The Impact of Cognitive Absorption Dimensions on the Appropriation of ICTs among students of Public Universities in the Casablanca-Settat region, Morocco

Impact des dimensions de l'absorption cognitive sur l'appropriation des TICE: Cas des étudiants des universités publiques de la région Casablanca-Settat, Maroc

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ABSTRACT. Over the past two decades, the use of Internet and Information and Communication Technologies (ICT) in the classroom as part of the learning environment has grown considerably. The value of the ICT in education (ICTE) is now widely recognized and accepted. The promptness of development in the digital has put forth pressure on organizations, particularly higher education institutions, to integrate ICT in teaching activities as well as in the entire university environment. These pressures have involved all the actors in higher education, who are increasingly improving the quality of their services. Within the same vein, teachers and learners are currently taking courses in a hybrid mode, to be acquainted with the new learning strategies. Previous research has focused heavily on studying the educational performance of students with regard to the use of ICT independently of the contribution of cognition and appropriation of ICT in student performance. Accordingly, this research explores the impact of the dimensions of cognitive absorption (CA), inspired by the flow theory (Csikszentmihalyi, 1990), on the appropriation of ICT. We conducted a quantitative study among students of Moroccan public universities in the Casablanca-Settat region, and used the structural equation method (SEM), through the SMART PLS 4.0 software. The study used data collected from a sample of 184 students. In our study, the structural equation modeling revealed that CA has a significant and positive impact on ICT appropriation among public higher education students. The findings indicate that an exploration of CA in the Moroccan higher education environment is important to understand students' learning needs for better educational performance.

KEYWORDS. Cognitive absorption, Flow theory, Appropriation of ICT in Education, Educational performance, University students, Morocco.

Introduction

For the past two decades, the world has evolved towards digitalization whereby information and communication technologies (ICT) have become a real substantial investment (Doorgapersad, 2022). This rapid development of technologies has spread to a number of areas, particularly the academic environment with the integration of ICT into almost all teaching activities. Indeed, Morocco has introduced a set of national programs and guidelines based on a national policy to ensure innovative learning practices that are flexible enough to live up to today's demands. According to (Hargreaves, 1997; Meighan, 1997), the impact of implementing ICT in education can only be observed if the university as an organization considers this change all the way through its entire system. Today, universities must act as learning organizations (Agarwal & Karahanna, 2000).

As the use of ICTs requires the involvement of all academic actors, the university now should grow instantaneously with the growth of its learners. As a result, both collective and individual performances will be noticed. The main change lies in innovation, which is becoming central to the learning process. Teachers, and specifically students who are the target population of our study, are exploring new possibilities offered by these technologies and building skills around ICT-enabled learning. A key element of this transformation is how students appropriate ICT, which is directly influenced by their cognitive absorption (CA). Appropriation is a voluntary personal investment that draws on the user's potential (Toure K, 2015). This definition highlights the importance of exploring the notion of CA, as understanding this concept can provide insights into the user's engagement with technology. According to (Agarwal & al. 2000), CA is linked to the user's motivation to use technology.

Nevertheless, the pedagogical landscape has undergone a radical transformation, evolving towards learning mediated by ICT (Leu & al., 2004). This paradigmatic shift has introduced several challenges, primarily due to the students' lack of psychological readiness for this transition, which has subsequently had adverse effects on their academic performance (Amarilla & Vargas, 2009; Batanero & al., 2021). Students' attitudes change over time, as they integrate new academic programs. It is therefore important to study the degree of students' CA of the ICT use and its impact on appropriation. The importance of students' beliefs has revealed their impact on educational effectiveness while using technologies. Few studies such as (Davis, 1993; Venkatesh & Davis, 1996) have focused on how these beliefs are constructed. Therefore, it is crucial to understand the underlying processes to enhance the productivity of learning (Balakrishnan & al., 2021). Although extensive research has been conducted on the impact of ICT on academic performance, a substantial theoretical gap persists about the specific role of CA within this context. It is therefore important to study the degree of students' CA of the ICT use and its impact on appropriation. Previous research has focused more on the study of students' educational performance with regard to the ICT use independently of the contribution of cognition and appropriation of ICT in the student's performance (Adeel & al., 2023). Indeed, recent studies (Santos & al., 2018; Balakrishnan & al., 2021; Kabore, 2021) reveal a lack of theoretical and empirical evidence in relation to these two variables.

The central question of this study is to determine how the dimensions of CA influence ICT appropriation in the Moroccan academic context. Specifically, we examine whether temporal dissociation, focused immersion, pleasure, a sense of control, and curiosity—key elements of CA (Agarwal & Karahanna, 2000)—significantly affect students' adoption and appropriation of ICT.

In response to this gap, the fundamental theories of social and individual psychology, particularly CA theory, also known as flow theory (Csikszentmihalyi, 1990), were mobilized. This research is driven by the need to explore how CA dimensions, such as focused immersion, control, and curiosity, influence students' ICT appropriation. It adopts an empirical approach through a quantitative study conducted among students at public universities in the Casablanca-Settat region of Morocco. We use structural equation modeling (SEM) through SMART PLS 4.0 to analyze the relationships between CA dimensions and ICT appropriation, providing new insights into the existing literature on how cognitive engagement contributes to successful ICT appropriation (Pelletier, 2008).

At the disciplinary level, this article enhances the understanding of the cognitive processes underlying ICT appropriation by providing specific empirical evidence from university students in the Casablanca-Settat region of Morocco and highlighting relationships often overlooked in previous research (Tseng & al., 2011; Andersén & Kask, 2012; Yildiz & al., 2019; Shirish & al., 2023). By leveraging CA and flow theories to understand educational ICT appropriation (TICE), this study offers a perspective that could influence future work on the interaction between cognition and technology appropriation. For practitioners, the findings of this research provide practical insights for designing and implementing more effective training programs, considering CA dimensions. By better understanding how these factors influence ICT appropriation, educators and policymakers can develop strategies to maximize student engagement and improve learning outcomes. To achieve this, the article is structured as follows:

First, a literature review will explore the theoretical foundations of CA, a central concept of flow theory, by examining its links to individual psychology and human-technology interaction. It will also address ICT appropriation, demonstrating how CA influences the effective use of technological tools in education. Then, the role of CA in learning will be examined, focusing on its impact on motivation and creativity. Additionally, knowledge absorption capacity will be studied to demonstrate its importance in performance. Finally, the integration of ICT into the educational system will be discussed, emphasizing its interaction with CA and its influence on performance.

Subsequently, the materials and methods section will outline the research design and data collection procedures. The results will be presented next with a focus on the assessment of the measurement scales' quality using structural equation modeling (SEM) and confirmatory factor analysis. This includes evaluating the convergent and divergent validity of the studied population. The analysis of the overall model will be conducted in two stages: the evaluation of the measurement model, followed by the evaluation of the structural model. Detailed descriptions of the tests performed and the indicators constructed and analyzed at each stage will be provided.

The main findings reveal that three out of five dimensions of CA, temporal dissociation, sense of control, and curiosity significantly and positively impact ICT appropriation: In contrast, focused immersion and heightened enjoyment do not affect ICT appropriation. We assert that the results of this study are authentic and will inform future research directions on the relationship between CA and ICT appropriation, thereby providing valuable insights for educators, policymakers, and researchers.

Literature Review

Cognitive absorption as a component of the Work Flow Theory

Cognitive absorption (CA) is a multi-faceted concept derived from three closely interconnected research areas within individual psychology: the personality trait of absorption, the flow state, and the notion of cognitive engagement (Agarwal & Karahanna, 2000). Firstly, (Tellegen & Atkinson, 1974) defined absorption as an intrinsic personality trait characterized by total attention. This trait is measured by Tellegen's Absorption Scale (TAS), which assesses nine dimensions, including responsiveness to stimuli and the ability to experience altered states of consciousness. The TAS is widely recognized for its effectiveness in capturing this diposition (Agarwal & Karahanna, 2000, p. 667). Secondly, (Csikszentmihalyi, 1990) introduced the concept of flow as a state of intense involvement characterized by deep concentration, a sense of control, loss of self-awareness, and time distortion. (Trevino & Webster, 1992) adapted the notion of flow to human-technology interactions, identifying four key dimensions: control, attention focus, curiosity, and intrinsic interest (Agarwal & Karahanna, 2000, p. 668). Thirdly, (Webster & Ho, 1997) explored cognitive engagement, a concept similar to flow but without the control component. They proposed that cognitive engagement encompasses intrinsic interest, curiosity, and attention focus. Moreover, (Webster & Hackley, 1997) found that cognitive engagement in distance learning is influenced by the perceived richness of the medium, the interactivity of teaching , and classmates' attitudes.

Despite extensive investigation of CA from these perspectives, a significant gap persists in understanding the interaction of its dimensions within contemporary educational technologies (Santos & al., 2018 ; Balakrishnan & al., 2021 ; Kabore, 2021). Specifically, limited research examines how the multifaceted nature of CA influences students' sustained engagement and academic outcomes in digital learning environments (Adeel & al., 2023). Further investigation is needed to integrate these theoretical frameworks with the evolving dynamics of ICT in education, particularly in understanding how CA dimensions mediate the relationship between technology use and academic success (Balakrishnan & al., 2021).

Cognitive absorption acts as a catalyst for engagement and individual learning

CA is a state of deep engagement and involvement that individuals experience when performing an activity (Heutte, 2012). This state is based on the individual's intrinsic motivation (Agarwal & Karahanna, 2000; Tharenou, 2001) and is characterized by optimal attention that fully absorbs and mobilizes cognitive resources, to the point where the individual prioritizes understanding the activity above all else. This level of absorption enables individuals to learn more deeply while performing a given activity (Vanhée, 2008) or during training sessions (Molinari & al., 2016), while also stimulating the generation of creative and innovative ideas at work (Cohen & Levinthal, 1989). CA fosters intrinsic motivation during learning (Heutte, 2017) and enhances the ability to process complex information (Grolnick & Ryan, 1987).

CA is based on deep engagement, where individuals immerse themselves so intensely in an activity that they perceive it as personally relevant and particularly interesting (Pelletier, 2008). Studies (Pelletier, 2016; Lardy, 2017; Reeve & al., 2017; Zoh & al., 2023) have shown that this engagement results from arousal regulated by the psychological states related to the individual's cognitive and affective motivation, which promotes more assertive attitudes and behaviors (Haymore & al., 1994). CA theory describes how individuals can become so focused on an activity that everything else loses importance, reaching a state of almost automatic consciousness, with no apparent effort but remarkable intensity (Agarwal & Karahanna, 2000).

However, while training can facilitate learning, it is the participants' deep engagement that allows them to get the most out of it (Brault, 2010). CA plays a crucial role in enhancing the learning experience: it motivates learners, encourages them to take risks, intensifies their engagement in the activity, and improves their concentration, thereby optimizing learning (Chandra & al., 2012). As a result, increased focus, better self-control, and amplified pleasure in accomplishing the activity while being curious (Shernoff, 2013) significantly contribute to learning (Leong, 2011).

The Importance of Knowledge Absorptive Capacity in Individual Learning

Knowledge absorptive capacity refers to the ability of individuals to acquire and integrate new information for future use (Cohen & Levinthal, 1990). Researchers specializing in cognitive learning within education show that this capacity plays a crucial role in the psychological context of learning and performance (Büchel, 1995; Vonder & Haelewyck, 2009; Dias, 2003; Camisón & Forés, 2010). While CA enables deep engagement in learning activities, its effectiveness on individual learning also depends on the individual's capacity to absorb knowledge (Vázquez & al., 2017). This capacity explains why CA alone does not always guarantee optimal learning. Learners' performance varies based on motivation, capacity, and the opportunities provided during training, such as the opportunity to use technologies in the learning process (Brown, 2011).

Recent research in this field (Adamides & Karacapilidis, 2020; Blichfeldt & Faullant, 2021; Kastelli & al., 2024) increasingly focuses on the absorptive capacity of knowledge, such as ICT, through the importance given to the knowledge economy (Fagerberg, 2006). Previous studies (Brian & al., 2003; Brachos & al., 2007; Lin & Huang, 2020) have emphasized the importance of knowledge and its dessimination for both individual and collective effectiveness, relying on concepts such as the integration of cognitive resources to improve performance (Franconeri & al., 2013).

Individual absorptive capacity is thus defined as a person's ability to recognize the value of new information, understand it, and apply it in a professional context (Roberts & al., 2012). Integrating this new knowledge with previously acquired knowledge facilitates the accomplishment of complex tasks

(Slavin, 1996) and can enhance performance (Gorelick & Monsou, 2005). Thus, the more capable an individual is of absorbing knowledge, the more they will benefit from it.

Consequently, knowledge absorptive capacity is often regarded as a key factor in effectively assimilating and applying knowledge, which in turn fosters more positive behaviors (Bretonès & Saïd, 2009). Studies have anticipated that combining this capacity with CA will elevate the level of individual learning (Nooteboom, 2000; Jumaan & Al-Ghazali, 2020; Al-shaikhli & al., 2022). Additionally, further research supports this hypothesis, showing that this capacity enriches the breadth and diversity of individuals' knowledge (Cohen & Levinthal, 1990; Nooteboom, 2000; Balakrishnan, 2021), facilitating better learning during knowledge exchanges, while increasing the likelihood that this knowledge will be effectively absorbed, connected, and applied (Zhou & Li, 2012).

Cognitive Absorption as a Key Driver for Learning and ICT Appropriation

In the field of ICT, CA acts as an intrinsic motivator that highly depends on the user's situation and plays a significant role in driving performance. When users experience CA in using a computer tool for task execution, they are inclined to operate with greater effectiveness and efficiency, thereby enhancing professional performance (Mathew, 2019, p. 56). The theoretical framework of CA provides an experiential understanding of flow theory (Csikszentmihalyi, 1990). Csikszentmihalyi described flow as the state experienced when an individual is fully engaged with a particular technology. This theory has received significant attention in information systems and ICT studies, primarily for its insights into user behavior (Bölen & al., 2021). As ariculated by (Bölen & al., 2021), the concept of flow represents “a psychological state in which a person feels simultaneously cognitively effective, motivated, and happy” (Moneta & Csikszentmihalyi, 1996, p. 277). Since Csikszentmihalyi's seminal work (1975, 1990), the core concepts underlying flow theory have been applied across various contexts, including education (Bölen & al., 2021, p. 6).

