

Research Article

Technology literacy as a post-COVID-19 survival competence in higher education: A narrative analysis of students' experiences and prospects

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COVID-19 pandemic has revolutionized not only world politics, science, economic fields, and social life, but also education. In Morocco, higher education, which is considered a potential environment for training students academically and professionally, has witnessed inevitable change at the interpersonal level. As the mode of delivery moved from physical, in-person classes to virtual, mostly synchronous interaction, students have found themselves in pressing need to safely, responsibly, appropriately, efficiently, and effectively use technology to learn and communicate. This research paper is thus conducted about technology literacy as a prerequisite necessity to survive in the post-pandemic higher education. Engaging three students from a biology master program belonging to the Faculty of Sciences in Rabat, a narrative method is implemented to explore and analyze their stories and experiences which have been lived in the COVID-19 educational situation, focusing on technological challenges faced and their implications on their learning. The study uses two tools, personal account and narrative interview, coded in a Three-Dimensional Space Structure. The results show that chief challenges lie in familiarity with educational ecology, rhythm control, time management, and technical problem solving. Indicating an indispensable link between technology and learning progress, the study draws on factors of motivation, interaction, and assessment, and exposes the necessary technology skills that students must acquire and learn, along with documenting their visions for promoting new technology-relevant prospects.

Keywords: Technology literacy, Technology competence, COVID-19 pandemic, Narrative analysis, Physical and virtual communication

1. Introduction

This paper follows a consistent research structure, moving from reviewing current Moroccan educational context from multiple views, through defining concepts and methodology framework, to discussing and interpreting narrative data. Thus in the first section of the paper, Morocco's education status is documented according to international and academic reports and research, with much focus on the connection between technology and education quality. Since the concept of technology literacy is a keystone in the present research, the following section is devoted to defining it with regard to eminent authorities in the field of technology education. The third section grounds the methodology framework used to study the problem. Next, fourth, fifth, and sixth sections includes, respectively, the collection and description of narrative data, analysis, and interpretation. A conclusion is drawn, at last, to emphasize further research need and the sort of the promising value it can add to the scientific and educational arena.

1.1. Morocco's Education Landscape

Morocco today has long tended to promote novel paradigms for the quality of life, a constitutional and institutional intention attested by international evaluation. The field of education, however, specifically

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higher education, has witnessed but a small share of the overall reward. For well-established institutes' reports which measure global competitiveness and prosperity, Morocco has proceeded to gain potential advance in some social and economic spheres, such as safety and security, economic quality, investment and infrastructure, but in education a passive stasis is conspicuously evident. The Legatum Prosperity Index ranks Morocco 111th in education, out of 167 countries covered by the annual ranking of 2020 (Legatum & Index, 2020). The Global Social Mobility Report 2020 puts it 66th in education quality and equity, out of 82 countries (World Economic Forum [WEF], 2020a). Further, the image of technology-relevant capabilities has not changed a lot since 2018, as confirmed by the Global Competitiveness Report. Out of 141 economies covered, the North African kingdom gains rank 97 in ICT adoption, and 111th in the pillar of skills (Schwab, 2019).

A consistent, yet non-developing tendency is documented all through these rankings, in which technology integration in education started to play a relatively significant role. Certainly, such reports and indexes do not offer a detailed description of the Moroccan education quality, nor do they pinpoint specific loci of deficit. Here resorting to scholarly research and academic community do not yield as much value as might be expected, owing to the parsimonious amount of ink spilt on the contribution of technology to the success of education in the current Moroccan context. Undertaking a corresponding and conceptual review can be, nonetheless, of paramount pertinence to the present paper.

1.1.1. On the origin of concern

The continuous failure of educational projects launched since the turn of the 21st century by the Moroccan government calls for multi-disciplinary scientific, independent explanation. Granting that a serious interest in developing the field of national education by the political elite coincided with the digital revolution in all areas of human life, inspecting curiosity often centers on the status of technological skills and technology-integrated tendencies in the processes of teaching and learning. The poor end-product and incompetent human capital urge our endeavors to examine the interrelationships among technological skills and learning achievement. Another incentive to conduct such narrative research is situational, originating from the current pandemic setting.

