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An Investigation on Information Technology Use: A Configurational Approach of Feature Use and User Experiences with Respect to Individual Performance

By

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Master of Science

User Experience

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HEC MONTRÉAL

Comité d'éthique de la recherche

Le 07 octobre 2022

À l'attention de :
Elise Labonté-LeMoyne

Projet # 2021-4153

Titre : Rédiger ensemble grâce à une application de formation à distance pour soutenir la persévérance et la réussite aux cycles supérieurs.

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Projet # : 2021-4153

Titre du projet de recherche : Rédiger ensemble grâce à une application de formation à distance pour soutenir la persévérance et la réussite aux cycles supérieurs.

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Maurice Lemelin
Président
CER de HEC Montréal

Signé le 2022-10-12 à 14:40

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Nom de l'étudiant(e) : Qingwen Gao

Titre du projet supervisé/mémoire/thèse : An Investigation on Information Technology Use: A Configurational Approach of Chrono's Features and User Experiences with Respect to Perceived Performance

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Date d'approbation initiale du projet : 05 octobre 2020

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Abstract

The COVID-19 pandemic stimulated the development and rise of a series of remote learning and online community web applications. This study focuses on the performance of IT use in the specific context of a web application named Chrono. The purpose of this exploratory research is to investigate and identify different combinations of the use of various features and quality perceptions of user experience (UX) that are associated to users' task performance with Chrono. Building upon the literature of information technology (IT) acceptance and use, as well as the theory of effective use (TEU) and the notion of features in use (FIU), this thesis develops rich conceptualization of effective IT use at the feature level. Specifically, in the context of Chrono, effective IT use is theorized in terms of two dimensions: the use of different features and individuals' quality perceptions of UX (i.e., pragmatic quality and hedonic quality). Survey data of forty-one (41) individuals, collected longitudinally at two points in time, were analyzed with a configurational approach, using fuzzy-set qualitative comparative analysis (fsQCA). The configurational approach, characterized by its equifinal properties, provides a comprehensive perspective for explaining and understanding the complex non-linear relationships of the use of different features, hedonic quality, and pragmatic quality that affect individual writing performance. The results of the configurational analysis confirm that the exclusive use of each different feature is not sufficient to reach good performance (i.e., above average and high perceived progress performance). In addition, when excluding the use of features, the presence of perceptions related to hedonic and pragmatic qualities by themselves alone does not suffice either to reach good performance. These findings also

underscore the significance of understanding effective IT use by considering both feature use and user experience perceptions holistically, as well as by the effect of such use on performance. Moreover, differentiating from traditional studies in the area that use variance-based methods, this study offers methodological implications by identifying complex combinations of variables capable of reaching the outcome. Furthermore, this thesis also provides theoretical implications for the IT use literature (e.g., theorization of effective use). It also offers practical implications for users, user experience, and the development of Chrono while discussing other avenues for future research.

Key Words

Web application, IT feature use, Effective use, Longitudinal study, Performance, Configuration, User experience, Hedonic quality, Pragmatic quality, fuzzy-set qualitative comparative analysis (fsQCA), Equifinality

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List of Abbreviations and Acronyms

ASU: Adaptive System Use

CCM: Cognition Change Model

COVID-19: Coronavirus Disease 2019

ECM: Expectation Confirmation Model

ECT: Expectation Confirmation Theory

EDT: Expectation Disconfirmation Theory

EFA: Exploratory Factor Analysis

FIU: Features in Use

FsQCA: Fuzzy-set Qualitative Comparative Analysis

HCI: Human Computer Interaction

HIS: Health Information Systems

IS: Information System

ISO: International Organization for Standardization

IT: Information Technology

NPO: Non-profit Organization

REB: Research Ethics Board

TAM: Technology Acceptance Model

TEU: Theory of Effective Use

TRA: Theory of Reasoned Action

UEQ: User Experience Questionnaire

UTAUT: Unified Theory of Acceptance and Use of Technology

UX: User Experience

Acknowledgments

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Chapter 1: Introduction

1.1 Research Context and Motivation

The COVID-19 pandemic disrupted education in over 150 countries and affected 1.6 billion students (Munoz-Najar et al., 2022). In response, many countries implemented diverse forms of remote learning through a variety of different channels. However, remote learning can be accompanied by loneliness and motivational challenges (Walker, 2010 & Vézina, 2016). For example, doctoral students and graduate students often face difficulties (e.g. loneliness, lack of support) that endanger their success chances, especially during academic writing stages. The writing stage is often fraught with pitfalls and moments of discouragement due to a sense of isolation, primarily because the writing phase is typically experienced alone (Levecque et al., 2017). For that reason, the benefits of a writing community can be significant. Students and/or researchers can find motivation and receive support from a writing community, enabling them to recognize each other's hard work within a writing group. Such a writing community can lead to an increased sense of flow, positive emotions, and enhanced creativity. Furthermore, studies have demonstrated the positive effects of writing in the presence of peers on a student's well-being (Papen & Thériault, 2018). However, physical co-writing spaces might not be accessible to all students due to financial, geographical, or pandemic-related limitations. This is where a virtual co-writing space could prove to be beneficial.