The pedagogical approach has undergone a radical transformation with the incorporation of ICT (Leu & al., 2004). This paradigm shift has exacerbated several dysfunctions, particularly because students are not mentally prepared for such a change, which resulted in adverse effects on their outcomes and performance (Amarilla & Vargas, 2009; Fernández-Batanero & al., 2021). Understanding these underlying processes is crucial for enhancing the productivity of learning experiences (Balakrishnan & al., 2021). To address this issue, this study integrates (Agarwal & al.’s model, 2000, p. 683) grounded in flow theory (Csikszentmihalyi, 1990). Researchers and practitioners have shown interest in understanding and managing user reactions to information technologies. In response to this concern, several theoretical models have been proposed to better understand and explain individual attitudes and behaviors towards new information technologies. Examples of relevant frameworks include the Diffusion of Innovation Theory (Brancheau & Wetherbe, 1990; Rogers, 1995), the Technology Acceptance Model (TAM, Davis & al., 1989), the Theory of Reasoned Action (TRA, Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975), and the Theory of Planned Behavior (TPB, Ajzen, 1985, 1988, 1991). Despite their varying constructs and specific relationships, these models converge on the idea that individuals' beliefs or perceptions regarding ICT use significantly influence user behavior (Agarwal & al., 2000, p. 666).

At the same time, although CA is recognized as a crucial element of high engagement and involvement during training (Webster & Ho, 1997), several studies (Tseng & al., 2011; Andersén & Kask, 2012; Yildiz & al., 2019; Shirish & al., 2023) have highlighted that focusing solely on this dimension is insufficient to understand the conditions under which it promotes individual learning. Indeed, CA primarily relies on an individual's intrinsic motivation (Agarwal & Karahanna, 2000). However, this motivation can sometimes reflect a total or partial lack of self-determination (Deci & Ryan, 2000, 2002). In the first case, the learner does not perceive the real reasons behind their behaviors and actions, attributing the results to factors beyond their control (intrinsic factors) (Kindelberger & al., 2023). In the second case, their attitudes and behaviors are dictated by external goals, such as avoiding penalties or passing exams to obtain a diploma, motivations that are not necessarily aligned with their personal values and desires (extrinsic factors) (Deci & Ryan, 2000; Blanchard, 2004). The self-determination theory, developed by (Deci & Ryan, 2000), supports this perspective and distinguishes different types of motivation in various learning contexts (Reeve, 2012), particularly in academic settings (Litalien & al., 2017).

On the other hand, studies have affirmed that learners face holistic training, characterized by the integration of multiple educational dimensions (Kolb & Kolb, 2009; Sharhan, 2016), encompassing cognitive, socioeconomic, technical, and political aspects (Kasongo, 2013). This approach, like ICT, is based on a complex and multidimensional reality. To fully grasp its scope, it is essential to consider the constitutive and interdependent elements of these dimensions comprehensively. The pedagogical use of ICT fits perfectly into this holistic logic, as it encompasses several essential dimensions: the cognitive aspect (Millerand, 2002; Norman, 1993), the technical aspect (Rigollet, 2005), the sociological aspect (Chambat, 1994; Mallein & Toussaint, 1994), and the political aspect (Vitalis & Vedel, 1994). Thus, to achieve optimal individual learning, it is crucial to take into account several dimensions, as none of them alone can guarantee this result (Huang & al., 2020). Research has shown that reduced levels of CA, knowledge absorption capacity, or access to technological opportunities can indeed limit learning (Blumberg & Pringle, 1982; Léger & al., 2014). Therefore, to maximize their learning potential, a learner must not only be cognitively engaged (Agarwal & Karahanna, 2000) but also capable of absorbing new knowledge (Cohen & Levinthal, 1990) and have access to adequate technological resources (Blumberg & Pringle, 1982; Kaikai, 2014). These conclusions are based on the motivation-ability-opportunity framework developed by (Blumberg & Pringle, 1982), which emphasizes that the learner's motivation is essential, but it must be supported by their capacity to integrate knowledge, as well as by the existence of learning opportunities (Cohen & Levinthal, 1990; Messaoudi & El Abidi, 2021).

Since its integration into pedagogical practices, technology has become a crucial lever for improving learning processes (Traoré, 2008; Brenji & al., 2016). The integration of ICT into the educational system, as defined by (Proulx, 2005), requires regular use of these technologies by all educational system actors. This integration not only involves the student's engagement in knowledge acquisition (CA) but also the adoption and use of technological tools in the learning process. For this integration to be fully successful, it is imperative that every actor in the educational system masters ICT and uses them frequently, effectively, and efficiently in their pedagogical activities. (Lund, 2004) emphasizes that the integration of ICT in education goes beyond mere access to technological tools; it also requires significant commitment from all actors involved in the educational process. Students, in particular, show a strong preference for technology-assisted learning devices, which they find more satisfying than traditional methods (Lai, 2021). The success of ICT integration thus relies on the clear, continuous, and sustained use of digital tools adapted to teaching and learning activities (Sayaf & al., 2021). According to (Kitschner & Davis, 2003), the pedagogical integration of ICT involves using it to develop skills or promote learning, whether by teachers or students. This approach goes beyond basic instruction on the use of computer tools and software; it aims to have students use ICT to learn disciplines such as sciences and languages. In short, integrating ICT means using it to teach a variety of subjects, thus enriching the educational experience at all levels.

When individuals are deeply absorbed in an activity, their involvement becomes so intense that they may lose track of time and neglect other elements of their environment (Agarwal & Karahanna, 2000). To fully benefit from this engagement, it is crucial that individuals not only have the capacity to absorb knowledge but also the technological opportunity to exchange, share, and collaborate with others, thereby deepening their understanding of available information (Nieto & Quevedo, 2005; Saemundsson & Candi, 2017). Technological opportunities play a central role in facilitating exposure to new information, contributing to learning and knowledge transfer (Park, 2011). The use of digital devices, by offering a variety of information, enriches individual learning (Gan & al., 2015; Saif & Laszlo, 2020). Moreover, technology can enhance work engagement through interaction, feedback (Burnett & Lisk, 2021), and the ability to freely control and choose the information sources deemed relevant by the user (Murray & al., 2021). However, for the technological experience to be beneficial, it must be both meaningful and positive, as negative experiences can disorient the user and lead to disengagement from the current activity or work (O'Brien & al., 2022). The user's experience is also influenced by their level of competence and potential, as a high degree of mastery and self-confidence encourages the adoption of ICT to accomplish tasks (Malureanu & al., 2021), hence the term "ICT Appropriation" (Toure, 2015; Jung & al., 2021).

Despite the importance of these factors, the specific role of CA in ICT appropriation remains largely unexplored (Kabore, 2021). We argue that individuals who possess both strong cognitive engagement, a high capacity for knowledge absorption, and who benefit from favorable technological opportunities are better positioned to take advantage of training programs and achieve high levels of individual learning. This combination of factors also encourages the adoption and integration of ICT into daily tasks. However, low CA can limit this learning, even in the presence of high knowledge absorption capacity and technological opportunities (Sjödin & al., 2019).

Therefore, we anticipate that CA, by enabling increased concentration, better self-control, and a sense of pleasure in accomplishing the activity, will play a key role in ICT appropriation (Agarwal & Karahanna, 2000). Research has shown that even with a high capacity for knowledge absorption and technological opportunities, low CA cannot be compensated for (Cohen & Levinthal, 1990; Oh & Sundar, 2015; Balakrishnan & al., 2021). While it is crucial to examine individual learning by considering these various factors (Kasongo, 2013), CA remains a central element. It is often associated with two major theories: flow theory (Csikszentmihalyi, 1990) and the Technology Acceptance Model (Davis & al., 1989), which predicts user behavior within a particular system (Liao & Pratt, 2009). However, according to flow theory, our primary focus is on the user experience (Morosan, 2014) in the presence of learning opportunities via ICT, which essentially translates into CA. Extensive research (Lin, 2009; Santos & al., 2018; Balakrishnan & al., 2021) underscores the importance of CA and flow in shaping attitudes and behaviors towards ICT. Thus, this study will address the concept of CA through the lens of Csikszentmihalyi's flow theory (1990).

Cognitive absorption: a five-dimensional concept

To substantiate the importance of CA in enhancing our understanding of students' reactions to information and communication technology, it is crucial to contextualize this concept within a specific theoretical framework. Figure 1 illustrates a network of plausible relationships for CA. While various studies draw on different theoretical models, as discussed earlier, our primary focus is not on projecting and explaining predictors of user behaviors within a system (Liu, & al., 2009). Instead, we aim to examine whether users are cognitively absorbed in ICT use through the five dimensions of CA proposed in Flow Theory (Csikszentmihalyi, 1990).

The first dimension is temporal dissociation, which reflects lack of ability to control the passage of time during interaction with software or technology in general. The second dimension of CA is attention focus, indicating that the individual concentrates solely on the current experience, excluding other stimuli. The remaining dimensions include the pleasure felt during interaction, the sense of control over events during interaction, and curiosity, which prompts individuals based on sensory and cognitive basesto either continue or extend the current experience (Schmidt, 2010, p. 605; Mpinganjira, 2019, p. 6). Here, we present theoretical arguments supporting the key concepts defining CA. Our objective is to test the impact of these CA dimensions on students' ICT adoption.

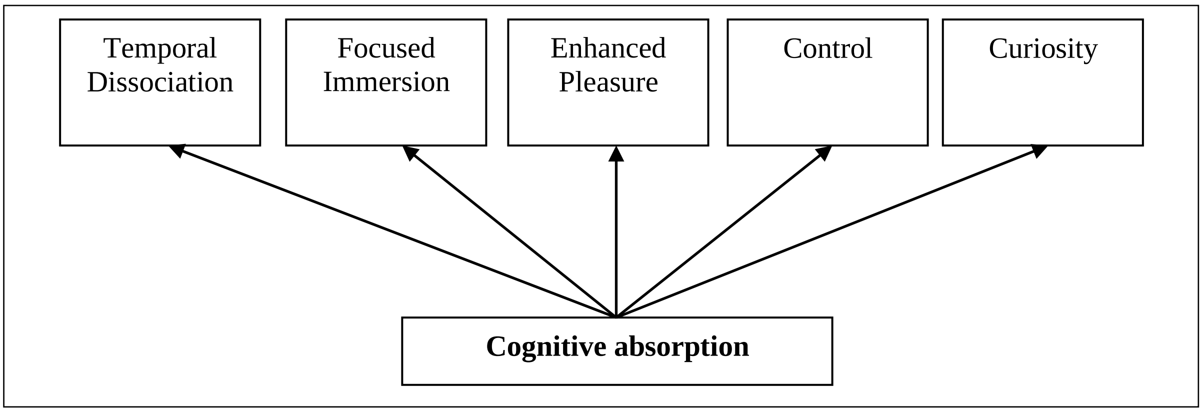


Figure 1. *Dimensions of Cognitive Absorption*

Source : (AGARWAL R. & al., 2000, p. 683)

CA, grounded in Csikszentmihalyi's Flow Theory (1990), encompasses five dimensions : temporal dissociation, focused immersion, heightened enjoyment, control, and curiosity. (see Figure 1). Firstlt, Temporal Dissociation refers to the inability to perceive the passage of time during interaction, allowing individuals to perceive they have ample time to complete a task (Zhang & al., 2006, p. 3). Secondly, Focused Immersion represents total engagement, where significant distractions are disregarded (Blasco & al., 2019, p. 256). Whereas, Heightened Enjoyment captures the pleasant aspects of interaction, leading individuals to participate repeatedly when they find pleasure in an activity (Celik & al., 2014, p. 584). Likewise, Sense of Control involves the perception of being in charge of the interaction, which is a key factor in the captivating nature of computer technology (Lepper & Malone 1987), cited in (Thomas, 2006, p. 1093). Lastly, Curiosity measures how an experience stimulates an individual's sensory and cognitive curiosity, with increased curiosity enhancing imagination and excitement during technological interactions (Webster & al. 1992, cited in Agarwal & al., 2000, p. 668).

The ICTs appropriation

(Salisbury & al., 2002, p. 93) define appropriation as the extent to which end-users agree on how to jointly use a specific technology. However, (Lund, 2004) concludes that appropriation processes are not limited to the adaptation of ICTs to existing practices, but involve an appropriation of technologies that also leverage the users' potential per (Toure, 2015, p. 5). In contrast, (Mbang, 2012, p. 34) sees appropriation as a voluntary personal investment. It is at once a domination, an acquisition and an assimilation of objects. However, when a natural or legal person appropriates technological tools, they are part of a voluntary process in which they procure the ability to make full use of their rights and have a strong sense of autonomy when integrating ICT into their workplace.

(Toure, 2015, p. 2) further elaborates that teachers who appropriate ICT integrate them into their teaching process and their personal lives. (Meza & al., 2018, p. 2) perceive that the inclusion of ICT in education requires appropriation by the user. It is understood as the meaningful use of computer and communication technologies, in which a degree of control and choice is taken over technology and content, being useful, fruitful, valuable and important for the user to consider. Moreover, technology appropriation is a phase that begins when people decide to adopt technology and use it as a support for their social, economic, political or cultural activities. Following this initial adoption, the next stage in the use cycle is the appropriation of technology, where users experiment with it, examine its possibilities and modify its features to suit their needs (Velasco, 2019, p. 56).

Following the findings of (Ko & al., 2021, p. 4), appropriation can be analyzed according to three components: The degree to which technologies are used and designed (loyalty), the degree of consensus on how to use or modify technologies and the instrumental use of technologies.

Materials and methods

Hypotheses and research model

Building upon the theoretical framework, the proposed research model (Figure 2) and its hypothetical draw from a comprehensive body of literature on human-technology interaction (Trevino & Webster, 1992), CA as articulated in Flow Theory (Csikszentmihalyi, 1990), and user experience studies. These sources collectively explore how users are cognitively absorbed by using ICTs to accomplish tasks and achieve technology appropriation. Particularly, the model emphasizes investigations into students' interactions with ICTs within academic environment, thereby situating the study within a relevant and critical context for understanding educational technology use. The proposed conceptual framework, illustrated in Figure 2, delineates the corresponding hypotheses for the models, which are subsequently discussed and described.