1.1.2. Education-Technology Convergence under Shifting Roles

Nabil Morchid (2020) published a review article in which he evaluates the quality education of Morocco in a 20-year timespan, from 1999 through 2019. Morchid (2020) traces some substantial successes in the journey to qualified model of education. He ends up by suggesting that the Moroccan system of education is still in need of renewing existing technological schemes and adopting emerging ones, both to measure up to international education performance standards and cater for students' needs and expectations. In this vein, human participants are assigned key roles. They have the power to determine the success or failure of a given virtual educational facility. WEF issued recently a report entitled 'The Future of Jobs' in which it says: "one of the most valuable assets of any economy or company is its human capital – the skills, capabilities, and innovation of its citizens" (WEF, 2020b). The quality of online learning through technology is judged mainly by key target audience, the students, their performance, and pro-activeness. This is also one of the points raised by Draissi and Zhang Yong (2020), after conducting a content analysis of different documents of news articles and Ministry of Education reports and notices from universities website, addressing areas needing urgent assessment during and after the outbreak of the pandemic (Draissi & ZhangYong, 2020).

In another study, Abioui et al. (2020) comment, though very shortly, on some essential aspects of concern in the COVID-19 educational situation in Morocco, putting much focus on the issue of equality and equity in respect to distance learning. Investigating the problem from broader perspective, Abioui and colleagues state that since education benefits both the individual and society, the government should control the risks of commercialization which has been increasingly prevailing, and provide better conditions for learning, lying in technology's availability, accessibility, and utilizability.

In fact, the need for technological skills are not a spur of the currently contingent moment, they are but basic part and parcel of the human capital that is believed to function better in the economic and educational future. Technology is deemed a survival power in new models of schooling, a fact revealed in another WEF document issued in January 2020 (2020c). Therefore, lessons learned from the COVID-19 situation are firmly connected to post-pandemic decision-making procedures and policies, some of which will force a generation of new laws, regulations, platforms and solutions for future problems (Basilaia & Kvavadze, 2020).

1.1.3. Scrutinized issues in technological skills in the COVID-19 pandemic

Scholars and researchers in educational ICT-relevant fields tackled a number of issues which have arisen as a consequence of virtual learning² during the COVID-19 pandemic. Their contributions vary in topics and findings. In the following paragraphs, I focus on those which are strongly related to technological skills, a package of elements that constitutes what I delineate later under the concept of Technology Literacy.

El Firdoussi et al. (2020) conducted a research paper which surveyed 3037 students and 231 professors enrolled in different stages of higher education programs, in order to find out the limitations of e-learning platforms and virtually-assigned activities which took place at public and private Moroccan universities during the pandemic confinement. Being a focal point under investigation, dropout from online courses is a result of multiple factors. According to researchers, social dimension, which encompasses the use of technology, its management, its regulation, trust, and security, plays a major role. Among factors bringing about successful involvement in online learning are computer training in the use and application of Internet technology, creating comfortability with the use of technology, monitoring students' involvement. Unless the stakeholders take decisions to promote the social dimension of distance learning, withdrawal would be the best action to take (Lee & Choi, 2011).

Al Gharibi and colleagues (2020) investigate cyber threats of adopting cloud computing by government. This issue is of critical importance, because cloud learning has been largely implemented by university students in Morocco and outside, especially at the beginning of the pandemic. Al Gharibi and colleagues examines a form of cloud computing in which public service is put online and delivered electronically. While adopting this form, users are vulnerable to three types of risks, namely, technical, information, and cascading effects risks. The intensive use of cloud computing urged students to question their virtual safety and security. The core point under discussion, according to researchers, is how to mitigate risks rather than to adopt such form of interaction or not. Scarcity of alternatives to resolve the problem results in either misuse or dismissal of learning opportunities.