As can be seen from the Figure 1, Chrono, which embeds the group pomodoro (from the Italian word for tomato) methodology, is a new time management and community writing webapp launched in January 2022. The webapp can be accessed at: https://chrono.thesez-vous.org/. It is developed through a collaboration between researchers and Thèsez-vous, a non-profit organization (NPO) based in Quebec, Canada. Thèsez-vous specializes in creating physical human and virtual environments to facilitate scientific writing, supporting students (e.g., graduate students and doctoral students) and researchers in academic writing, from dissertation to thesis, including scientific articles, scholarship applications, session work, comprehensive exam, or the internship report (Thèsez-vous, 2023).

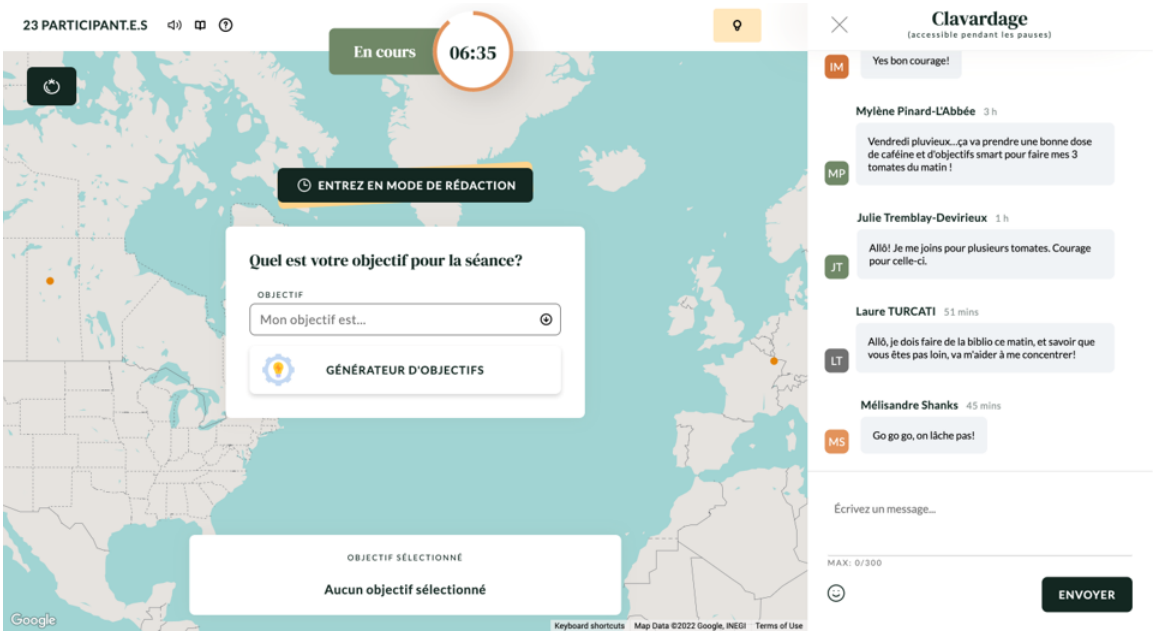

Figure 1: Chrono's home page

The Chrono offers a shared and fixed work timer: scheduled breaks happen every hour, on the hour, while each work period starts 10 minutes past the hour and ends 50 minutes later. Users can talk with each other with the text-based chat feature (only accessible during the break times). It adopts the pomodoro technique, a time management method developed by Francesco Cirillo in the late 1980s. Chrono also offers a geolocation feature, which allows users to see how many people are actively writing simultaneously and their geographic positions. Moreover, Chrono includes other supporting features such as a digital notebook for intrusive thoughts, a space to write precise objectives, and a random generator for objectives, as well as a session-based dashboard on recording objective achievements and tomato accomplishments. In addition, it is interesting to indicate that Chrono's user interface implements nudges (e.g., a pop-up suggestion providing strategies for enhancing writing focus, and a conspicuous objective generator located at the center of the webpage) to guide users write effectively and efficiently. This powerful tool is called digital nudging. Digital nudging is defined as "the use of user interface design elements to guide people's behaviour in digital choice environments" (Schneider et al., 2018, p. 68), and it can work by changing the design of user interfaces, such as modifying the presentation of the choice content or the visualization of the choices.

In summary, Chrono provides users with a feature to enter a digital environment (a virtual writing space with interaction) that enables them to write alongside students and/or researchers worldwide (the geo-localisation feature offers a real-time view of the students currently working). Furthermore, Chrono nurtures writing motivation through mutual

encouragement in its chat zone and facilitates the utilization of the pomodoro time management method to enhance writing productivity.

The rich and varied scientific literature on IT acceptance and use helps in evaluating the potential impacts of Chrono's use. First, a lot of the literature has investigated antecedents to IT acceptance, focusing primarily on whether an individual will use or continue to use a given IT without delving into the specifics of what occurs during its utilization (Ortiz de Guinea & Webster, 2013). Most research fails to study the performance impacts of IT use and has developed superficial conceptualizations of IT use (Benbasat & Barki 2007; DeLone & McLean, 2003). It often treats IT use as a black box and overlooks the fact that an IT involves diverse features. Second, some literature offers richer conceptualizations of IT use and highlights the need to look at how richer conceptualizations of IT use (e.g., that include different features and quality perceptions) relate to performance. For example, Ortiz de Guinea and Webster (2013) develop a rich conceptualization of IT use patterns as individuals' emotions, cognitions, and behaviors while employing an IT to accomplish work-related tasks and investigate how these patterns influence short-term performance. Third, additional literature pays attention to the notion of features in use (FIU) (Sun, 2012) and suggests studying IT use at the feature level (i.e., differentiating between use as a whole and the use of distinct features). Finally, the complexity of IT use suggests the need for alternative approaches to variance approaches predominantly employed in this literature. Meanwhile, the time management and community writing web applications, like Chrono, have not been studied in IT use. Thus, it would be interesting and meaningful to investigate IT use and its impacts on performance in the context of Chrono.