According to (Pelletier, 2008), the concept of technology appropriation involves the presence of three critical elements: personal efficacy with technologies, user skills, and CA. This study specifically emphasizes CA identified by (Pelletier & al., 2008, p. 83) as a defining elements of technology appropriation. CA is also considered a key component of the psychosocial dimensions of ICT acceptance (Leong, 2011).

(Csikszentmihalyi, 1990, p. 3) posits that individual behavior is distinct from others and the external world at large. A person who has experienced flow feels more capable and competent. Flow leads to effective integration and appropriation of ICTs as thoughts, intentions, and feelings are concentrated on a singular goal, referred to as focused immersion. According to the author's conclusions, it is possible to learn to develop a mental attitude conductive to achieving flow (Biasutti, 2011, p. 525). This occurs when: (1) individuals are wholly focused and convinced that nothing is more important than the current activity; (2) the person's skills align with the task demands; and (3) individuals demonstrate their ability to direct their consciousness during the activity, requiring different levels of skills, effort, and inspiration for each person (Wang & Huang, 2022, p. 2).

As discussed in the literature review, a significant outcome of human-technology interaction is cognitive engagement, similar to the state of flow (Agarwal & Karahanna, 2000; Webster & Ho, 1997; Chi & Wylie, 2014). This engagement emphasizes intrinsic interest, curiosity, and attentional focus of ICT users. Similarly, studies have supported the idea that human-technology interactions can generate higher cognitive engagement, which can lead to positive ICT learning outcomes based on their attitudes and problem-solving abilities (Shukor & al., 2014).

Furthermore, during cognitive engagement, users develop intrinsic motivation and derive pleasure in interacting with machines (Agarwal & Karahanna, 2000; Szalma, 2014). The concept of CA in the realm of ICT use, grounded in social psychology, suggests that intrinsic motivation enhances users' experiential involvement (Wild & al., 1995). According to (Wild & al., 1995), intrinsic motivations can lead to increased absorption in knowledge dissemination and enjoyment. Indeed, such dissemination, fuelled by intrinsic motivation, enhances users' cognitive ability to process complex information and thereby create a rich experience (Calderón & al., 2020). During CA while using ICTs, users typically experience both control and pleasure during interactions (Celik, 2023).

As explained above, CA is a profound engagement that fosters dynamic motivation towards user interaction (Sohn & Kwon, 2020). (Saadé & Bahli, 2005) argue that the diffusion of cognition between humans and ICTs can generate more intrinsic motivation to sustain or resume user interactions. When these interactions deepen, they can result in significant CA (Ghasemaghaei, 2019). Additionally, empirical evidence supports the hypothesis that CA can induce technology adoption behavior (Balakrishnan & al., 2021, p. 646).

According to (Agarwal & Karahanna, 2000), CA is a multidimensional construct that includes temporal dissociation, focused immersion, pleasure, control, and heightened curiosity. Given the arguments preseneted, it is evident that human-technology interactions can significantly enhance deep cognitive engagements. The same understanding can be further extended by exploring the role of human-technology interaction in fostering CA, particularly in the context of students' interactions with ICTs in the academic environment.

This leads us to formulate the following main hypothesis:

H1: CA has a significant and positive impact on ICT appropriation

This in turn prompts us to draw up the following sub-hypotheses:

H1.1: Temporal dissociation has a significant and positive impact on ICT appropriation

H1.2: Focused immersion has a significant and positive impact on ICT appropriation

H1.3: Increased pleasure has a significant and positive impact on ICT appropriation

H1.4: Sense of control has a significant and positive impact on ICT appropriation

H1.5: Curiosity has a significant and positive impact on ICT appropriation

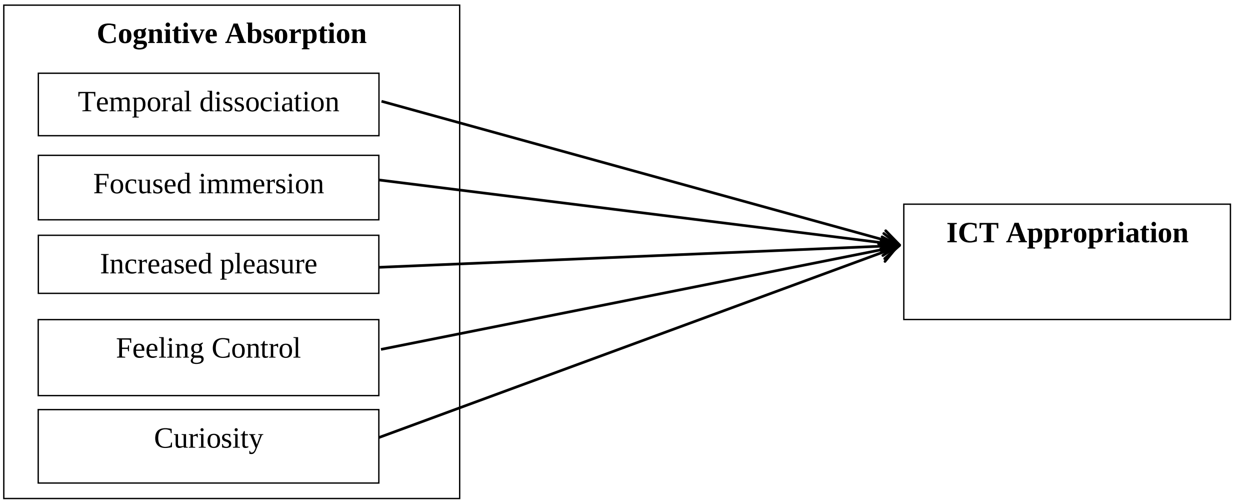


Figure 2. *Research model*

Source: (Authors)

Research Methodology

This section will focus on the research methodology of our study, starting with an understanding of the choice of our population, then highlighting our epistemological positioning and sampling procedure, before concluding with the data collection procedure used to address our research question.

Population

In our study, the sample size was determined based on considerations of the student population's complexity, our research objectives, and the specific statistical analyses targeted. To achieve this, we focused on three prominent public universities in the Casablanca-Settat region: Chouaib Doukkali University, Hassan 1st University, and Hassan II University. The choice the Casablanca-Settat region was driven by its status as the region with the highest concentration of university students, as reported by the Ministry of Higher Education, Scientific Research, and Innovation for the Academic Year 2022-2023. Additionally, this region is recognized for its advancements in teaching quality and ICT skills development. We recruited students from diverse fields and academic levels to ensure a comprehensive exploration of their perceptions regarding ICT usage across various disciplines and educational stages.

Epistemological positioning

We have chosen to adopt a quantitative methodology to understand our research topic. The quantitative approach to our work seeks to generalize our findings by collecting data from a representative sample of the same population. We do so through a positivist stance, based on the principle that science is the sole ground of reality, and that the scientific method is the only means of establishing objective truth. In this case, we consider that the techniques, procedures and methods we have adopted will enable us to better define the problem and the topic of our contribution.

On this basis, we use an epistemological approach based on deduction, or the so-called "hypothetico deductive" method, to measure the model's variables and test the research hypotheses derived from them by means of empirical tests, using structural equation modeling (SEM) to assess the causal relationships and model evaluation through the Smart PLS software. The aim of this work is therefore to highlight and test the dimensions of CA and its impact on the students' appropriation of ICTs at Moroccan public institutions.

Sampling

We chose snowball sampling primarily for its effectiveness in reaching hidden or marginalized populations, collecting data non-intrusively, and saving time and resources by using current participants to recruit new ones, thereby increasing our sample size (Gile & Handcock, 2010). Our sample consists of 84 men and 100 women, predominantly aged between 18 and 30 years, constituting 64% of the total respondents. The distribution by university affiliation is as follows: 50.5% (93 respondents) from Hassan II University; 25.4% (47 respondents) from Chouaib Doukali University; and 24.2% (44 respondents) from Hassan 1st University.

Measurement scales

In assessing CA, we have used the five dimensions adopted by (Agarwal & al., 2000). This instrument consists of 20 items, covering 5 dimensions of CA, namely, Temporal Dissociation, Focused Immersion, Intensity of Pleasure, Sense of Control and Curiosity.

To measure ICTs appropriation, our approach incorporated 3 dimensions adopted by (Pelletier & al., 2008). The instrument consists of 4 items, covering 3 dimensions of ICTs appropriation, namely CA, inspired by the "Flow Theory" presented by (Csikszentmihalyi, 1990), user skills, inspired by the model unveiled by (Munro & al., 1997), and feelings of self-efficacy with regard to technologies, inspired by the "Social Cognitive Theory" influenced by (Bandura, 1977).

Data Collection Procedure

A questionnaire survey was carried out among students at public universities in the Casablanca - Settat region of Morocco, covering all streams and cycles. The Casablanca - Settat region hosts 3 universities, as specified above: Hassan II University of Casablanca (UH2C), Chouaib Doukkali University of El Jadida (UCD), and Hassan I University of Settat (UH1). These universities are home to 35 educational institutions, with a total of 212 877 students[1]. The choice of this region is justified by its very significant development of skills in ICT between 2015 and 2018. The region recorded an ICT sub-dimensional index of 36.3%, coming first in the regional rankings. We focused on students at the region's universities.

we distributed 327 questionnaires. After careful review, we retained 184 completed and eligible questionnaires that met our study criteria. The sample was made up of 46% men and 54% women, with an average age of 18 to 30. Respondents took part in the survey voluntarily. The data collection

[1] Management and information systems report: Evolution of university statistics (2016-2023): https://www.enssup.gov.ma/storage/36/Evolution%20des%20statistiques%20universitaires%20par%20r%C3%A9gion%202016-2023%20V2.pdf

method differed from one facility to another. Indeed, each school had its own particular constraints when it came to approaching the students.

Throughout our research, we distributed the questionnaire across the three targeted universities between April and September 2022 via Google Forms. To maximize student reach, we used a range of tailored methods, including university portals, email, social media platforms like LinkedIn, interactive phone calls, and in-person interviews. Additionally, the 'snowball' sampling technique was deployed to further facilitate distribution. Each institution presented distinct challenges in effectively engaging students.

Results

The results stem from evaluating the measurement scales' quality through Structural Equation Modeling (SEM), using confirmatory factor analysis to calculate convergent and divergent validity within the studied population. The analysis of the overall model proceeded in two stages: first, the assessment of the measurement model, followed by the evaluation of the structural model. Here, we present the outcomes of these tests, detailing the procedures conducted and the indicators constructed and analyzed at each stage.

The measurement model (outer model)

Convergent construct validity

Validating the measurement model entails testing the convergent and discriminant validity of the reflexive construct, "cognitive absorption", and the "appropriation of ICTE" construct. This is assessed according to three indicators: the significance of factorial contributions (CF), which must be greater than 0.5 (Fernandes, 2012); the composite reliability indicator (CF), which must be greater than 0.7 (Fernandes, 2012); and Cronbach's Alpha, which must be greater than 0.7 (George & Mallery, 2003).

Constructs	Items	CF	FC	Alpha
Curiosity	Absorp_cogni_curiosité_1	0.896	0.933	0,892
	Absorp_cogni_curiosité_2	0.925		
	Absorp_cogni_curiosité_3	0.901		

Tableau 1. *Convergent validity indicators* *(Continued)*

Constructs	Items	CF	FC	Alpha
Temporal Dissociation	Absorp_cogni_dissoci_temp_1	0.856	0.927	0.901
	Absorp_cogni_dissoci_temp_2	0.870		
	Absorp_cogni_dissoci_temp_3	0.890		
	Absorp_cogni_dissoci_temp_4	0.833		
	Absorp_cogni_dissoci_temp_5	0.782		
Focused Immersion	Absorp_cogni_immers_cible_1	0.742	0.871	0.804
	Absorp_cogni_immers_cible_2	0.867		
	Absorp_cogni_immers_cible_3	0.861		
	Absorp_cogni_immers_cible_4	**0.327**		
	Absorp_cogni_immers_cible_5	0.688		
	Absorp_cogni_immers_cible_6	0.867		
Increased pleasure	Absorp_cogni_intensite_plaisir_1	0.895	0.928	0.885
	Absorp_cogni_intensite_plaisir_2	0.899		
	Absorp_cogni_intensite_plaisir_3	0.909		
Control	Absorp_cogni_sent_controle_1	0.915	0.891	0.757
	Absorp_cogni_sent_controle_2	**0.011**		
	Absorp_cogni_sent_controle_3	0.878		
ICTs Appropriation	Approp_TICE_1	0.809	0.881	0.821
	Approp_TICE_2	0.845		
	Approp_TICE_3	0.737		
	Approp_TICE_4	0.829		

CF : Factorial Contribution, FC : composite reliability, Alpha : cronbach Alpha *Source: (Smart PLS 4.0)*

Tableau 1. *Continued*

Factor loadings were assessed for each item. As shown in Table 1, all values are above 0.50, except for the two items “Absorp_cogni_immers_cible_4” and “Absorp_cogni_ sent_controle_2”, which we have decided to eliminate. The reliability of the constructs is assessed by calculating Cronbach alpha and the composite reliability indicator (CR). The results in Table 1 indicate that these indices far exceed the required acceptability threshold of 0.7 (Fernandes, 2012; George & Mallery, 2003). To assess convergent validity, we have examined the average variance extracted (AVE) of the constructs, with all three values exceeding (Fornell & Larcker, 1981) required thresholds of 0.5. (See Table 3).

Indeed, the results of the reliability analysis confirm, on the one hand, the validation of the CA measurement scale proposed by (Csikszentmihalyi, 1990), (Cronbach's Alpha >0.7). On the other hand, we tested the validity of the scales used to measure the 5 dimensions of CA, and the results came out as follows: The 5-item scales measuring temporal dissociation are reliable (Cronbach's Alpha= 0.90). The scales used to measure focused immersion are nonetheless reliable (Cronbach's Alpha=0.80). With regard to pleasure intensity, the measurement scales are stable (Cronbach's Alpha=0.88). For Sense of control, the measurement scales are reliable (Cronbach's Alpha=0.757) and we have retained 2. As for Curiosity, the results are acceptable, taking into account all 3 items. The measurement scales are also reliable (Cronbach's Alpha=0.892).