In a larger-scale study, Boor and Cornelisse (2021) spoke to more than 300 lecturers and students at different university schools about the switch to virtual education, uncovering effects of the COVID-19 on students' self-regulation. Researchers found three main issues regarding self-regulating learning in an online environment, which are a) disrupted curriculum structure and study rhythm, b) less feedback, and c) fewer opportunities to reflect together. Despite tenuous connection to the core capabilities of technology use, to question these issues is to seek favorable ground on which such use can be constructively refined.

1.2. Technology Literacy Demarcated

To take the COVID-19 pandemic situation into account, students are deemed active participants in new models and approaches of interpersonal didactic processes. Learning, which had been purely physical, taking place in interactive in-person classes, now are virtual, mostly synchronous. Since it is still history in the making, the current pandemic might no longer stand as a solely recognized pretext to such interaction shift. Putting education in a technological environment has been always one of the trends of globalizing digital information in the third millennium. This is by no means a change to which no student is fully immune. At a practical level of knowledge, the change assesses academic communities' aptitude at effective and efficient use of technology; to put it differently, to see to what extent these communities, particularly students, are technologically literate.

Tracked back by Leonard Waks (2006), the notion of Technology Literacy emerged in the late 1970s and early 1980s in the United States and other developed nations, particularly in the English speaking world, as a response to specific social and economic factors of that time. Several terms are bound, sometimes used interchangeably, with technology literacy (TL henceforth), such as technoliteracy and cyber literacy. Broadly, TL is defined as an understanding of the nature and capabilities, the limitations, and trends of technology (Petrina, 2014). The International Technology Education Association (ITEA, 2007) describes it as the ability to use, manage, assess, and understand technology³. In doing so, technologically literate participants become sensitive to the impact of new emerging technologies on their technologically mediated world (Dakers, 2006).

To Steve Keirl (2006), TL is a 21st century component; he assumes that TL has three dimensions: a) Operational dimension; students acquire technical skills to use materials in order to make products and

² I use the term *learning*, not *teaching*, because I investigate the problem from students' experiences and perspectives.

³ In 2001 ITEA set a range of standards used by educators and practitioners to assess TL. It updated it twice, first in 2004, and later in 2007. The last version will be used to draw connections when interpreting the narratives.

systems, b) Cultural dimension; students apply and contextualize technical learning in practical ways to make designs and solve problems through technology, and c) Critical dimension; students take full and critical role in autonomous citizenry in technological societies.

1.3. The Aim

Recent research, some of which reviewed up till now, proves the importance of technology competence in education. It is by all measures a prerequisite necessity in the present and post-COVID-19 times. Lack of skills in using technology poses critical barriers to effective learning in higher education. To the review I have undertaken to the time of writing this paper, this problem has not been approached from student's experiences. In the Moroccan context, research tends to cover but broad interrelations between technology literacy and higher education quality and performance. Hence, this paper delves into students' experiences and prospects about such survival competence in the post-19 pandemic higher education's ecology, through a narrative inquiry.

Narrative framework, used in the present paper, was modeled by many educational qualitative researchers. I implement the one illustrated by Creswell (2002), by combining two types of narrative tools, namely personal accounts and narrative interview, coded into Three-Dimensional Space Structure, described by Clandinin and Connelly (2000), in Interaction, Continuity, and Situation. This qualitative method goes in accordance with many prominent works in the narrative research (e.g. McAlpine & Mitra, 2015)

The objective is to explore technological challenges faced by higher education students in the COVID-19 pandemic educational situation and their impacts on their learning process and outcomes. It also aims, through delving into their stories and experiences, at unfolding the necessary skills students must acquire to deal with technology and document their visions for promoting new technology-relevant prospects. Thus six questions are to be answered. They can be stated as follows:

- RQ 1) How have higher education students' feedback and concerns been about virtual learning?
- RQ 2) What are technology-specific challenges experienced while learning?
- RQ 3) Where do these challenges stem from?
- RQ 4) Does the use/misuse of technology affect students' learning growth?
- RQ 5) What skills should students master to best learn through technology?
- RQ 6) How they view the integration of technology in education in the future?