1.2 Research Objectives and Research Questions

The research objective of this thesis is to investigate the diverse configurations in which the use of different features and hedonic and pragmatic quality perceptions enable users to attain high performance in the context of Chrono. Furthermore, this research seeks to address the following question: What are the different combinations of Chrono features that users employ that, along with their perceptions of the pragmatic and hedonic qualities of Chrono, allow them to achieve the same level of perceived performance equally?

To answer this question, this study employs exploratory approach to investigate effective IT use in the context of Chrono. In doing so, a longitudinal study with a configurational analysis is performed.

1.3 Potential Research Contributions

Overall, this thesis attempts to unveil different configurations involving the use of different features and user experience perceptions (i.e., hedonic quality and pragmatic quality perceptions) that equally influence goal-oriented performance (i.e., effectiveness) within a specific context of Chrono.

In order to address the research gap found in IT use literature, this thesis focuses on IT use at the feature level by distinguishing different features of Chrono. Meanwhile, this thesis

conceptualizes effective IT use in a richer way (Burton-Jones & Grange, 2013; Burton-Jones & Straub, 2006) by considering the use of different features, hedonic quality perceptions, and pragmatic quality perceptions. With taking a configurational approach, this study offers various combinations of research variables that lead users to achieve optimal performance (such as high or above-average performance) when using Chrono for writing-related tasks. It allows for evaluating the user experience of Chrono and understanding the differences between the elements (i.e., the use of different features and user experience perceptions) that explain different levels of writing progress performance. Besides, the research can contribute to the ongoing development of Chrono. For instance, managers should prioritize investing in strategies (e.g., ethical digital nudging mechanisms) that encourage users to use features that align with their writing goals and guide users avoid use combinations associated to the absence of high performance.

1.4 Personal Contributions to the Research

Table 1: Student's contributions and responsibilities in the realization of this thesis

Steps in the Process	Contribution
Defining the research question	Identifying the gaps in the literature to define the main research problem – 85% Defining the research project's general directions and the research objectives – 85%
Theoretical background	Conducting in-depth research on scientific articles related to the topic – 100% Identifying the configurational research model to be used in the study – 75% My supervisor continuously offered feedback and guidance, which allowed to consolidate and refine the research model. Synthesizing the relevant literature and concepts for writing the articles – 80%

	I identified the articles to deeply understand the studies' concepts. My supervisor provided guidance on relevant literature.
Ethics	Preparing documentation related to application submission to the REB – 30% Thèsez-vous had already submitted and obtained approval from the REB for collecting the data of the longitudinal study. My supervisor helped me with the renewal of ethic certificate, and I was added as co-researcher to the project.
Recruitment	Recruitment of participants – 100% Creating online recruitment forms and emails (both English & French) – 90% My supervisor helped me with the French translation using a double-blind translation. I managed the communications (emails) of three waves data collection. Managing participants compensations – 100% Thèsez-vous provided me with the financial support of participants compensation.
Data collection	Following on participants' contribution to the study – 100% I followed up on participants to reduce the attrition rate of the longitudinal study as much as possible. Ensuring the appropriate functioning of the online questionnaires – 100% Ensuring the data quality and completeness – 100% During the second and third wave of data collection, I ensured participants had appropriately completed all questionnaires. Replying participants' email about the questionnaires (French) – 90% My supervisor helped me with the translation.
Analysis	Extracting and cleaning of data for analysis – 100% Conducting the factor analysis for the data – 100% Conducting the configurational analysis for the data – 100% Identifying and analyzing key results – 100% I received advice from my supervisor on how to holistically analyze configurational results.
Writing the thesis	Writing my thesis – 100% My thesis supervisor guided me through the entire process with detailed feedback allowing me to make the appropriate changes to improve the overall quality and coherence of my thesis.

1.5 Thesis Structure

This exploratory study comprises six chapters. The first chapter introduces the thesis by outlining its motivations and providing a brief overview of the thesis context – Chrono. Chapter 2 delves into the theoretical background, primarily focusing on the literature on effective IT use, involving the antecedents of IT use and the impacts of IT use on performance. In Chapter 3, the study theorizes and contextualizes the use of different features, user experience quality perceptions, and individual performance within the specific context of Chrono. Chapter 4 details the methodology employed in this thesis, encompassing research methods, data collection, sample selection, and measures for each research variable. Chapter 5 illustrates the application of the configurational analysis and presents the yielded results. Finally, Chapter 6 serves as the conclusion, summarizing the research findings, discussing implications for both research and practice, and identifying limitations while proposing avenues for future research.

Chapter 2: Theoretical Background

Since the research question deals with perceptions of features and information technology (IT) use, this section focuses on the literature on IT use. Given that this literature is extensive, this section revises on two main subsections notably the antecedents of IT use and the impacts of IT use on performance. Since IT use is a core construct in the information system (IS) research field, it has been studied at the individual, group, and organizational levels. This literature review narrows its focus to the individual level, aligning with the specific research question under examination in this thesis.