Discriminant Validity

Assessing discriminant validity means checking that items prone to measure one construct are distinguishable from items intended to measure other constructs of the same model (Fernandes, 2012). This type of validity can be verified using the orientations of (Chin, 1998; Fornell & Larcker, 1981). As demonstrated in Table 3, the average variance extracted (AVE) is greater than 0.5, and its square root is greater than all the correlation coefficients with the other variables (Chin, 1998).

	Curiosity	Temporal Dissociation	Focused Immersion	Increased Pleasure	Control	ICTE Appro-priation
Absorp_cogni_curiosite_1	***0.896***	0.302	0.454	0.599	0.485	0.487
Absorp_cogni_curiosite_2	***0.925***	0.228	0.407	0.603	0.405	0.518
Absorp_cogni_curiosite_3	***0.901***	0.242	0.439	0.617	0.435	0.497
Absorp_cogni_dissoci_temp_1	0.334	***0.856***	0.284	0.295	0.283	0.365
Absorp_cogni_dissoci_temp_2	0.230	***0.870***	0.251	0.211	0.151	0.304
Absorp_cogni_dissoci_temp_3	0.246	***0.890***	0.250	0.250	0.239	0.333
Absorp_cogni_dissoci_temp_4	0.173	***0.833***	0.250	0.188	0.116	0.300
Absorp_cogni_dissoci_temp_5	0.195	***0.782***	0.249	0.155	0.106	0.299
Absorp_cogni_immers_cible_1	0.347	0.123	**0.742**	0.475	0.493	0.290
Absorp_cogni_immers_cible_2	0.442	0.285	**0.867**	0.499	0.433	0.461
Absorp_cogni_immers_cible_3	0.425	0.284	**0.861**	0.484	0.425	0.384
Absorp_cogni_immers_cible_5	0.271	0.251	**0.688**	0.411	0.330	0.279
Absorp_cogni_intensite_plaisir_1	0.623	0.196	**0.522**	0.895	0.495	0.451
Absorp_cogni_intensite_plaisir_2	0.617	0.239	**0.558**	0.899	0.579	0.456
Absorp_cogni_intensite_plaisir_3	0.574	0.271	**0.512**	0.909	0.593	0.552
Absorp_cogni_sent_controle_1	0.437	0.175	0.495	0.543	***0.915***	0.475
Absorp_cogni_sent_controle_3	0.435	0.219	0.445	0.571	***0.878***	0.400
Approp_TICE_1	0.461	0.287	0.343	0.403	0.341	***0.809***
Approp_TICE_2	0.448	0.363	0.454	0.477	0.456	***0.845***
Approp_TICE_3	0.336	0.307	0.214	0.315	0.356	***0.737***
Approp_TICE_4	0.515	0.271	0.429	0.528	0.419	***0.829***

Source: (Smart PLS 4.0)

Tableau 2. *Discriminant validity Cross Loadings or (Chin 1998) criterion*

Cross-contribution results (Table 2) allow us to ensure that all items contribute strongly to the variables to which they are attached, in comparison with the other variables. As to (Fornell & Larcker, 1981) criterion, we can noticethat it is fully met: the values below the diagonal are much lower, so that each variable shares a higher variance with its indicators than it does with the other variables (Table 2).

Similarly, the average variance extracted (AVE) is greater than 0.5, and its square root is greater than all the correlation coefficients with the other variables (Chin, 1998).

	AVE	Curiosité	Dissociation temporelle	Immersion ciblée	Intensité du plaisir	Sentiment de contrôle	Appro-priation des TICE
Curiosity	0.823	**0.907**					
Temporal Dissociation	0.718	0.283	**0.847**				
Focused Immersion	0.630	0.477	**0.304**	**0.794**			
Increased pleasure	0.812	0.668	**0.264**	**0.587**	0.901		
Control	0.804	0.486	**0.218**	**0.526**	0.619	0.896	
ICTE Appropriation	0.649	0.552	**0.380**	**0.459**	0.544	0.491	0.806

The diagonal : Square Roots of the AVE *Source: (Smart PLS 4.0)*

Table 3. *Discriminant validity and Correlations model variables*

Indeed, confirmatory factor analysis has enabled us to test the model and the various research hypotheses. First, we tested the reliability of the indicators through the measurement model. The results confirmed the reliability of all constructs (Composite Reliability= CF > 0.7) and convergent validity (Average Variance Extracted= AVE > 0.5). In other words, the constructs can be used to test our conceptual model. Secondly, the main results of the structural model confirm that we have a single independent variable, i.e. ICTE appropriation. The R^2 value is in the order of 0.433, which means that 43.30% of the variance in ICTE appropriation is attributed to the independent variables, a moderate value according to (Chin, 1998).

Structural Model Assessment (Inner Model)

Following the validation of the measurement model, we shall introduce the processing of the structural model. In the case of the structural model, we have decided to take the five dimensions of CA as first-order variables, since the aspect of this study that we are interested in is to investigate the influence of each dimension on the appropriation of ICTE.

Hypothesis Testing

To assess the validation of our hypothesis, we have evaluated the significance of structural relationships at a 95% confidence level, based on the T-value and the probability of error (p-value). A significant and positive relationship emerges as far as the hypothesis H1.1 is concerned, given that the value of T=3.154 is greater than 1.96 with a p-value of less than 0.05. We can hence notice that temporal dissociation has a significant and positive effect on ICT appropriation. Similarly, a second significant relationship is well established, relating to hypothesis H1.4. Its T=2.238 value is greater than 1.96, and the observed p-value is less than 0.05. Thus, the feeling of control has a significant and positive impact on the appropriation of ICT. The H1.5 hypothesis is also confirmed, with T=2.634>1.96 and a p-value of less than 0.05.

However, the T values of the two hypotheses H1.2 and H1.3, 1.069 and 1.349 respectively, are lower than the value 1.96, indicating that the two dimensions of CA, focused immersion, and intensity of pleasure, have no impact on the ICT appropriation. Figure 3 illustrates the results of our overall research model, wherein three sub-hypotheses are corroborated, thereby confirming the non-rejection of the primary hypothesis.

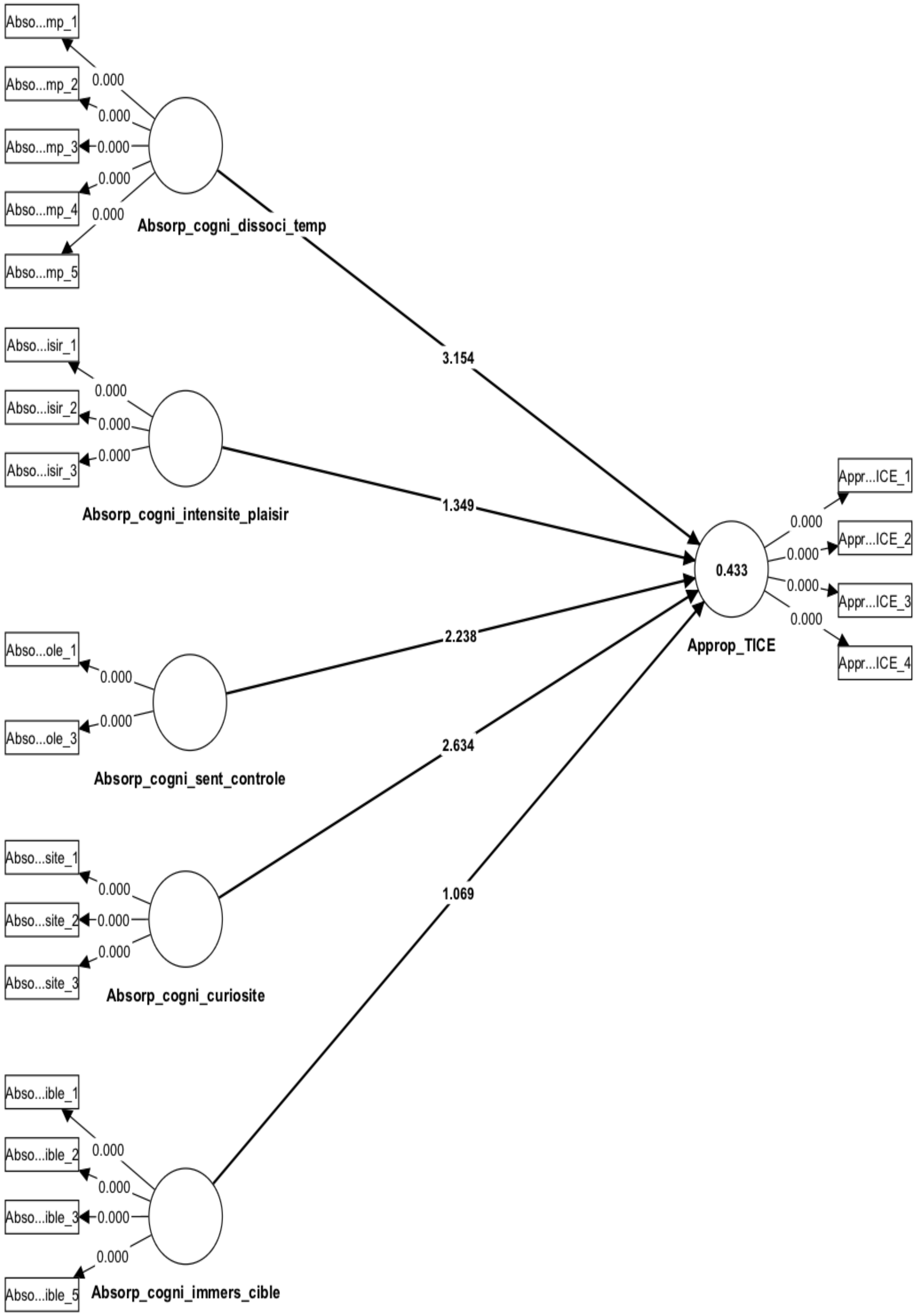
Furthermore, hypothesis testing shows that H1.1, H1.4 and H1.5 are strongly corroborated in the overall model. Indeed, the results affirm that three out of five of the dimensions of CA significantly and positively impact ICTE appropriation namely: Temporal dissociation (T=3.154>1.96; P-value<0.05), sense of control (T=2.238>1.96; P-value<0.05) and curiosity (T=2.634>1.96; P-value<0.05). Focused immersion and intensity of pleasure, on the other hand, gave values of (T=1.069 and T=1.349; less than the 1.96 value) respectively, and therefore had no impact on ICT appropriation.

Model Quality

The overall model's quality is assessed by the coefficient of determination R2, which refers to the explained variance. In our structural model, we have only a single independent variable, ICTE appropriation, and the R2 value is of the order of 0.433, which means that 43.30% of the variance in ICTE appropriation is accounted for by the independent variables. This value is moderate, according to (Chin, 1998). All hypotheses H1.1, H1.4 and H1.5 display a low size f2 (respectively 0.062; 0.032; 0.066); a value between 0.2 and 0.15 corresponds to a low size according to (Cohen, 1988) criterion.

In other words, this implies that all the H1.1, H1.4 and H1.5 validated links have a positive impact on ICTE appropriation, albeit not a particularly significant one. The overall quality of our model can also be assessed by observing the Geisser-Stone Q2 coefficient and the GoF "Goodness of fit" index. The calculation under SmartPLS via the PLS-Predict option, gives a positive Q2 value of around 0.386, which indicates that the overall model quality is valid.

As to the GoF index, it is used to test whether the model sufficiently interprets the empirical data (Tenenhaus & al., 2005). In the case of our model, its value is of the order of 0.5301, exceeding the 0.36 threshold set by (Wetzels & al., 2009) for the approval of a model.



Source: (Smart PLS 4.0)

Figure 3. *Hypothesis Testing Results (T value)*

Discussion

Our study primarily seeks to examine the influence of the dimensions of Cognitive Absorption (CA) on the adoption and appropriation of Information and Communication Technology (ICT) among students at public universities in the Casablanca-Settat region. It is divided into two parts. The theoretical part addresses the influence of CA dimensions on ICT appropriation. CA, based on Csikszentmihalyi's Flow Theory

(1990), consists of five dimensions: temporal dissociation, focused immersion, heightened pleasure, sense of control, and curiosity. These dimensions are crucial for understanding of technology appropriation (Pelletier & al., 2008, p. 83).

The empirical part, on the other hand, tests our research model using data from university students. The primary findings involve evaluating the quality of measurement scales through Structural Equation Modeling (SEM) with confirmatory factor analysis, which includes calculations of convergent and divergent validity within the studied population.

The hypothesis testing results reveal strong support for hypotheses H1.1, H1.4, and H1.5 within the overall model. Specifically, three of the five CA dimensions—temporal dissociation, sense of control, and curiosity—significantly and positively influence ICT appropriation. In contrast, focused immersion and heightened pleasure do not significantly influence ICT appropriation. Our findings are consistent with those of (Pelletier & al., 2008, p. 94), (Csikszentmihalyi, 1990, p. 3), and (Agarwal & al., (2000), who highlight the importance of CA in ICT appropriation. (Pelletier & al., 2008, p. 94) state, "This impact is due to the degree of temporal dissociation, sense of control, and curiosity, which represent the dimensions having the most effect in CA."

These results establish a strong connection with research, underscoring the fundamental role of CA (Hypothesis 1) in ICT appropriation, particularly the impact of its dimensions (sub-hypotheses H1.1, H1.2, H1.3, H1.4, H1.5) (Agarwal & al., 2000). Thus, these findings align with (Csikszentmihalyi, 1990, p. 3), who suggests that the impact of CA on ICT appropriation can vary among individuals and across different environments. Furthermore, as we highlighted in the literature, several studies have established a link between flow state as a student engagement state and their success (Blasco & al., 2019). Consequently, it is reasonable to assume that experiential benefits in ICT can motivate students to persist and improve their skills over time (Millat & al., 2014). It is also plausible to suggest that these experiential benefits lead to heightened pleasure among students and encourage increased use of ICT in their learning processes, as confirmed by (Buil & al., 2019, p. 9). However, our results contradict these claims, indicating a negative impact of focused immersion and heightened pleasure on ICT appropriation among students, thereby rejecting hypotheses (H1.2 and H1.3).