To answer these questions, this paper analyzes narratives pertaining to three students from a biology master program entitled '*master biologie des pathologies humaines spécialité sciences du cancer*', belonging to the Faculty of Sciences, Mohammed V University in Rabat, Morocco. Narrative method, abovementioned, is implemented to explore and analyze their stories and experiences which have been lived in the COVID-19 educational situation.

2. Method

2.1. Participants

Three participants are involved in this research: Mohammed (Participant 1, henceforth), Taoufiq (Participant 2), and Hafsah (Participant 3). The narrative covers the period of three semesters: S1, S2, and S3 (which extends from the late 2019 through early 2021).⁴ It is worth noting that many students from the Master program showed immense interest in participation; but for reasons of deep understanding of the issues under study, the number was limited in three. The participants were selected for their open-mindedness, mastery of English which facilitate the process of transcription and storying, and great motivation to share their stories in details. They were introduced to the topic and objectives of the study from an interviewee's perspective. That is, points of discussion and concepts of the research were simplified in a preliminary conversation.

2.2. Data Collection and Data Analysis

Data were collected using two narrative tools, namely personal accounts and narrative interview. Participants were engaged in an individual interview that has been conducted in several rounds through May and June of 2021. Rounds were organized on a regular time basis, hence opportunity

⁴It is worth noting that Moroccan universities started to adopt distance learning about a dozen days after the first COVID-19 case was reported on March 2nd (See diagram 2, 3, and 4 in the Analysis section).

was given to participants to reflect on their experiences, telling their stories in non-stressed, motivated, and diverse conditions. Guaranteeing the maximum freedom and comfortability of expression, participants were asked to choose suitable time at which they can commence each round of the interview. Besides, two sub-tools were used to collect narrative information, checklists, which aim at internal, emotional experience while learning virtually through technology, plus plot diagram in which participants were asked to draw learning growth line (these aids are elaborated in McAlpine 2016). The first round of the interview was introductory, the data that were narrated concentrated on subjective experience of each one of the participant. Subsequent rounds, numbered in six, delved into the story of learning through technology.

In the beginning of each round, an interview guide was handed over to the participant in order to have a general idea about the axes of the topic under discussion and also to draw particular limits of narration. The checklist was kept in participants' hands for about a week, they had enough time to draw a representative line of progress, in the round that followed the participant describes the papers which were modified. Though there was a recorder that documents each response, the researcher took significant notes that could initiate further parts of the story. Initial recorded handout was transcribed, then handed to the participants to see if they had any additional comments on the narrative, as well as to have chance to remove undesirable details.

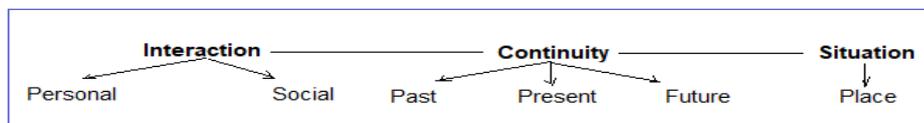
3. Findings

3.1. Three-Dimensional Space Structure

The data analyzed in this section is thematically-coded under the Three-Dimensional Space Structure mentioned in the Methodology section, which follows the chart in Figure 1.

Figure 1

Narrative Three-Dimensional Space Structure



3.1.1. Interaction

Personal. The Ministry of Health confirmed the first COVID-19 case on March 2nd, 2020. The switch to distance learning was as quickly adopted by universities as the pandemic conditions required. Nevertheless, students were greatly excited about the new experience. Hence participant 1 expresses "I had a very positive feedback when I'd heard that learning would take place online; I was happy, excited about the idea to experience something different." Participant 2 also had similar feedback towards the sudden switch as "I still remember when I was young, I was imagining these situations where we could stay at home and study, study from our homes without going to school.. I was thrilled to experience it."

Accordingly, high intrinsic motivation and internal aptitude were sustained at the very beginning. There was an earnest aspiration to take study from far, induced by a positive notion on technology-based learning.

