reaches an agreement on the use of software and specialized databases, however, this is not a generalized situation in all institutions, generating new processes of differentiation, segmentation, and inequality between HEIs.

Implications and Conclusion

Technological change has caused an abrupt transformation in HE, unfolding new dynamics. There are at least three major changes with specific characteristics indicating that it is so far an ongoing, unspecified, and inconclusive process.

We found out that the use of software has passed through three main periods one of naïve use with the purpose of solving office problems, a more specialized era with discipline sensitive uses and one more triggered in the lock down due to the pandemic that appoints to the virtualization or *hybridization* of the instruction in HE. The three-time cycles overlap as layers taking the very the best from the latest periods to incorporate it into new environments for constant development. However, there is a lack of HE policies in all three periods, which has created problems for HEI resulting in unnecessary spending, improvisation, insufficient experience acquired, and major difficulties regarding instructional learning practices. These three historical phases, the massive use of computers and office automation software, the increasing use of specialized software, and the widely extended use of LMS and communication software to cope with the pandemic restrictions that affected schools, all show a route that could be capitalized for institutional improvement.

The initial socialization and incorporation of ICT into HE brought with it multiple software to all academic disciplines. Meanwhile, distance and online education modalities became the best solution for coping with the pandemic lockdown boosting synchronous and asynchronous communication and learning through video conferencing system applications, guided reading, LMS, social media, collaboration, and communication software.

Particularly, the use of specialized software situates HE in a different position compared to other educational levels. Thus, using basic Office software remains a task for secondary education, meanwhile learning specialized software becomes a task for the HEI, where the digital knowledge set may correlate to the needs of an academic discipline. However, ICT for academic disciplines is a subject that has not been fully explored among university scholars. Teaching basic research tools and operative systems remains equivocally central, while specialized software needs to make it to the curriculum or

descriptions of study programs. This challenge remains unattended. In our study, we were able to identify a tendency towards the use of specialized software and its expansion at HE. A review of the data indicates that, in line with Becher's findings about different academic cultures under the common roof of universities, various faculties or departments have incorporated distinct types of specialized software. These variations in specialized disciplinary software are the result of a different "digital habitus." As academic communities automate processes, create digital resources, and optimize digital problem-solving protocols, their digital culture and appropriation of specialized software will grow.

The use of accounting, office automation and, more recently, computer-aided learning software, Generative Artificial Intelligence suggests new developments in specialized software for HE. The dynamics of change discussed here are not policy-oriented or dictated by a particular rational choice. There is therefore a great deal of uncertainty and a lack of guidance by policy as there are no specific plans of development that are scientific-oriented. As chaotic as it sounds, this is the present scenario of technological change in HEI. Therefore, we need to advocate for further discussions on how to fully incorporate ICT in HEI. The use of GenAI, specific software and other technological challenges opens a more specialized perspective that is sensitive to the disciplines and professions.

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