The explanation of these results can be understood by highlighting the contrast between students' expectations and perceptions regarding ICT-based learning and the actual impact observed on their ICT appropriation (Sayaf & al., 2022). Regarding focused immersion, the results obtained in this study contradict existing theories, which suggest that CA, as a state of intense concentration and deep engagement (Pelletier, 2008), should promote learning and ICT appropriation (Pelletier, 2008, p.83). However, our findings reveal a negative impact of focused immersion, a relevant dimension of CA (Tharenou, 2001; Vanhée, 2008), on students' ICT appropriation (Agarwal & Karahanna, 2000). A possible explanation for this phenomenon may lie in the very nature of absorption. While focused immersion can be beneficial in certain contexts (Bölen & al., 2021), it can sometimes limit individuals' ability to diversify their learning sources and adapt to the changing demands of technological environments (Fernández-Batanero & al., 2021). Intense concentration can, at times, result in cognitive inflexibility (Thompson, 1967; Weisholtz & al., 2017), wherein the learner's attention becomes disproportionately fixated on a particular task, thereby undermining the expansive and adaptable perspective crucial for the proficient integration of ICT.

Moreover, excessive focused immersion could also lead to cognitive overload (Rutkowski & Saunders, 2018), where the individual is overwhelmed by the complexity of information, potentially resulting in resistance to ICT use (Diller, 2016; Arnold & al., 2023) or discouragement in the face of encountered difficulties (Müller & al., 2023). This cognitive overload may reduce the learner's intrinsic motivation (Poupard & al., 2024), making them less inclined to explore new technologies or persevere in their use (Poupard & al., 2024, p. 5). Consequently, although CA is widely recognized as a critical element and catalyst for learning and engagement, recent research underscores the importance of reevaluating its function within an ICT-based learning environment (Salanova & al., 2013; Rutkowski & Saunders, 2018; Hauk & Gröschner, 2022; Adeel & al., 2023). It seems that in certain environments, an inadequate level of focused immersion can actually hinder the technological learning process by limiting cognitive flexibility (Gilbert, 2006) and increasing learners' mental overload (Poupard & al., 2024). Cognitive flexibility, as defined by (Cañas & al., 2006), refers to an individual's ability to adapt cognitive strategies to explore an environment and solve encountered problems. This skill can involve a learning process and develop with experience. It enables individuals to adapt to new and unexpected changes in their environment, particularly after having completed a task for a certain period (Cañas & al., 2006, p. 296). Nonetheless, this adaptability, regarded as an individual's capacity to adjust, is not universally present. When an individual encounters situations that demand adaptation to changing environments but fails to respond appropriately, this is termed cognitive inflexibility (Barak & Levenberg, 2016) or "cognitive rigidity" (Werner, 1946; Barak, 2018). Indeed, the rise of ICT in various aspects of daily life has raised questions about their influence on the ability to maintain high attention (focused immersion) during a specific task (Pelletier, 2008; Bölen & al., 2021). However, understanding the role and adoption of ICT in individuals' environments remains limited (Zwanenburg, 2019). This suggests that a balanced approach with diverse learning experiences (Conrad & al., 2022) may be more effective in promoting ICT appropriation (Dehghani & al., 2021).

On the other hand, regarding heightened pleasure, our results mention a negative impact on students' ICT appropriation. This outcome can be explained by several factors related to the complexity of the dynamics between pleasure as an intrinsic user motivation and their engagement in learning and sustainable use of ICT (Peters & al., 2018), which also involves extrinsic motivations (Deci & Ryan, 2000). Although CA theory (Agarwal & Karahanna, 2000) suggests that pleasure can initially capture users' attention, it does not seem sufficient to sustain the long-term intrinsic motivation necessary for long-term learning, as observed by (Rheinberg & Engeser, 2018). Recent studies have presented intriguing results regarding the sense of pleasure in the context of ICT-based learning (Peters & al., 2018; Rheinberg & Engeser, 2018; David & Weinstein, 2024), with others linking it more to a sense of well-being (Kahu & Nelson, 2017; Asad & al., 2023) and the pleasure-pain dilemma (Gómez, 2020; Vallone & al., 2023). These studies emphasize that if pleasure becomes the primary goal, students may not develop the necessary skills for effective ICT appropriation (Brault & al., 2017), as they may lack the discipline to persist through more complex or less enjoyable tasks (Morais & al., 2021), leading to a disconnect between pleasure and learning (David & Weinstein, 2024).

It is also pertinent to note that Self-Determination Theory (Deci & Ryan, 2000) indicates that extrinsic motivations, which can sometimes be linked to the sense of pleasure, are often less effective in fostering deep and lasting engagement in learning (Ryan & Deci, 2017). If students are primarily motivated by external obligations (e.g., passing an exam, avoiding penalties, etc.), their ICT appropriation may remain superficial and limited (Peters & al., 2018, p. 6). Furthermore, an excessive focus on pleasure, particularly if it stems from playful or distracting elements of ICT, could divert students' attention from essential learning goals. This could reduce their ability to use ICT effectively for academic purposes, as their engagement may become superficial, centered on immediate gratifications (Brault & al., 2017, p.9) rather than deep learning.

We can thus conclude that the pedagogical integration of ICT, as described by (Kirschner & Davis, 2003), requires not only cognitive immersion and intense pleasure (Agarwal & Karahanna, 2000; Bölen & al., 2021), but also a deep understanding of technological tools and their application in various contexts (Batanero & al., 2021). Although the literature on CA and the state of flow (Csikszentmihalyi, 1990) generally supports that these states are beneficial for learning and technology adoption, students who focus solely on pleasure and focused immersion may overlook the technical and methodological aspects, which can hinder their ICT appropriation (Adeel & al., 2023).

Finally, the holistic approach to education (Huang & al., 2020), which integrates cognitive, socioeconomic, and technical dimensions, shows that ICT appropriation cannot be reduced to a simple question of pleasure and immersion (Kasongo, 2013). An engagement too centered on these aspects may lead to superficial ICT adoption (Peters & al., 2018), without a real understanding or ability to use them effectively (Pelletier, 2008; Ryan & Deci, 2017). In conclusion, although CA can contribute positively to ICT appropriation, its influence may become detrimental if its aspects are poorly balanced or excessively prioritized, potentially hindering practical learning and technological proficiency.

Main and Sub hypotheses	Final decision
H1 : Cognitive absorption has a significant and positive impact on ICT appropriation	Confirmed
H1.1 : Temporal dissociation has a significant and positive impact on ICT appropriation	Confirmed
H1.2 : Focused immersion has a strong and positive impact on ICT appropriation	Non-confirmed
H1.3 : Increased pleasure has a significantly positive impact on ICT appropriation	Non-confirmed
H1.4 : Sense of control has a significant and positive impact on ICT appropriation	Confirmed
H1.5 : Curiosity has a significant and positive impact on ICT appropriation	Confirmed

Source: (Authors)

Table4. *Results summary*

Conclusion

This study investigates the impact of CA dimensions on the appropriation of ICT among students from public universities in the Casablanca-Settat region, employing Csikszentmihalyi's Flow Theory (1990) as a conceptual framework. Our research reveals that three dimensions of CA, temporal dissociation, sense of control, and curiosity, positively and significantly influence ICT appropriation by students. Conversely, focused immersion and pleasure intensity do not exhibit a significant effect.

These findings contribute to existing literature by providing valuable insights into how students interact with ICT in an academic environment (Mazid & al., 2024). They confirm the importance of considering psychological and motivational aspects (Buil & al., 2017), such as CA, when designing and implementing educational technologies. Our conclusions suggest that promoting effective ICT appropriation requires pedagogical strategies that stimulate curiosity (Bencivenga, 2017), foster a sense of control (Hauk & Gröschner, 2022) among students, and create learning environments conducive to positive temporal dissociation (Mazzoni & al., 2016).

Thus, the contributions primarily concern the literature on CA and its role in ICT appropriation within educational contexts. While flow states and deep engagement are often seen as catalysts for learning and performance (Molinari & al., 2016), our results underscore that these benefits are not guaranteed and largely depend on the conditions under which CA manifests (Yildiz & al., 2019; Shirish & al., 2023). This nuance is crucial for enriching disciplinary understanding of the relationship between CA and learning through ICT, especially in complex academic environments (Barak & Levenberg, 2016; Barak, 2018).

From a practical perspective, the implications of this study are significant for educators and educational technology designers. Promoting CA indiscriminately, focusing solely on pleasure and immersion, can be counterproductive if it diverts students from the technical and methodological skills necessary for effective ICT appropriation (Adeel & al., 2023). To maximize the positive impact of CA, it is imperative to develop balanced pedagogical approaches that foster student engagement and incorporate technical and practical elements. This study highlights the significance of a comprehensive educational approach that extends beyond fostering enjoyment and concentrated immersion, also promoting the mastery of technological tools across diverse contexts. By considering these aspects, practitioners can better guide students toward deep and sustainable ICT appropriation, thereby enhancing the effectiveness of digital technologies in higher education.

However, this study has limitations. The results may be influenced by response bias, and the sample, drawn exclusively from the Casablanca-Settat region, limits the generalizability of the conclusions to other geographical or institutional contexts. Future research should explore the underlying mechanisms of these CA dimensions and extend the study to other student populations.

In conclusion, this research significantly enhances our understanding of the complex dynamics between CA and ICT appropriation in higher education. It offers pertinent insights for educational practitioners, policymakers, and researchers interested in the effective integration of digital technologies in contemporary educational environments.

Abbreviations

ICT	Information and Communication Technologies
CA	Cognitive Absorption
ICTE	Information and Communication Technologies in Education
SEM	Structural Equation Method
PLS-SEM	Part Least Squared Structural Equation Modeling

References

[Ajz 80] Ajzen, I., & Fishbein, M. (1980). Understanding Attitudes and Predicting Social Behavior. Englewood Cliffs, NJ: Prentice- Hall.

[Ama 09] Amarilla S.B.G., Vargas S.F.P. (2009). Teacher's technostress: The other side of the use of new technologies by High School teachers. Rev. Cient. Estud. E Investig. 8, 21–35.

[Apa 20] Aparicio Gómez, O.Y. (2020). The Education of Desire and the Use of ICT. In: Bosch, M. (eds) Desire and Human Flourishing. Positive Education. Springer, Cham. https://doi.org/10.1007/978-3-030-47001-2_22

[Aga 15] Agarwal, R. and Karahanna, E. (2000) Time Flies When You're Having Fun: Cognitive Absorption and Beliefs about Information Technology Usage. MIS Quarterly, 24, 665-694. DOI:10.2307/3250951

[Al-S 22] Al-shaikhli, Dhuha, Jin, Li, Porter, Alan and Tarczynski, Andrzej 2022. Visualising weekly learning outcomes (VWLO) and the intention to continue using a learning management system (CIU): the role of cognitive absorption and perceived learning self-regulation. Education and Information Technologies. 27. https://doi.org/10.1007/s10639-021-10703-z

[Apa 20] Aparicio Gómez, O.Y. (2020). The Education of Desire and the Use of ICT. In: Bosch, M. (eds) Desire and Human Flourishing. Positive Education. Springer, Cham. https://doi.org/10.1007/978-3-030-47001-2_22

[An 12] Andersén, J., & Kask, J. (2012). Asymmetrically realized absorptive capacity and relationship durability. *Management Decision*, *50*(1), 43–57. https://doi. org/10.1108/00251741211194868

[Ada 20] Adamides, E., & Karacapilidis, N. (2020). Information technology for supporting the development and maintenance of open innovation capabilities. *Journal of Innovation & Knowledge*, *5*(1), 29–38. https://doi.org/10.1016/J.JIK.2018.07.001

[Ale 21] Alex Murray, Jen Rhymer, Gavid G. (2021). Humans and technology: forms of conjoined agency in organizations. Academy of management review. vol. 46, no. 3, 552–571. https://doi.org/10.5465/amr.2019.0186

[Ami 16] Amira EL BRENJI, Boudour BZEOUICH, Mouna BEN AL, (2016). Rôle du connectivisme dans l'amélioration de la professionnalisation des étudiants. academia. https://www.academia.edu/75669855/R%C3%B4le_du_connectivisme_dans_lam%C3%A9lioration_de_la_professionnalisation_des_%C3%A9tudiants

[Arn 23] Arnold M, Goldschmitt M and Rigotti T (2023) Dealing with information overload: a comprehensive review. Front. Psychol. 14:1122200. doi: 10.3389/fpsyg.2023.1122200

[Bal 21] Balakrishnan, J., & Dwivedi, Y. K. (2021). Role of cognitive absorption in building user trust and experience. Psychol Mark. 38, 643–668. https://doi.org/10.1002/mar.21462

[Bar 16] Barak, M., & Levenberg, A. (2016). Flexible thinking in learning: An individual differences measure for learning in technology-enhanced environments. *Computers & Education*, *99*, 39–52. https://doi.org/10.1016/j.compedu.2016.04.003

[Bar 18] Barak, M. (2018). Are digital natives open to change? Examining flexible thinking and resistance to change. Computers & Education, 121, 115–123. https://doi.org/10.1016/j.compedu.2018.01.016

[Ban 77] Bandura, A. (1977). Self-efficacy: Toward a unifying theory of behavioral change. *Psychological Review*, *84*(2), 191–215. https://doi.org/10.1037/0033-295X.84.2.191

[Bec 92] Beck, L. A. (1992). Csikszentmihalyi, Mihaly. (1990). *Flow: The Psychology of Optimal Experience*. *Journal of Leisure Research*, *24*(1), 93–94. https://doi.org/10.1080/00222216.1992.11969876

[Bec 19] Becerril-Velasco C.I. (2019). "Appropriation of information and communication technologies (ICTs) to reduce poverty in Aguascalientes, Mexico" Entreciencias 7 (21): 53-68. https://doi.org/10.22201/enesl.20078064e.2021.23.79212

[Bol 21] Bölen, M. C., Calisir, H., & Özen, Ü. (2021). Flow theory in the information systems life cycle: The state of the art and future research agenda. International Journal of Consumer Studies, 45(4), 546–580. https://doi.org/10.1111/ijcs.12641

[Bia 11] Biasutti, (2011) Flow and optimal experience. https://api.semanticscholar.org/CorpusID:140749285

[Bui 19] Buil, I., Catalán, S., & Martínez, E. (2019). The influence of flow on learning outcomes: An empirical study on the use of clickers. Br. J. Educ. Technol., 50, 428-439.Buil, I., Catalán, S., & Martínez, E. (2019). The influence of flow on learning outcomes: An empirical study on the use of clickers. Br. J. Educ. Technol., 50, 428-439.