Only a little time was needed to immerse into the experience and unearth barriers to learning, which are basically technological. Participant 1's response is worth quoting in full:

".. Later on, a number of challenges started to appear.. the use of technology was not really successful.. This is because of the strategy and behavior of dealing with it, let alone lack of materials and unstable connection.. In the Q&A sessions, there were few students to be engaged; there was limited interaction. This is perhaps a consequence of the lack of capabilities in using the available technological facilities.. The challenge emerges even on the side of professors. For instance, we had a professor who suffered a lot with the microphone; he could not fix the problem. Even though he was a great professor who loves the subject and did a great job in physical teaching, he could not know how to activate the microphone, nor did he know how to manipulate other online alternatives."

The overall theme under which such reflections can be coded is that the use of technology was not very successful; thus learning was limited. Being the only means of syllabus information delivery, technology as a teaching-learning vehicle has not been fitted well in the national educational framework.

To vary narrative assessment of students' dealing with technology in learning, a checklist was distributed to each of them within the interview. Their responses are presented collectively in Table 1.

Table 1

Experienced personal feelings during learning virtually through technology

<i>Learning virtually using educational technology, I have felt:</i>	<i>very+</i>	<i>+</i>	<i>-</i>	<i>very-</i>	<i>neutral</i>
Comfortable		*	X		
Ready	*	X			
Familiar			*	X	
Financially capable				*X	
Stressed		*X			
Scared		*X			
Bored	X	*			
Proactive				*	X
Socially affiliated					*X
Autonomous		*X			
Disappointed	*				X
Isolated	X				*
Interactive		*X			
Motivated		*X			
Inspired					*X
Strong		*			X
Multi-tasker		*X			
Enlightened			*		X
Interested		*			X
Self-confident		*X			
Secured and safe		*			X
Free		*X			
Privileged			*		X
Rewarded		X		*	
Self-regulated				*X	
Energetic		*			X
Interdependent				X	*

Note. Participant 1 (*); Participant 2 (X); Participant 3 (grey)

Noticeable in the responses the unstable emotions students have borne while learning virtually through technology. They have felt somehow comfortable with technology, ready to use it, motivated, interested, self-confident and autonomous; again, they express strong feelings of unfamiliarity, stress, boredom, fear, disappointment, and lack of self-regulation.

Social. Certainly, the above checklist also offers social information about students' use of technology. Common across the whole narratives are similar positive feedback to opportunities of interactivity and freedom which technology has provided them with. They have been able to work in group actively, to build social network, not on the account of autonomy, but in firm connection with personal freedom, safety and security. On the contrary, social interaction was hence manipulated to express suppressed personal capabilities. There was a setting in which students find an opportunity to share their stress, uncomfotability, fear, and disappointment.

3.1.2. Continuity

Past and Present. Past and present are interconnected in students' narrative journeys. Regarding the past experience, students claim negative impression. Participant 1 stated, "Let me say that the switch, all of a sudden, from in-person to distance learning is dramatically terrible.. because we had not been ready, prepared, technologically speaking, as students, to learn remotely."

To dig deeper into students' past, a plot diagram was given to each one of them to draw a line that reflects their learning growth. The diagram (shown below) starts from semester 1 (late 2019) through semester 3 (early 2021). Each rising or falling point initiated a discussion of challenges, problems, solutions, and alternatives. In spite of having a good reaction to the switch from physical to distance learning explained by their excitement in navigating through a new life experience, the line of learning growth has been increasingly falling down, or running a constant monotonous negative state. Even for participant 3's plot, which seems to have ups and downs distributed across the diagram periods, the rise is confined within summertime where studies at university stop for two-month holiday.