2.1 Antecedents of IT Use

Understanding the individual acceptance and adoption of information systems (IS) is crucial because the anticipated benefits of IS usage (e.g., effectiveness) cannot be realized if users do not initially accept and use these systems (Bhattacherjee & Sanford, 2006). It is vital to note that this thesis use the terms of use and usage interchangeably. In the IS field, there is a large volume of articles has explored IT use, with a primary focus on understanding the factors that influence intentions to use or accept new systems. The technology acceptance model (TAM) has been particularly influential in research on individual acceptance and adoption of information systems, which is used to examine the effects of user beliefs and attitudes on IS usage intention and behavior (e.g., Ajzen & Fishbein, 1977; Davis et al., 1989; Taylor & Todd, 1995; Venkatesh & Davis, 2000;

Venkatesh & Bala, 2008; Gefen & Straub, 2000; Kim et al., 2008). As introduced by Davis (1986), TAM explains the behavior of computer usage as resulting from intentions to use the IT, which are a function of perceived usefulness and perceived ease of use (Davis, 1989). TAM is derivate from on the theory of reasoned action (TRA) (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980). TRA is a cognitive theory that helps psychologists understand human behavior in specific contexts (Fishbein & Ajzen, 1975; Ajzen & Fishbein, 1980) and it has become the foundation to investigate individuals' IT usage behaviour (Kuo et al., 2015).

Over the years, the additions that have been made to TAM include constructs such as disconfirmation, information satisfaction, cognitive absorption, self-efficacy, job relevance, image, top management commitment, personal innovativeness, information quality, system quality, computer anxiety, computer playfulness, perceptions of external control, experience and voluntariness, etc. (e.g., Bhattacherjee & Sanford, 2006; Bhattacherjee & Premkumar, 2004; Abdullah & Ward, 2016; Venkatesh et al., 2003). In addition, TAM has been extended and revised to account for related research concerning IT acceptance and use. The unified theory of acceptance and use of technology (UTAUT) combines elements of TAM and other related models to summarize antecedents of intention to use a given IT into four factors: (1) performance expectancy, which is defined as the extent to which an individual believes that using the system will enable them to improve their job performance; (2) effort expectancy, which is "the degree of ease associated with using the system" (Venkatesh et al., 2003, p. 451); (3) social influence, which refers to the degree to which one perceives that significant others believe he or she should use the new

system; and (4) facilitating conditions, which is defined as “the degree to which an individual believes that an organizational and technical infrastructure exists to facilitate using of the system” (Venkatesh et al., 2003, p. 453). According to Venkatesh et al. (2003), UTAUT could provide managers with the ability to evaluate the likelihood of success for the acceptance of new technologies and gain insights into the factors that drive this acceptance. In fact, information system adoption is just the start of the overall IS success (Limayem et al., 2007). Any change in beliefs or attitudes will likely have a corresponding impact on and may even reverse users' continuance intention and behavior (Bhattacherjee & Premkumar, 2004). Moreover, TAM has evolved to explain why individuals continue to use a given system or software after initial acceptance has taken place. Serval studies (Chiu & Wang, 2008; Wu & Kuo, 2008; Vatanasombut et al., 2008) employed TAM and UTAUT for explaining IS continuance intention, continuance behaviors, and/ or combined IS continuance theories with acceptance theories within a singular model.

Besides these two acceptance models, TAM and UTAUT, the expectation confirmation theory (ECT) (Oliver, 1980) is broadly applied to elucidate user behaviors related to IS continuance (or discontinuance) and satisfaction (Bhattacherjee, 2001; Hossain & Quaddus, 2012). ECT is also known as expectation disconfirmation theory (EDT). Originally, ECT is used in most marketing research to provide an explanation on customer satisfaction, repurchase intentions, and complaining behaviors. However, in IS context, the traditional ECT has limitations in capturing products’ quality factors (system quality, information quality, and service quality) and explaining IS expectation formation process (Khalifa & Liu, 2004). In order to study users’ continued usage behavior of IS products,

Bhattacherjee's (2001) first proposed an expectation confirmation model (ECM) of IS continuance based on ETC and research findings from IS usage literature. ECM posits that an individual user's intention for continued use of an IS is dependent on three variables: the user's level of satisfaction with the IS, the extent of user's confirmation of expectations, and post-usage perceived usefulness (Bhattacherjee, 2001). Moreover, drawing upon EDT and IT usage literature, Bhattacherjee and Premkumar (2004) elaborate how users' beliefs and attitudes change during their IT usage and proposes a temporal model of belief and attitude change. In the context of continued IS usage, Limayem and Cheung (2008) extend ECM by incorporating the concept of habit and its major antecedents (i.e., frequency of prior behavior, satisfaction, stable context, and comprehensiveness of usage).

2.2 Limitations of Research on Antecedents of IT Use

2.2.1 Research Gap in the Literature

TAM and its extension have contributed greatly to understand the antecedents of IS usage. Nevertheless, studies that concentrate on the antecedents and consequences of IT use often overlook the examination of the usage construct itself and its consequences. As a result, this simplistic view of IT use has significant drawbacks (DeLone & McLean, 2003; Doll & Torkzadeh, 1998; Straub et al., 1995). Traditional research uses superficial conceptualizations of use, primarily explaining whether an individual will use (or continue to use) a given system based on behavioral beliefs (or evaluative perceptions of IS) (e.g.,

Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004; Venkatesh & Davis, 2000, Venkatesh & Bala, 2008; Gefen & Straub, 2000), but cannot describe what happens during the utilization of a system (Ortiz de Guinea & Webster, 2013). In summary, prior research exhibits three overall limitations. First, it views IT use as a dependant variable, thereby neglecting the investigation of performance impacts derived from it. Second, the existing conceptualizations of IT use have been criticized for being too simplistic, lacking the capacity to capture its richness (Benbasat & Barki 2007; DeLone & McLean, 2003). Third, the use of information technology has primarily been treated as a black box, with few attempts to differentiate usage among features, leading to inconsistent results regarding the consequences of such use, such as users' perceived performance (Ortiz de Guinea & Webster, 2013). While past research has investigated the use of various IT applications, it often fails to consider that IT applications comprise specific feature sets, focusing more on the overall use of certain applications rather than examining IT use at the feature level (Sun, 2012).