[Bit 20] Bitrián, P., Buil, I. and Catalán, S. (2020), "Gamification in sport apps: the determinants of users' motivation", European Journal of Management and Business Economics, Vol. 29 No. 3, pp. 365-381. https://doi.org/10.1108/EJMBE-09-2019-0163

[Bra 10] Brault-Labbé, A., & Dubé, L. (2010). Engagement scolaire, bien-être personnel et autodétermination chez des étudiants à l'université [School engagement, personal well-being and self-determination in university students]. Canadian Journal of Behavioural Science / Revue canadienne des sciences du comportement, 42(2), 80–92. https://doi.org/10.1037/a0017385

[Büc 95] Büchel (F. P.) (1995). De la métacognition à l'éducation cognitive. L'éducation cognitive. Le développement de la capacité d'apprentissage et son évaluation, Éditions Delachaux et Niestlé, Lausanne, 1995, p. 9-44.

[Bro 11] Brown, K. G., & Sitzmann, T. (2011). Training and employee development for improved performance. In S. Zedeck (Ed.), *APA handbook of industrial and organizational psychology, Vol. 2. Selecting and developing members for the organization* (pp. 469–503). American Psychological Association. https://doi.org/10.1037/12170-016

[Bra 07] Brachos, D., Kostopoulos, K., Eric Soderquist, K. and Prastacos, G. (2007), "Knowledge effectiveness, social context and innovation", Journal of Knowledge Management, Vol. 11 No. 5, pp. 31-44. https://doi.org/10.1108/13673270710819780

[Ber 18] Bernard Coulibaly, (2018). Pour une approche socioculturelle et sociocritique de l'appropriation des dispositifs d'apprentissage soutenus par les TIC dans l'enseignement supérieur en France. Education. Université de Strasbourg, 2018. fftel03548648f. https://hal.science/tel-03548648/document

[Bli 21] Blichfeldt, H., & Faullant, R. (2021). Performance effects of digital technology adoption and product & service innovation – A process-industry perspective. Technovation, 105, 102275. https://doi.org/10.1016/J.TECHNOVATION.2021.102275

[Bur 21] Burnett, J. R., & Lisk, T. C. (2021). The future of employee engagement: Real-time monitoring and digital tools for engaging a workforce. In M. Segalla (Ed.), *International perspectives on employee engagement* (pp. 117–128). Routledge/Taylor & Francis Group. https://doi.org/10.4324/9781003142492-9

[Cal 20] Calderón, A., Meroño, L., & MacPhail, A. (2020). A student-centred digital technology approach: The relationship between intrinsic motivation, learning climate and academic achievement of physical education pre-service teachers. European Physical Education Review, 26(1), 241-262. https://doi.org/10.1177/1356336X19850852

[Csi 75] CsiCsikszentmihalyi M. (1975). Beyond Boredom and Anxiety. San Francisco, CA: Jossey-Bass Publishers.

[Cel 14] Celik, V., Yesilyurt, E., Korkmaz, O., & Usta, E. (2014). From the Perspective of Loneliness and Cognitive Absorption Internet Addiction as Predictor and Predicted. Eurasia Journal of Mathematics, Science and Technology Education, 10(6), 581-594. https://doi.org/10.12973/eurasia.2014.23560a

[Chi 14] Chi, M. T. H., & Wylie, R. (2014). The ICAP Framework: Linking Cognitive Engagement to Active Learning Outcomes. Educational Psychologist, 49(4), 219–243. https://doi.org/10.1080/00461520.2014.965823

[Chi 98] Chin, W.W. 1998. "The partial least squares approach to structural equation modeling." Advances in Hospitality and Leisure 8 (2): 295-335. https://www.researchgate.net/publication/311766005

[Coh 88] Cohen, J. (1988). Statistical Power Analysis for the Behavioral Sciences (2nd ed.). Hillsdale, NJ: Lawrence Erlbaum Associates, Publishers.

[Coh 89] Cohen, W. M., & Levinthal, D. A. (1989). Innovation and Learning: The Two Faces of R & D. The Economic Journal, 99(397), 569–596. https://doi.org/10.2307/2233763

[Con 22] Conrad, C., Deng, Q., Caron, I., Shkurska, O., Skerrett, P., & Sundararajan, B. (2022). How student perceptions about online learning difficulty influenced their satisfaction during Canada's Covid-19 response. British journal of educational technology : journal of the Council for Educational Technology, 53(3), 534–557. https://doi.org/10.1111/bjet.13206

[Cha 12] Chandra, S., Srivastava, S.C., & Theng, Y.-L. (2012). Cognitive absorption and trust for workplace collaboration in virtual worlds : an information processing decision making perspective. Journal of the association for information systems, 13(10), 797-835. https://aisel.aisnet.org/jais/vol13/iss10/3/

[Cam 10] Camisón, C. and Forés, B. (2010), "Knowledge absorptive capacity: new insights for its conceptualization and measurement", Journal of Business Research, Vol. 63 No. 7, pp. 707-715.

[Car 21] Caron, P.-A. (2021). La mise en place de l'enseignement à distance au temps de la pandémie. Revue internationale des technologies en pédagogie universitaire / International Journal of Technologies in Higher Education, 18(1), 102–113. https://doi.org/10.18162/ritpu-2021-v18n1-10

[Dan 17] Daniel S. Weisholtz, John F. Sullivan, Aaron P. Nelson, Kirk R. Daffner, David A. Silbersweig,(2017). Cognitive, Emotional, and Behavioral Inflexibility and Perseveration in Neuropsychiatric Illness. Executive Functions in Health and Disease, Academic Press. Pages 219-248. ISBN: 9780128036761. https://doi.org/10.1016/B978-0-12-803676-1.00010-6

[Dav 24] David, L., Weinstein, N., (2024). Using technology to make learning fun: technology use is best made fun and challenging to optimize intrinsic motivation and engagement. Eur J Psychol Educ 39, 1441–1463. https://doi.org/10.1007/s10212-023-00734-0

[Dis 03] Dias, B. (2003). Apprentissage cognitif médiatisé : l'apport de la psychologie cognitive à l'enseignement et à l'apprentissage. Lucerne : SZH/CSPS.

[Dil 16] Diller, Heike, 2016. "Life is tough so you gotta be rough: How resilience impacts employees' attitude towards ICT use," Passauer Diskussionspapiere, Betriebswirtschaftliche Reihe B-24-16, University of Passau, Faculty of Business and Economics. https://hdl.handle.net/10419/179473

[Deh 21] Dehghani, M., Acikgoz, F., Mashatan, A., & Lee, S. H. (Mark). (2021). A holistic analysis towards understanding consumer perceptions of virtual reality devices in the post-adoption phase. Behaviour & Information Technology, 41(7), 1453–1471. https://doi.org/10.1080/0144929X.2021.1876767

[Dec 00] Deci, E. L., & Ryan, R. M. (2000). The "what" and "why" of goal pursuit: Human needs and the self-determination of behavior. Psychological Inquiry, 11, 227–268. http://dx.doi.org/10.1207/S15327965PLI1104 01

[Dim 21] Dimkêeg Sompassaté Parfait Kabore, (2021). L'intégration pédagogique des TIC dans l'enseignement supérieur au Burkina Faso : accessibilité, usages et appropriation par les étudiants. Education. Université de Strasbourg; Université de Koudougou. Français. (NNT : 2021STRAG005).

[Dav 89] Davis, F. (1989) Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13, 319-340. https://doi.org/10.2307/249008

[Dav 93] Davis, F. D. (1993). User Acceptance of Information Technology: System Characteristics, User Perceptions and Behavioral Impacts. International Journal of Man-Machine Studies, 38, 475-487. http://hdl.handle.net/2027.42/30954 https://doi.org/10.1006/imms.1993.1022

[Den 22] Dennis Hauk and Alexander Gröschner, (2022). How effective is learner-controlled instruction under classroom conditions? A systematic review. Learning and Motivation. 80,ISSN:0023-9690. doi: https://doi.org/10.1016/j.lmot.2022.101850

[Eun 21] Eun-Jung Ko, A-Hyun Kim and Sang-Soo Kim (2021). "Toward the understanding of the appropriation of ICT-based Smart-work and its impact on performance in organizations." Technological Forecasting & Social Change 171: 1-12. https://doi.org/10.1016/j.techfore.2021.120994

[Fer 21] Fernández-Batanero, J.-M.; Román-Graván, P.; Reyes-Rebollo, M.-M.; Montenegro-Rueda, M. (2021). Impact of Educational Technology on Teacher Stress and Anxiety: A Literature Review. *Int. J. Environ. Res. Public Health*, *18*, 548. https://doi.org/10.3390/ijerph18020548

[Fis 75] Fishbein, M. and Ajzen, I. (1975) Belief, Attitude, Intention and Behaviour: An Introduction to Theory and Research. Addison-Wesley Publishing Co, Inc., Boston.

[Fer 12] Fernandes, V. (2012). En quoi l'approche PLS est-elle une méthode a (re)-découvrir pour les chercheurs en management ?. M@n@gement, 15, 102-123. https://doi.org/10.3917/mana.151.0102

[For 81] Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research, 18*(1), 39–50. https://doi.org/10.2307/3151312

[Geo 03] George, D., & Mallery, P. (2003). SPSS for Windows Step by Step: A Simple Guide and Reference. 11.0 Update (4th ed.). Boston: Allyn & Bacon.

[G.r 22] G., R., Jose, A., Mathew, S., Chacko, D.P. and Asokan-Ajitha, A. (2022). Towards a theory of well-being in digital sports viewing behavior, Journal of Services Marketing, Vol. 36 No. 2, pp. 245-263. https://doi.org/10.1108/JSM-06-2020-0247

[Gui 19] Guinaliu-Blasco, M., Hernández-Ortega, B. and Franco, J.L. (2019), "The effect of cognitive absorption on marketing learning performance", Spanish Journal of Marketing - ESIC, Vol. 23 No. 2, pp. 249-271. https://doi.org/10.1108/SJME-10-2018-0048

[Gil 10] Gile, K. J., & Handcock, M. S. (2010). Respondent-Driven Sampling: An Assessment of Current Methodology. *Sociological methodology*, *40*(1), 285–327. https://doi.org/10.1111/j.1467-9531.2010.01223.x

[Gaë 16] Gaëlle Molinari, Bruno Poellhuber, Jean Heutte, Elise Lavoué, Denise Sutter Widmer et Pierre-André Caron (2016).L'engagement et la persistance dans les dispositifs de formation en ligne : regards croisés. Distances et médiations des savoirs. https://doi.org/10.4000/dms.1332

[Gro 87] Grolnick, W. S., & Ryan, R. M. (1987). Autonomy in Children's Learning: An Experimental and Individual Difference Investigation. Journal of Personality and Social Psychology, 52, 890-898. https://doi.org/10.1037/0022-3514.52.5.890

[Gan 15] Gan, Benjamin; MENKHOFF, Thomas; and SMITH, Richard R.(2015). Enhancing students' learning process through interactive digital media: New opportunities for collaborative learning. Computers in Human Behavior. 51, (Part B), 652-663. https://ink.library.smu.edu.sg/sis_research/2533

[Gor 05] Gorelick, C. and Tantawy-Monsou, B. (2005), "For performance through learning, knowledge management is the critical practice", The Learning Organization, Vol. 12 No. 2, pp. 125-139. https://doi.org/10.1108/09696470510583511

[Hay 94] Haymore, J., Ringstaff, C. & Dwyer, D. (1994). Student engagement revisited: Views from technology-rich classrooms. Apple classrooms of tomorrow (acot) research. Cupertino, CA: Apple Computer inc. https://www.academia.edu/52921819/Student_Engagement_Views_from_Technology_Rich_Classrooms

[Har 97]Hargreaves, A. (1997). Cultures of Teaching and Educational Change. In: Biddle, B.J., Good, T.L., Goodson, I.F. (eds) International Handbook of Teachers and Teaching. Springer International Handbooks of Education, vol 3. Springer, Dordrecht. https://doi.org/10.1007/978-94-011-4942-6_31

[Ism 23] Ismail Celik, (2023).Exploring the Determinants of Artificial Intelligence (AI) Literacy: Digital Divide, Computational Thinking, Cognitive Absorption.Telematics and Informatics. 83 ISSN 0736-5853. https://doi.org/10.1016/j.tele.2023.102026

[Jam 90] James C. Brancheau and James C. Wetherbe (1990). The Adoption of Spreadsheet Software: Testing Innovation Diffusion Theory in the Context of End-User Computing. Information Systems Research, 1990, vol. 1, issue 2, 115-143. http://dx.doi.org/10.1287/isre.1.2.115

[Jan 06] Jan Fagerberg, 2006. "Innovation, technology and the global knowledge economy: Challenges for future growth," Working Papers on Innovation Studies 20060301, Centre for Technology, Innovation and Culture, University of Oslo. https://ideas.repec.org/p/tik/inowpp/20060301.html

[Jan 03] Janz, Brian D, Prasarnphanich, Pattawaran. (2003). Understanding the Antecedents of Effective Knowledge Management: The Importance of a Knowledge-Centered Culture.Decision Sciences, Vol 34, Issue 2, p. 351. ISSN 0011-7315. Doi: 10.1111/1540-5915.02328

[Jan 21] Janarthanan Balakrishnan, Yogesh K. Dwivedi. (2021). Role of cognitive absorption in building user trust and experience. Psychology & Marketing. Volume38, Issue4. https://doi.org/10.1002/mar.21462

[Jum 20] Jumaan, I. A., Hashim, N. H., & Al-Ghazali, B. M. (2020). The role of cognitive absorption in predicting mobile internet users' continuance intention: An extension of the expectation-confirmation model. Technology in Society, 63, Article 101355. https://doi.org/10.1016/j.techsoc.2020.101355

[Jan 05] Jansen, J. J., Van Den Bosch, F. A., & Volberda, H. W. (2005). Managing potential and realized absorptive capacity: How do organizational antecedents matter? *Academy of Management Journal*, *48*(6), 999–1015. https://doi.org/10.5465/ AMJ.2005.19573106

[Jeey 15] Jeeyun Oh, S. Shyam Sundar, (2015). How Does Interactivity Persuade? An Experimental Test of Interactivity on Cognitive Absorption, Elaboration, and Attitudes, Journal of Communication. Volume 65, Issue 2, Pages 213–236. https://doi.org/10.1111/jcom.12147