Figure 2

Learning growth for Participant 1

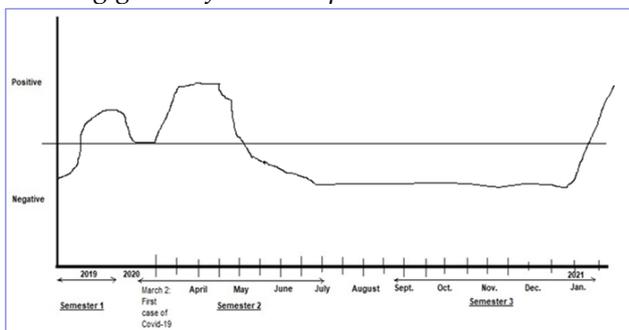


Figure 3

Learning growth for Participant 2

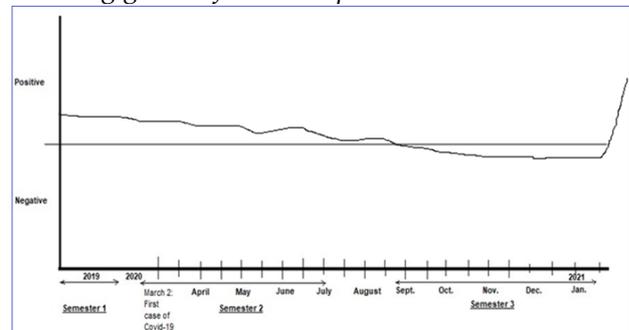
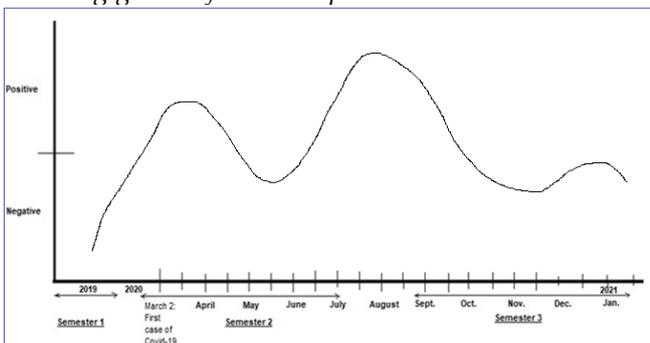


Figure 2

Learning growth for Participant 3



The journey to present is not favorable; technology has been viewed itself as a barrier to learning. In other words, misuse of technology has brought about challenges which keep students' from effective learning.

Future. Based on their past and present experience, students have made contrastive view of learning in-person versus through technology, expressing needs and lacks. Participant 1 asserted, "We need increasing integration of technology in our academic programs, to explore issues and fix them.. This is a serious matter of surviving educationally." Also, Participant 2 stated that, "We need formation in technology use." In another response, Participant 3 mentioned "It is really a catastrophe not to use them.. I saw a lot of people found themselves lonely and confused." In this way, technology has become a prerequisite necessity in modern times.

3.1.3. Situation

Learning through technology determines new modes of interaction, acquiring information, and view of the overall learning experience in its whole picture. For such a setting to be favorably constructive, it needs to be built on fundamental pillars and enjoyable experience, which is not basically judged by final evaluation; this point expressed by Participant 1 as “The final grades do not reflect the success/failure of the process and experience of distance learning..” He continued, “I remember when I was about to leave my town and go to Rabat for physical classes.. It was like moving out from Hell going into Heaven.”

In this context, Participant 2 stated that:

“You can come back to the forest, to the wild, you will survive! You would survive here in the forest (technology), too.. We had already survived in the forest around thousands of years ago.. so why not, again! we are adaptive species.. we created technology, not that technology created us.. Yet a person who doesn't know how to use technology will miss a lot of necessary information.”

Technology, which is learnable by humans, who created it, is becoming an inevitable place to get necessary information.

3.2. Restoried Challenges

Based on the analyzed themes in respect to students' narratives, challenges can be restoried concisely in the following points:

Accessing to alternative platforms; intrinsic motivation to learn through technology was confronted by a failure to access properly, lasting negative feelings and absence of good assessment.

Following procedures of tasks submission; there was no uniform guide to how to submit tasks and track their progress, a skill reinforced by trying a number of alternatives.

Familiarity with platforms and applications structure; socially and culturally, familiarity is established by continuous exposure to the means in target and drawing constructive conclusions on one's performance.