2.3 Impacts of IT Use on Performance

After identifying the research gap not addressed in previous literature, this subsection reviews related literature on the impacts of IT use on perceived performance, encompassing a richer conceptualization of IT use, the theory of effective use, quality perceptions of user experience, and individual performance. Additionally, this subsection provides an overview of how researchers define, conceptualize, and contextualize these terms. It further

emphasizes the importance of taking account of feature usage and user experiences within a given IT system when investigating the impacts of effective IT use on performance in a specific context.

2.3.1 IT Use

While research addressing antecedents of IT use (or acceptance) has predominantly focused on frequency-based conceptualizations, studies focusing on the impacts of IT use have conceptualized IT use in richer ways. Straub et al. (1995) conclude that IT use is typically conceptualized and measured through self-reported measures (i.e., subjectively) and computer-recorded measures (i.e., objectively). Cronbach (1971) states that IT use is a complex activity, involving a user, IS, and task over time. Similarly, Burton-Jones and Straub (2006) propose that IT use is an activity, comprising (1) a user, i.e., the subject using the IS, (2) a system, i.e., the artifact being used, and (3) a task, i.e., the function being performed. According to Burton-Jones and Straub (2006), the rich measure encompasses the nature of usage, including the system, user, and/or task, while the lean measure solely reflects overall usage itself. Thus, choosing relatively rich measures to capture IT use in a particular context is recommended by Burton-Jones and Straub (2006). However, measuring each usage element can be methodologically complex and difficult; hence, a two-step method has been developed for selecting measures of IT use. One is supposed to begin with select the most relevant elements of usage and then select measures of these

elements that are conceptually aligned with other construct(s) in the proposed theoretical framework or nomological network (Burton-Jones & Straub, 2006).

As it was explained before, from an individual level perspective, IT use is generally viewed as an overall behavior, measured through indicators such as frequency of use or duration of usage (e.g., Trice & Treacy, 1986; Davis et al., 1989; Venkatesh et al. 2008; Kim, 2009). Other researchers include affective and cognitive dimensions in the conceptualization of IT use. For example, researchers view IT usage as affect, measuring it via observations of users' wariness when interacting with an IS (Webster, 1998). Burton-Jones and Straub (2006) conceptualize and operationalize IT use via cognitive absorption and uses of different features (i.e., deep structure usage). Cognitive absorption refers to the extent to which a user is absorbed when using the system (Agarwal & Karahanna, 2000); deep structure usage represents "use of features in the IS that support the underlying structure of the task" (Burton-Jones & Straub, 2006, pp. 237-238). Moreover, richer conceptualizations of use add emotions to behaviors and cognitions. Ortiz de Guinea and Webster (2013) conceptualize IT use as a complex configurational pattern of different emotions, cognitions, and behaviors that occur together when an individual uses IT to accomplish a work-related task.

Overall, previous research widely acknowledges that IT use involves a user employing a system to perform a specific task. It emphasizes the importance of employing a richer way to contextualize and measure IT use, encompassing the system, task, user, and even

aligning with user's goals. Additionally, it also suggests that studying user experience or usability perceptions (e.g., pragmatic quality and hedonic quality) can be helpful to better understand IT use.

2.3.2 The Theory of Effective IT Use

Research on IT acceptance and use helps researchers learn the importance of user's attitudes, beliefs and behaviors when confronted with a new system; however, the use of a given IT is not per se sufficient to obtain benefits (Seddon, 1997). The use must be effective. That is, one need to effectively utilize IT to attain desired performance outcomes and benefits from IS implementation. To that end, the theory of effective use (TEU), derived from representation theory (Wand & Weber, 1990, 1995), is proposed by Burton-Jones and Grange (2013), as a point of departure from the previous conceptualization of IT use. TEU involves two main concepts: performance and effective use. Burton-Jones and Grange (2013, p. 633) define effective use as "using a system in a way that helps attain the goals for using the system (i.e., increasing performance)." Different from the idea emphasizing the rewards derived from overall usage (e.g., satisfaction), effective use focuses more on the benefits that stem from the way an IT is employed (Burton-Jones & Grange, 2013).