[Jea 12] Jean Heutte (2012). Mesure de l'immersion (absorption cognitive) et de ses déterminants psychosociaux appliqués au Serious Game : Vers une modélisation théorique.Conference: Colloque scientifique international du e-virtuose "Evaluer et mesurer l'impact du Serious game",At: Valenciennes (France). http://jean.heutte.free.fr/IMG/pdf/Heutte-2012-Impact_SG-eVirtuose.pdf

[Jea 89] Jean Heutte (2017). L'environnement optimal d'apprentissage : contribution de la recherche empirique sur les déterminants psychologiques de l'expérience positive subjective aux sciences de l'éducation et de la formation des adultes. Sciences & Bonheur. 2, pp.82-99. hal-01597551. https://hal.science/hal-01597551

[Joa 24] Ioanna Kastelli, Petros Dimas, Dimitrios Stamopoulos & Aggelos Tsakanikas (2024). Linking Digital Capacity to Innovation Performance: the Mediating Role of Absorptive Capacity. J Knowl Econ 15, 238–272. https://doi.org/10.1007/s13132-022-01092-w

[Jos 06] José J. Cañas, Inmaculada Fajardo, and Ladislao Salmerón, (2006). Cognitive flexibility. International encyclopedia of ergonomics and human factors. 1 (3), 297-301. https://www.researchgate.net/profile/Jose-Canas-2/publication/272022148_Cognitive_Flexibility/links/54d8e2440cf24647581cd8f0/Cognitive-Flexibility.pdf

[Ko 21] Ko, Eun-Jung & Kim, A-Hyun & Kim, Sang-Soo, 2021. "Toward the understanding of the appropriation of ICT-based Smart-work and its impact on performance in organizations," Technological Forecasting and Social Change, Elsevier, vol. 171(C).DOI: 10.1016/j.techfore.2021.120994

[Kol 09] Kolb, A., & Kolb, D. (2009). Experiential learning theory: a dynamic, holistic approach to management learning, education and development. In The SAGE Handbook of Management Learning, Education and Development (pp. 42-68). SAGE Publications Ltd. https://doi.org/10.4135/9780857021038

[Kah 17] Kahu, E. R., & Nelson, K. (2017). Student engagement in the educational interface: understanding the mechanisms of student success. Higher Education Research & Development, 37(1), 58–71. https://doi.org/10.1080/07294360.2017.1344197

[Leu 04] Leu, D. J., Kinzer, C. K., Coiro, J. L., & Cammack, D. W. (2004). Toward a Theory of New Literacies Emerging from the Internet and Other Information and Communication Technologies. In R. B. Ruddell, & N. J. Unrau (Eds.), Theoretical Models and Processes of Reading (5th ed., p. 1570). Newark, DE: International Reading Association.

[Liu 09] Liu, S.-H., Liao, H.-L., & Pratt, J. A. (2009). Impact of media richness and flow on e-learning technology acceptance. *Computers & Education*, *52*(3), 599–607. https://doi.org/10.1016/j.compedu.2008.11.002

[Lin 09] Lin, H. F. (2009). Examination of cognitive absorption influencing the intention to use a virtual community. Behaviour & Information Technology, 28(5), 421–431. https://doi.org/10.1080/01449290701662169

[Lep 87] Lepper, M. R., & Malone, T. W. (1987). Intrinsic motivation and instructional effectiveness in computer-based education. In R. E. Snow & M. J. Farr (Eds.), Aptitude, learning and instruction (pp. 255-286). Hillsdale, NJ: Erlbaum.

[Lun 04] Lund Vinding, A. (2004), "INTERACTION BETWEEN FIRMS AND KNOWLEDGE INSTITUTIONS", Christensen, J.L. and Lundvall, B.-A. (Ed.) Product Inovation, Interactive Learning and Economic Performance

(Research on Technological Innovation, Management and Policy, Vol. 8), Emerald Group Publishing Limited, Leeds, pp. 257-283. https://doi.org/10.1016/S0737-1071(04)08011-4

[Leo 11] Leong, P. (2011). Role of social presence and cognitive absorption in online learning environments. Distance Education, 32(1), 5–28. https://doi.org/10.1080/01587919.2011.565495

[Lau 17] Laurent Lardy (2017). Les facteurs qui influencent la réussite académique dans la filière technologique de l'université française.. Education. Université Grenoble Alpes. Français. (NNT : 2017GREAH016). https://theses.hal.science/tel-01690165/

[Leo 13] Leong, P. (2011). Role of social presence and cognitive absorption in online learning environments. Distance Education, 32(1), 5–28. https://doi.org/10.1080/01587919.2011.565495

[Lin 20] Lin, C.-Y., & Huang, C.-K. (2020). Understanding the antecedents of knowledge sharing behaviour and its relationship to team effectiveness and individual learning. Australasian Journal of Educational Technology, 36(2), 89–104. https://doi.org/10.14742/ajet.4549

[Lit 17] Litalien, D., Morin, A. J. S., Gagné, M., Vallerand, R. J., Losier, G. F., & Ryan, R. M. (2017). Evidence of a continuum structure of academic selfdetermination: A two-study test using a bifactor-ESEM representation of academic motivation. Contemporary Educational Psychology, 51, 67–82. http://dx.doi.org/10.1016/j.cedpsych.2017.06.010

[Lég21] Léger, P.-M., Davis, F. D., Cronan, T. P., & Perret, J. (2014). Neurophysiological correlates of cognitive absorption in an enactive training context. *Computers in Human Behavior*, *34*, 273–283. https://doi.org/10.1016/j.chb.2014.02.011

[Lai 21] Lai, C.-L. (2021). Exploring University Students'Preferences for AI-Assisted Learning Environment: A Drawing Analysis with Activity Theory Framework. Educational Technology & Society, 24(4), 1–15. https://www.jstor.org/stable/48629241

[Mar 03] Martin, X., & Salomon, R. (2003). Knowledge transfer capacity and its implications for the theory of the multinational corporation. *Journal of International Business Studies*, *34*(4), 356–373. https://doi.org/10.1057/palgrave.jibs.8400037

[Mar 05] Mariano Nieto and Pilar Quevedo, (2005). Absorptive capacity, technological opportunity, knowledge spillovers, and innovative effort. Technovation. Vol 25 N° 10. p.1141-1157, ISSN: 0166-4972. https://doi.org/10.1016/j.technovation.2004.05.001

[Mik 13] Miki Kasongo (2013), Repenser l'école en Afrique entre tradition et modernité. Études africaines. Harmattan. ISBN 2343021538, 9782343021539

[Mal 21] Malureanu, Adriana, Georgeta Panisoara, and Iulia Lazar. 2021. "The Relationship between Self-Confidence, Self-Efficacy, Grit, Usefulness, and Ease of Use of eLearning Platforms in Corporate Training during the COVID-19 Pandemic" Sustainability 13, no. 12: 6633. https://doi.org/10.3390/su13126633

[Muh 24] Muhammad Mujtaba Asad, Darakshan Erum, Prathamesh Churi, Antonio José Moreno Guerrero, (2024). Effect of technostress on Psychological well-being of post-graduate students: A perspective and correlational study of Higher Education Management. International Journal of Information Management Data Insights. Volume 3, Issue 1. ISSN: 2667-0968. https://doi.org/10.1016/j.jjimei.2022.100149.

[Moh 20] Mohammed, S.H., & Kinyó, L. (2020). Constructivist theory as a foundation for the utilization of digital technology in the lifelong learning process. Turkish Online Journal of Distance Education. 21 (4) , 90-109 . DOI: 10.17718/tojde.803364

[Mei 97] Meighan, Roland (1997) The Next Learning System: and Why Home-Schoolers are Trailblazers. Bramcote Hills, Nottingham: Educational Heretics Press. Education Review. https://doi.org/10.14507/er.v0.35

[Meh 20] Mehmet Cem Bölen, (2020). Exploring the determinants of users' continuance intention in smartwatches, Technology in Society,Volume 60,101209, ISSN 0160-791X, https://doi.org/10.1016/j.techsoc.2019.101209.

[Mon 96] Moneta, G. B., & Csikszentmihalyi, M. (1996). The effect of perceived challenges and skills on the quality of subjective experience. *Journal of Personality*, *64*(2), 275–310. https://doi.org/10.1111/j.1467-6494.1996.tb00512.x

[Mor 14] Morosan, C. (2014), "Toward an integrated model of adoption of mobile phones for purchasing ancillary services in air travel", International Journal of Contemporary Hospitality Management, Vol. 26 No. 2, pp. 246-271. https://doi.org/10.1108/IJCHM-11-2012-0221

[Mpi 19] Mpinganjira, M. (2019), "Cognitive absorption and behavioural intentions in virtual health communities: A focus on content posters", Journal of Systems and Information Technology, Vol. 21 No. 1, pp. 122-145. https://doi.org/10.1108/JSIT-06-2017-0044

[Mba 12] Mbang C.E. 2012. "Appropriation d'outils technologiques par les acteurs : le cas des entreprises du secteur financier au Cameroun." Gestion et management. PhD diss., Paris-Est university. https://theses.hal.science/tel-00807270/document

[Mez 18] Meza M. and C García 2018. "Use and appropriation of ICT in the educational practices of teachers of the program of environmental engineering of the Universidad Francisco de Paula Santander." Journal of Physics: Conference Series 1126, 012048: 1-6. https://iopscience.iop.org/article/10.1088/1742-6596/1126/1/012048/meta

[Mun 97] Munro, M.C., S.L. Huff, B.L. Marcolin et D.R. Compeau (1997), Understanding and measuring user competence, Information & Management, vol. 33, p. 45-57. https://doi.org/10.1016/S0378-7206(97)00035-9

[Mar 19] Maryam Ghasemaghaei and Goran Calic. (2019). Does big data enhance firm innovation competency? The mediating role of data-driven insights. Journal of Business Research. 104, 69-84, ISSN= 0148-2963 doi: https://doi.org/10.1016/j.jbusres.2019.07.006

[Maz 24] Mazid, Afrin; Samantaray, Narendra Nath; Chaudhury, Suprakash. (2024)/ Theoretical underpinnings of flow and its relation with academic engagement: A narrative review. Industrial Psychiatry Journal ():10.4103/ipj.ipj_26_24, June 28, 2024. DOI: 10.4103/ipj.ipj_26_24

[Maz 16] Mazzoni, E., Cannata, D., & Baiocco, L. (2016). Focused, not lost: the mediating role of Temporal Dissociation and Focused Immersion on Problematic Internet Use. Behaviour & Information Technology, 36(1), 11–20. https://doi.org/10.1080/0144929X.2016.1159249

[Mül 22] Müller, R., Schischke, D., Graf, B., & Antoni, C.H. (2022). How can we avoid information overload and techno-frustration as a virtual team? The effect of shared mental models of information and communication technology on information overload and techno-frustration. Comput. Hum. Behav., 138, 107438. https://api.semanticscholar.org/CorpusID:251682521

[Mor 21] Morais. P, Ferreira. M. J. and Veloso. B, (2021). Improving Student Engagement With Project-Based Learning: A Case Study in Software Engineering. in IEEE Revista Iberoamericana de Tecnologias del Aprendizaje. vol. 16, no. 1, pp. 21-28, doi: 10.1109/RITA.2021.3052677

[Nat 08]Nathalie Van Hée (2008). Distance cognitive et capacités d'absorption : deux notions étroitement imbriquées dans les processus d'apprentissage et d'innovation. Revue d'économie industrielle. 121 (5). https://doi.org/10.4000/rei.3814

[Noo 00] Nooteboom, B. (2000). Learning by Interaction: Absorptive Capacity, Cognitive Distance and Governance. Journal of Management & Governance 4, 69–9. https://doi.org/10.1023/A:1009941416749

[O'Br 22] O'Brien, H. L., Roll, I., Kampen, A., & Davoudi, N. (2022). Rethinking (dis)engagement in human-computer interaction. *Computers in Human Behavior, 128,* Article 107109. https://doi.org/10.1016/j.chb.2021.107109

[Oli 18] Oliveira dos Santos, W., Bittencourt, I., Isotani, S., Dermeval, D., Brandão Marques, L., & Frango Silveira, I. (2018). Flow Theory to Promote Learning in Educational Systems: Is it Really Relevant?. *Revista Brasileira de Informática na Educação, 26*(02), 29. doi:https://doi.org/10.5753/rbie.2018.26.02.29

[Pin 06] Ping Zhang, Na Li and Heshan Sun, (2006). Affective Quality and Cognitive Absorption: Extending Technology Acceptance Research. Proceedings of the 39th Annual Hawaii International Conference on System Sciences (HICSS'06), Kauia, HI, USA, pp. 207a-207a, doi: 10.1109/HICSS.2006.39

[Pel 08] Pelletier C. and Moreau M.F. 2008. "L'appropriation des technologies de l'Internet et ses facteurs critiques de succès : un défi de plus pour les PME ?" Revue internationale P.M.E. : économie et gestion de la petite et moyenne entreprise 21 (2): 75-117. https://doi.org/10.7202/029432ar

[Pell 16] Jérôme Pelletier (2016). Quand l'émotion rencontre la fiction. Françoise Lavocat. L'interprétation littéraire et les sciences cognitives, Editions Hermann, pp.123-155, 2016, 9782705691592. ffhal-03882191f. https://hal.science/hal-03882191/document

[Par 11] Park, Byung Il, (2011), Knowledge transfer capacity of multinational enterprises and technology acquisition in international joint ventures, International Business Review, 20, issue 1, p. 75-87, https://EconPapers.repec.org/RePEc:eee:iburev:v:20:y:2011:i:1:p:75-87.

[Pro 05] Proulx S. (2005). Penser la conception et l'usage des objets communicationnels in Johanne Saint-Charles et Pierre Mongeau, éds., Communication. Horizon de recherches et de pratiques, Presses de l'Université du Québec, Québec, p. 297-318. http://sergeproulx.uqam.ca/wp-content/uploads/2010/12/2005-proulx-penser-laconc-44.pdf

[Pet 18] Peters, D., Calvo, R. A., & Ryan, R. M. (2018). Designing for motivation, engagement and wellbeing in digital experience. Frontiers in Psychology, 9, Article 797. https://doi.org/10.3389/fpsyg.2018.00797

[Mat 22] Matisse Poupard, Florian Larrue, Hélène Sauzéon, André Tricot, (2022). A systematic review of immersive technologies for education: effects of cognitive load and curiosity state on learning performance. hal-03906797v1f

[Rog 95] Rogers, E.M. (1995) Diffusion of Innovations. 4th Edition, the Free Press, New York.