Innovative design and development of activities; a challenge lies in knowing how activities are technologically processed. The point is not only to imitate a computer-based task, but to contribute to creative projects actively and interdependently.

Rhythm control and time management; students were unable to regulate their learning. Lack of self-regulatory skills, as part of technological literacy, could affect the process of information selection and investment. Since learning is rhythmic and subject to time management, the ability to regulate periods of information reception and production is a substantial skill.

Fixing technical problems; adopting a particular means of information acquisition requires techniques to deal with sudden barriers that arise in the middle of the process. There was but little attention paid to this.

Carrying out meetings, without resorting to procrastination as a result of technologically-driven failure; strategy of procrastination has been notoriously unsuccessful but in rare occasions. Since conditions of online platform are unchanged, there was limited flexibility to uncover original problems and solve them.

Self-assessment; assessment is the last phase of learning. It is also a transitional point at which a learner can make an objective judgment on his performance. In the study's narratives, the same negative feelings that were triggered in the beginning prevailed among them at the end. It is a natural consequence of a multitude of personal, social, and situational reasons linked to the use of technology in learning.

4. Conclusion

Reviewed from a total interpretive perspective, challenges restoried above show that students' technological literacy, as defined by Petrina (2014), ITEA (2007), and Dakers (2006), is highly

questionable. To view narratives from a broader lens, a number of implications are to be highlighted for technology literacy in Moroccan higher education. First, personal motivation is perpetuated by constant, effective use of technology. We have seen how students' beginning was full of excitement and aptitude; yet to avoid stimulus extinction, students have to monitor their growth and watch rewards which stimulate their progress.

Second, engagement in technological environment is necessary for students, who are considered as digital citizens (Williams, 2014). Provided such awareness of digital duties and rights, students can question more deeply their responsibilities, interests, and paths. Therefore, survival in the post-COVID-19 higher education requires mastery of technology skills. There has been no denial of the sort of students' understanding of the efforts needed to be made, and the role to be played by them. Their stories tell clearly an existential as well as institutional question whose answer lies in a collective endeavor played by multiple individuals. To put it differently, technology literate students follow international standards and recommendations linked to the best manipulation of technology. This includes developing knowledge about the scope, concepts, and connections between technology and other fields, learning about cultural, social, economic, and political effects of technology, its influence on society and history, and developing abilities for the technological and designed world (ITEA, 2007).

Third, an open tendency in merging operational, cultural, and critical dimensions (Keirl, 2006) must be adopted by students. Abstract knowledge missing appropriate methods of application never turn into practices in the physical world, so does technological literacy. Now being a prerequisite necessity in learning, strategies, economic and productive, are to be sought. Unless proper immersion into novel vision of learning through technology, students would stay naïvely strange in a changing educational ecology. Here, last, technology is a human innovation; students ought to control it, take full advantage of it in their life-long learning experience (Warwick, 2016).

This paper is a qualitative attempt to delve into higher education students' experiences with the use of technology during the COVID-19 pandemic situation in Morocco. Since "past conveys significance, the present conveys value, and the future conveys intention", in Connelly and Clandinin's words (Connelly & Clandinin 1990), this research extends an interconnected thread between such time elements, in order to uncover stories of challenge through a narrative inquiry. Indeed, narrative is not a full-fledged approach to scrutinize such problem, stated that lack of skills in using technology poses critical barriers to effective learning in higher education, but it stands as one of the best methodological framework to study stories of experience with specific interaction elements, continuity, and situation. The limitation of this study, particularly, lies not in the adopted method, but there is an increasing need of investigation larger population with keeping the same or more depth under scrutiny. This is expected in prolonged scientific inquiry that requires not only a team of researchers, but also a multiplicity of disciplines. It is concluded, using this method of inquiry, that past conveys substantial idea, an idea which present still proves its significance, which is the fact that technology literacy is a post-COVID-19 pandemic survival competence in higher education, a fact to be more investigated, using other research methods, and then put into intentional personal, social, academic, and institutional projects.

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