As it was just mentioned, Burton-Jones and Grange (2013) point out that effective use is based on representation theory (Weber, 1997), which states that the ultimate goal of an

information system is to faithfully provide representations of its target domain. To be specific, representation theory describes that the nature of an information system consists of three components: (1) deep structure, which conveys meaning about a domain to users, (2) surface structure, which provides facilities (such as a user interface) through which users can access the deep structure, and (3) physical structure, which is the machinery supporting the other structures (Burton-Jones & Grange, 2013). In order to gain benefits from an IT, a user must be able to access these representations through its surface and physical structure (Burton-Jones & Grange, 2013). TEU posits three dimensions that are meant to conceptualize users' ability to effectively employ IT in a given context. Firstly, transparent interaction represents “the extent to which a user is accessing the system's representations unimpeded by its surface and physical structures” (Burton-Jones & Grange, 2013, p. 642). Secondly, representational fidelity refers to “the extent to which a user is obtaining representations from the system that faithfully reflect the domain being represented” (Burton-Jones & Grange, 2013, p. 642). Thirdly, informed action refers to “the extent to which a user acts upon the faithful representations he or she obtains from the system to improve his or her state” (Burton-Jones & Grange, 2013, p. 642). It is worth noting that this thesis employs the theory of effective use as a guiding framework to explore the impacts of effective IT use on performance, rather than extensively delving into the various dimensions of TEU in relation to performance.

As Burton-Jones and Grange (2013) point out, building upon the work from Hartson (2003), representation theory can be linked with theory of affordances, as the foundation of TEU. An affordance is an action possibility formed by the relationship between an agent

and its environment (Gibson 1977, 1979). Over the years, the theory of affordances has attracted more and more attention and has been studied and contextualized in human-computer interaction (HCI) and IS research field (e.g., Gibson, 1979; Norman, 1999; McGrenere & Ho, 2000; Graver, 1991; Hartson, 2003; Zammuto et al., 2007). Hartson (2003) describes that an affordance is what an artifact offers someone; in addition, there are four distinguished types of affordances:

> "A cognitive affordance is a design feature that helps, aids, supports, facilitates, or enables thinking and/or knowing about something; a physical affordance is a design feature that helps, aids, supports, facilitates, or enables physically doing something; a sensory affordance is a design feature that helps, aids, supports, facilitates, or enables the user in sensing (e.g., seeing, hearing, feeling) something; a functional affordance helps or aids the user in doing something (e.g., accomplishing a goal) (Hartson, 2003, pp. 319-322)."

Over time, TEU has been extended, applied, and tested in different contexts. For example, Adenuga and Kekwaletswe (2017) developed a conceptual model for the effective use of health information systems (HIS) to examine the effective use of the HIS context and what drives effective use from the health partitioners' perspective. Choi and Tulu (2017) employ TEU to investigate the role of user interface design on facilitating effective use and examine its impacts on performance and users' perceptions about the IS in the context of

mobile application platforms. Moreover, Campbell and Roberts (2019) measure effective use and test its relationship with job performance in the context of analytic decision support systems. Additionally, through a field study of hospitals' digital transformation, Eden et al. (2019) make a comparison between theory-driven and context-driven approaches in operationalizing effective use.

Nevertheless, effective use is complex, encompassing diverse constitutive elements – such as users, systems, and tasks – and varying perspectives on goals from stakeholders (e.g., users, managers) when engaging with an information system. This complexity suggests that a configurational approach – that will be explained in the next section – to study effective use could be theoretically and practically useful. A configurational approach allows for the identification of different configurations of IT use (e.g., the use of features and quality perceptions of different features) capable of achieving the same level of a given outcome (Ortiz de Guinea & Webster, 2013). Within this thesis, employing the configurational approach means analyzing the various combinations of three elements – use of distinct features, hedonic quality, and pragmatic quality – that might interact in non-linear manners to equally achieve perceived performance (Woodside, 2017; Ortiz de Guinea & Raymond, 2020). In doing so, the configurational approach enables one to have a comprehensive and systemic perspective on the diverse pathways through which perceived performance can be attained.

Apart from that, other past research has investigated configurations of different elements (e.g., emotions, cognitions, and behaviors) in relation to performance. Ortiz de Guinea and Webster (2013) investigate IT use configurations of emotions (affect and physiological arousal), cognitions (computer-related thoughts and non-computer-related thoughts), and behaviors (exploitive behaviors and adaptive behaviors) that are modified and change during IT interactions and that relate differently to performance. Through conceptualizing IT use as configurational patterns and investigating them over time, this research demonstrates how an individual engages in different patterns of IT use that have different consequences for short-time performance (Ortiz de Guinea & Webster, 2013).

2.3.3 Use of IT Features

Some research has gone beyond previous conceptualizations of IT use (user-task-system) that treat IT as a black box, by taking into account that an individual usually employs a diverse set of features of a given IT to attain their goals (e.g., accomplish a task). This is done to overcome the fact that, most times, the use/usage construct is not disaggregated to explore the use of different features and how this different feature usage relates to performance, nor takes into consideration how perceptions of IT qualities (e.g., hedonic and pragmatic qualities) contribute to perceived performance. For example, Sun (2012) breaks this black box approach by delving into the exploration of different features included in the given technology that can help in accomplishing tasks. Studying IT use at the feature level can be instrumental in understanding why different users employ different

feature use patterns and the differential benefits they extract from using an IT application (Jasperson et al., 2005; Sun, 2012). Sun (2021, p. 455) defines features in use (FIU) as "the basket of system features that are ready to be used by a particular user to accomplish tasks". FIU represents a user's understanding of the IT in use, and it includes two aspects: the content (refers to which features are included in one's FIU) and the spirit of features (relates to how the features are used, separately or together, to achieve a goal) (Sun, 2012).