[Raa 05] Raafat Saadé, Bouchaib Bahli,(2005). The impact of cognitive absorption on perceived usefulness and perceived ease of use in on-line learning: an extension of the technology acceptance model. Information & Management.Volume 42, Issue 2, ISSN 0378-7206. https://doi.org/10.1016/j.im.2003.12.013

[Ree 17] Reeve, J., Nils, F., Kaelen, R., Vallerand, R.J.., Fenouillet, F. (2017). Psychologie de la motivation et des émotions. De Boeck Supérieur.

[Ree 12] Reeve, J. (2012). A self-determination theory perspective on student engagement. In S. L. Christenson, A. L. Reschly, & C. Wylie (Eds.), Handbook of research on student engagement (pp. 149–172). New York: Springer

[Rob 12] Roberts, N., Galluch, P. S., Dinger, M., & Grover, V. (2012). Absorptive Capacity and Information Systems Research: Review, Synthesis, and Directions for Future Research. MIS Quarterly, 36(2), 625–648. https://doi.org/10.2307/41703470

[Rut 18] Rutkowski, A.-F., & Saunders, C. (2018). Emotional and Cognitive Overload: The Dark Side of Information Technology (1st ed.). Routledge. https://doi.org/10.4324/9781315167275

[Rhe 18] Rheinberg, F., Engeser, S. (2018). Intrinsic Motivation and Flow. In: Heckhausen, J., Heckhausen, H. (eds) Motivation and Action . Springer, Cham. https://doi.org/10.1007/978-3-319-65094-4_14

[Sal 13] Salanova, M., Llorens, S., & Cifre, E. (2013). The dark side of technologies: technostress among users of information and communication technologies. International journal of psychology : Journal international de psychologie, 48(3), 422–436. https://doi.org/10.1080/00207594.2012.680460

[Sae 17] Saemundsson, R. J., & Candi, M. (2017). Absorptive capacity and the identification of opportunities in new technology-based firms. Technovation, 64-65, 43-49. Advance online publication. https://doi.org/10.1016/j.technovation.2017.06.001

[Saf 23] Safae ANFOUD & Lalla Fatima Zohra ALAMI TALBI, (2023). Education 5.0: Cross-Perspectives From Japan And Zimbabwe. Annals of the University of Craiova, Series Psychology, Pedagogy, Teacher Training Department, University of Craiova, vol. 45(2, Supple), pages 55-70. https://www.ceeol.com/search/article-detail?id=1229075

[She 13] Shernoff, D. J. (2013). *Optimal learning environments to promote student engagement.* Springer Science + Business Media. https://doi.org/10.1007/978-1-4614-7089-2

[Sol 17] Solis Vázquez, S.Y., García Fernández, F. and Zerón Félix, M. (2017). Impacto de la capacidad de absorción del conocimiento en la innovación. El caso del sector petroquímico en Reynosa, México (Impact of knowledge absorption capacity on innovation. The case of the petrochemical sector in Reynosa, Mexico). Innovar, Vol. 27 No. 66, pp. 11-27.

[Ste 13] Steven L. Franconeri, George A. Alvarez, Patrick Cavanagh (2013). Flexible cognitive resources: competitive content maps for attention and memory. Trends in cognitive sciences. Volume 17, ISSUE 3, p. 134-141. https://doi.org/10.1016/j.tics.2013.01.010

[Sla 96] Slavin, R.E. (1996). Research on cooperative learning and achievement: What we know, what we need to know. Contemporary Educational Psychology, 21, 43-69. https://api.semanticscholar.org/CorpusID:17294710

[Seo 15] Seo, Y. W., Chae, S. W., & Lee, K. C. (2015). The impact of absorptive capacity, exploration, and exploitation on individual creativity: Moderating effect of subjective well-being. *Computers in Human Behavior*, *42*, 68–82. https://doi. org/10.1016/j.chb.2014.03.031

[Sjö 21] Sjödin, D., Frishammar, J., & Thorgren, S. (2019). How Individuals Engage in the Absorption of New External Knowledge : A Process Model of Absorptive Capacity. The Journal of Product Innovation Management, 36(3), 356–380. https://doi.org/10.1111/jpim.12482

[Shi 23] Shirish, Anuragini, Verstraete, Nina, and Tantan, Olfa Chourabi, (2023). The Impact of ICT Characteristics on Students' Learning Outcomes During COVID-19 Lockdown Period: The Crucial Role of Techno Eustress Perception. Vol 42 (2). p. 149 – 162. DOI: 10.3233/HSM-22005

[Say 21] Sayaf, Amer Mutrik, Mahdi Mohammed Alamri, Mohammed Ayid Alqahtani, and Waleed Mugahed Al-Rahmi. (2021). Information and Communications Technology Used in Higher Education: An Empirical Study on Digital Learning as Sustainability. *Sustainability* 13, no. 13: 7074. https://doi.org/10.3390/su13137074

[Say 22] Sayaf, Amer Mutrik, Mahdi M. Alamri, Mohammed Ayid Alqahtani, and Waleed Mugahed Alrahmi, (2022). Factors Influencing University Students' Adoption of Digital Learning Technology in Teaching and Learning. Sustainability. 14, no. 1: 493. https://doi.org/10.3390/su14010493

[Sal 16] Salah Al-Sharhan, (2016). Smart classrooms in the context of technology-enhanced learning (TEL) environments. Transforming Education in the Gulf Region. p. 27. ISBN: 9781315621586. https://www.taylorfrancis.com/chapters/edit/10.4324/9781315621586-16/smart-classrooms-context-technology-enhanced-learning-tel-environments-salah-al-sharhan

[Sch 10] P. J. Schmidt, (2010). The Role of Challenge in Information Systems Use. 43rd Hawaii International Conference on System Sciences, Honolulu, HI, USA, , pp. 1-10, doi: 10.1109/HICSS.2010.393.

[Shu 14] Shukor, N. A, Tasir, Z., Van der Meijden, H., & Harun, J. (2014). Exploring Students' Knowledge Construction Strategies in Computer-Supported Collaborative Learning Discussions Using Sequential Analysis. Educational Technology & Society, 17 (4), 216–228.

[Sza 14] Szalma, J. L. (2014). On the Application of Motivation Theory to Human Factors/Ergonomics: Motivational Design Principles for Human–Technology Interaction. Human Factors, 56(8), 1453-1471. https://doi.org/10.1177/0018720814553471

[Soh 20] Sohn, K., & Kwon, O. (2020). Technology Acceptance Theories and Factors Influencing Artificial Intelligence-Based Intelligent Products. Telematics and Informatics, 47, Article 101324. https://doi.org/10.1016/j.tele.2019.101324

[Tel 74] Tellegen, A., & Atkinson, G. (1974). Openness to absorbing and self-altering experiences ("absorption"), a trait related to hypnotic susceptibility. *Journal of Abnormal Psychology*, *83*(3), 268–277. https://doi.org/10.1037/h0036681

[Tho 06] Thomas, Patricia, (2006). Cognitive Absorption: Its antecedents and effect on user intentions to use technology. AMCIS Proceedings. 147. http://aisel.aisnet.org/amcis2006/147

[Tre 92] Trevino, L. k., & Webster, J. (1992). Flow in Computer-Mediated Communication: Electronic Mail and Voice Mail Evaluation and Impacts. Communication Research, 19(5), 539-573. https://doi.org/10.1177/009365092019005001

[Tre 02] Wm. David Salisbury, Wynne W. Chin, Abhijit Gopal, Peter R. Newsted, (2002) Research Report: Better Theory Through Measurement—Developing a Scale to Capture Consensus on Appropriation. Information Systems Research 13(1):91-103. https://doi.org/10.1287/isre.13.1.91.93

[Tre 14] Irene Esteban-Millat and Francisco J. Martínez-López and Rubén Huertas-García and Antoni Meseguer and Inma Rodríguez-Ardura. (2014). Modelling students' flow experiences in an online learning environment. 71, 111-123. ISSN; 0360-1315 doi: https://doi.org/10.1016/j.compedu.2013.09.012

[Tou 15] Toure K. (2015). "Appropriation pédagogique des technologies de l'information et de la communication (TIC) par les éducateurs ouest-africains." Université de Montréal - Faculté des études supérieures et postdoctorales. Montréal. DOI:10.2307/j.ctv12pnnwr.6

[Ten 05] Tenenhaus, M., Vinzi, V., Chatelin, Y., et al. (2005) PLS Path Modeling. Computational Statistics & Data Analysis, 48, 159-205. https://doi.org/10.1016/j.csda.2004.03.005

[Tha 01] Tharenou, P. (2001). The relationship of training motivation to participation in training and development. *Journal of Occupational and Organizational Psychology, 74*(5), 599–621. https://doi.org/10.1348/096317901167541

[Tse 11] Tseng, C.-Y., Chang Pai, D., & Hung, C.-H. (2011). Knowledge absorptive capacity and innovation performance in KIBS. *Journal of Knowledge Management*, *15*(6), 971–983. https://doi.org/10.1108/13673271111179316

[Tra 08] Traoré, D. (2008). Quel avenir pour l'usage pédagogique des TIC en Afrique subsaharienne? Cas de cinq pays membres du ROCARE. In K. Toure, T.M.S. Tchombe, & T. Karsenti (Eds.), ICT and Changing Mindsets in Education. Bamenda, Cameroon: Langaa; Bamako, Mali: ERNWACA / ROCARE.

[Tho 67] Thompson, J. D. (1967). Organizations in Action. New York, McGraw Hill.

[Van 09] Vande Vonder, L. & Haelewyck, M. (2009). Les apprentissages cognitifs dans l'enseignement spécialisé de types 1 et 2. La nouvelle revue de l'adaptation et de la scolarisation, 48, 227-241. https://doi.org/10.3917/nras.048.0227

Venn, E., Park, J., Andersen, L. P., & Hejmadi, M. (2020). How do learning technologies impact on undergraduates' emotional and cognitive engagement with their learning? Teaching in Higher Education, 28(4), 822–839. https://doi.org/10.1080/13562517.2020.1863349 [ven 23] Venance Saho ZOH, Tiémoman KONE, Konan YAO (2023). Rôle des actifs du jeu dans la motivation des joueurs à travers la réalité virtuelle. Sciences Appliquées et de l'Ingénieur. Vol. 5, No1. http://publication.lecames.org/index.php/ing/article/view/29871

[Wes 90] Wesley M. Cohen; Daniel A. Levinthal (1990). Absorptive Capacity: A New Perspective on Learning and Innovation. Administrative Science Quarterly, Vol. 35, No. 1, Special Issue: Technology, Organizations, and Innovation. (Mar., 1990), pp. 128-152. https://josephmahoney.web.illinois.edu/BA545_Fall%202022/Cohen%20and%20Levinthal%20(1990).pdf

[Ven 96] Venkatesh, V. and Davis, F.D. (1996). “A Model of the Antecedents of Perceived Ease of Use: Development and Test,” Decision Sciences (27:3), 1996, 451-481. https://doi.org/10.1111/j.1540-5915.1996.tb00860.x

[Vya 22] Vyas-Doorgapersad, S. (2022). The Use of Digitalization (ICTs) in Achieving Sustainable Development Goals. *Global Journal of Emerging Market Economies*, *14*(2), 265-278. https://doi.org/10.1177/09749101211067295

[Val 23] Vallone, F., Galvin, J., Cattaneo Della Volta, M. F., Akhtar, A., Chua, S., Ghio, E., Giovazolias, T., Kazakou, Z., Kritikou, M., Koutra, K., Kovacevic, S., Lee-Treweek, G., Mašková, I., Mavritsaki, E., Nastic, J., Plassova, M., Stuchlíková, I., & Zurlo, M. C. (2023). Technostress and academic motivation: direct and indirect effects on university students' psychological health. Frontiers in psychology, 14, 1211134. https://doi.org/10.3389/fpsyg.2023.1211134

[Wan 22] Wang, X., & Huang, C. (2022). Conceptualization and Measurement of Flow in a Chinese Blended English as a Foreign Language Learning Context. Frontiers in psychology, 13, 839267. https://doi.org/10.3389/fpsyg.2022.839267

[Web 97] Webster, J., & Ho, H. (1997). Audience engagement in multimedia presentations. *Data Base*, *28*, 63-77. https://doi.org/10.1145/264701.264706

[Web 97] Webster, J., & Hackley, P. (1997). Teaching effectiveness in technology-mediated distance learning. *Academy of Management Journal*, *40*(6), 1282–1309. https://doi.org/10.2307/257034

[Wet 09] Wetzels, R., Raaijmakers, J.G.W., Jakab, E. et al. How to quantify support for and against the null hypothesis: A flexible WinBUGS implementation of a default Bayesian t test. Psychonomic Bulletin & Review 16, 752–760. https://doi.org/10.3758/PBR.16.4.752

Werner, H. (1946). The concept of rigidity: a critical evaluation. *Psychological Review*, *53*(1), 43–52. https://doi.org/10.1037/h0056454

[Wil 95] Wild, T. Cameron,Kuiken, Don,Schopflocher, Don (1995). The role of absorption in experiential involvement.Journal of Personality and Social Psychology, Vol 69(3), Sep 1995, 569-579. https://psycnet.apa.org/buy/1996-01315-001

[Yil 19] Yildiz, H. E., Murtic, A., Zander, U., & Richtnér, A. (2019). What fosters individual-level absorptive capacity in MNCs? An extended motivation–ability–opportunity framework. *Management International Review*, *59*(1), 93–129. https://doi. org/10.1007/s11575-018-0367-x

[Zho 12] Zhou, K.Z. and Li, C.B. (2012) How Knowledge Affects Radical Innovation: Knowledge Base, Market Knowledge Acquisition, and Internal Knowledge Sharing. Strategic Management Journal, 33, 1090-1102. https://doi.org/10.1002/smj.1959

[Zwa 19] Zwanenburg, Sander Paul Zwanenburg Paul, (2019). Focused Immersion: When Do Information Technology Affordances Disrupt It?. ACIS 2019 Proceedings. 52. https://aisel.aisnet.org/acis2019/52