Moreover, Jasperson et al. (2005) emphasize the significance of adopting a feature-centric perspective on IT use, suggesting that individuals are likely to revise their usage of various features as they become more familiar with or utilize those features over time. Though exclusively from a theoretical viewpoint, Jasperson et al. (2005) posit that aligning the features of an application with the requirements of a specific work task can obtain positive performance benefits for individuals. Consequently, this research recommends that one could modify his or her behaviors after adopting an IT by selectively utilizing different features to benefit from the fit between the task and the technology. Likewise, Sun (2012) develops the concept of adaptive system use (ASU), which is defined as one's revisions regarding what and how features are used. ASU targets a given individual's FIU, and it is conceptualized as a user's revisions of which and how system features are used. As per Sun (2012), ASU involves two main dimensions: (1) revising the content of features in use, which represents a user's revisions regarding what features are used in his/her FIU; and (2) revising the spirit of features in use, refers to the user's revisions regarding how features are used. Furthermore, revising the content of FIU has two sub-dimensions, namely, trying new features and feature substituting; and revising the spirit of FIU also has two sub-

dimensions, namely, feature combining and feature repurposing (Sun, 2012). More specifically, trying new features represents adding new features to FIU and expanding the scope of FIU (Sun, 2012). Feature substituting refers to "replacing features in the FIU with other features with similar functionalities" (Sun, 2012, p. 456). Feature combining is defined as first-time application of FIU features together, and feature repurposing is defined as using features in the FIU in new ways (Sun, 2012). While this thesis does not investigate how users employ features initially and adapt by exploring and using (or discarding) other features, it primarily focuses on how users leverage different features (along with quality perceptions of UX) in distinct ways to equally attain good performance, and it is nonetheless influenced by the concept of FIU.

Additional research has been conducted to examine IT use at the feature level empirically (e.g., Hiltz & Turoff, 1981; Kay & Thomas, 1995; Straub et al., 1995). It shows that the use of IT features changes over time (e.g., Hiltz & Turoff, 1981; Kay & Thomas, 1995). For example, Hiltz & Turoff (1981), in their study of an electronic information exchange system, identify that the number of features considered "extremely valuable" or "fairly useful" varied with a user's experience in using the application. In addition, Benlian (2015) investigates how the use of IT features evolves over time with performance implications. The results show that when users start using an IT application for task accomplishment, IT feature use increases non-linearly over time with diminishing growth rates.

2.3.4 Quality Perceptions of User Experience

There is a growing interest and attention to user experience (UX), which has emerged as a comprehensive concept which offers a holistic perspective on how a user interacts with a given IT. The term "user experience" appeared in 1995, attributed to Don Norman. Code 9241-210 of the International Organization for Standardization (2019) defines UX as a person's perceptions and responses resulting from the use and/or intended use of a product, system, or service. However, there is no shared definition of user experience in the existing literature. The proposed definitions of user experience were inherent in the researcher's background and interests and could not be used as a standard definition. More specifically, there are three main reasons why defining user experience can be difficult. First, UX is associated with wide range of fuzzy and dynamic concepts, involving emotional, affective, experiential, hedonic, and aesthetic variables (Law et al., 2009). Second, the unit of analysis for UX can flexible, for instance, ranging from a singular interaction aspect of an individual user with an IT application to all aspects of multiple users' interactions (Law et al., 2009). Third, UX research is fragmented and complicated by diverse theoretical models with different foci such as pragmatism, emotion, affect, experience, value, pleasure, beauty, hedonic quality (Law et al., 2009).

Moreover, there is an increasing trend of research on the different aspects, dimensions and measurement methods associated to UX. Here, aspect refers to the quality attribute that has an impact on UX. According to Zarour and Alharbi (2017), aspects that affect UX can be characterized into four types. First, user's needs, which involve perceptions of the

pragmatic and hedonic qualities of an IS (Väätäjä et al., 2009; Sproll et al., 2010). Second, brand aspect, which relates to the marketing and the business communications between users and organizations. Third, technology aspect, which refers to the development and production technologies that affect the overall experience. Finally, the context of use, which refers to the aspect that is not related to any of the previous aspects but still influences or affects them (Zarour & Alharbi, 2017).

This thesis focuses on the aspect of user's need, and thus investigates the pragmatic and hedonic qualities of a given IT. Pragmatic quality encompasses utility and usability (instrumental) aspects in relation to a given task (Hassenzahl et al., 2008), while the hedonic quality involves the joy (while using) and emphasizes stimulation (i.e., novelty and change, personal growth), identification (i.e., communication of identity to relevant others, relatedness) and evocation (i.e., keeping of memories, symbolizing) brought about by the use of a given IT (Merčun & Žumer, 2017; Hassenzahl, 2003). Similarly, other researchers (e.g., Schrepp et al., 2017) claim that pragmatic quality includes aspects of perspicuity, efficiency, and dependability aspects, which relate to the goals (or tasks) achievement when using a product; whereas hedonic quality involves stimulation and novelty, which describes perception qualities pertaining to pleasure or fun while interacting with a product (Schrepp et al., 2017). Consistently, Beurden et al. (2011) define pragmatic quality as the extent to which a system allows for effective and efficient goal achievement and hedonic quality as the extent to which "a system allows for stimulation by its challenging and novel character or identification by communicating important personal values (p. 37)".

With regards to studies investigating the quality perceptions of user experience (i.e., pragmatic and hedonic qualities), Beurden et al. (2011) compare gesture-based interaction with device-based interaction in terms of pragmatic and hedonic quality. Their findings reveal that while device-based interfaces scored higher on perceived performance in general, and the mouse scored higher on pragmatic quality, gesture-based interfaces scored higher in terms of hedonic quality and fun. In addition, Tong et al. (2022) contribute to UX modeling by proposing a data-driven approach that automatically integrates hedonic and pragmatic qualities derived from online customer reviews.

Overall, this thesis takes user experience into consideration through user's perceptions of hedonic and pragmatic qualities following the adoption of Chrono. This helps better understand how a user perceives and values a given IT application (i.e., Chrono).

2.3.5 Individual Task Performance

This part reviews the concept of individual task performance concretely and relates what has already been explained in previous sections to it. A large and growing body of literature has investigated the impact of IT use on task performance at the individual level (e.g, Doll & Torkzadeh, 1998; Goodhue & Thompson, 1995; Igbaria & Tan, 1997; Lucas & Spitler, 1999; Pentland, 1989; Szajna 1993; Ortiz de Guinea & Webster, 2013). According to Meister (1986), task performance represents behaviors carried out to complete a job. There

is a consensus among researchers that one has to differentiate task performance between behavior and outcome aspects when conceptualizing it (e.g., Campbell, 1990; Sonnentag & Frese, 2002; Campbell et al., 1997). The behavior aspect deals with the actions taken to accomplish, while the outcome aspect deals with the consequences of one's behaviors. This thesis focuses on individual task performance as an outcome orientation (because the individual has complete control of their own task) (Burton-Jones & Straub, 2006; Beal et al., 2003). Moreover, effectiveness and efficiency are two dimensions of performance (Campbell, 1990; Beal et al., 2003). More specifically, effectiveness is typically evaluated concerning goal attainment (the extent to which the task results meet the task goals for using a given IT); in contrast, efficiency pertains to the level of goal attainment for a given level of input (such as effort or time) (Sonnentag & Frese, 2002; Campbell, 1990; Gattiker & Goodhue, 2005). This study focuses on the assessment for the outcome of a user's task performance in terms of effectiveness rather than efficiency.

As described on the preceding subsections, the complexity of effective IT use includes users, tasks and systems. Thus, there are diverse ways in which IT use has been explored and related to individual task performance. Burton-Jones and Straub (2006) empirically investigate the relationship between IT use (i.e., cognitive absorption, deep structure usage) and short-run task performance (effectiveness, i.e., the degree to which it meets the task goals) in cognitively engaging tasks. Their research demonstrates a positive relation between IT use and short-term performance. Burton-Jones and Grange (2013) explain dimensions of effective IT use (i.e., transparent interaction, representational fidelity, informed action) and their links with performance (effectiveness) by deriving a high-level

framework. Additionally, Ortiz de Guinea and Webster (2013) conceptualize IT use patterns (consists of an individual's emotions, cognitions, and behaviors) as a configurational construct while employing an IT to accomplish a task and illustrate how automatic and adjusting IT use patterns affects short-term task performance over time.

2.4 Conclusion

Overall, the goal of this chapter is to thoroughly explore prior literature, specifically delving into two focal topics: the antecedents of IT use and the impacts of IT use on performance, which necessarily includes the different ways in which IT use has been conceptualized. To summarize, effective IT use entails a user utilizing a particular IT to accomplish a task or reach a goal, a process that needs to be contextualized (Burton-Jones and Grange, 2013). In addition, it appears that there have been discussions regarding the performance impacts derived from IT use. Most past research views IT use as a whole, with a few exploring how the use of different dimensions of features (feature use) and the perceptions of hedonic and pragmatic qualities may lead to the same level of task performance. However, relations among variables are naturally complex, sometimes non-linear, and sudden changes can cause different results and outcomes (Urry, 2005). In this regard, most research employs variance-based approaches, which operate under the assumption of unifinality, positing that a single factor or a set of specific factors is both necessary and sufficient for a given outcome (Ortiz de Guinea & Raymond, 2020; Ortiz de Guinea & Webster, 2017). Therefore, to explore how performance can be achieved entails equifinality, which allows for different ways of reaching the same outcome (Meyer et al.,

1993; Gresov & Dazin, 1997). One way to accomplish this is to examine complex phenomena as clusters of interrelated conditions (Woodside, 2017), which offers a step towards a holistic and simultaneous understanding of the patterns these conditions create, by employing a configuration theory approach (El Sawy et al., 2010). Thus, configurational approaches can be useful to explain how different combinations of IT feature use and quality perceptions can equally lead to the same level of performance.

Chapter 3: Theorizing about Effective IT Use in the Context of Chrono

The purpose of this chapter is to theorize and contextualize the use of different features, perceptions of hedonic and pragmatic qualities, as they relate to perceived task (or progress) performance within the particular context of Chrono, employing a configurational approach. In doing so, this chapter emphasizes the need for an exploratory approach to comprehend the different configurations resulting in high perceived performance and delves into the distinction between a configurational approach and a variance approach.

3.1 Effective Use of Chrono

As it was explained in the preceding chapter, contextualizing IT use can be complex. Building upon the literature on IT use (e.g., Burton-Jones & Straub, 2006), the use of Chrono involves three vital elements, namely, the system (Chrono, the artifact that being used to help users perform a task), the user (Chrono's users), and the task (making writing progress). To be specific, Chrono's target users mainly include researchers, doctoral students, and graduate students; in addition, users' tasks are to make writing progress and accomplish their writing goals. In this thesis, IT usage on an individual level is defined as an individual users' employment of one or more features of Chrono to perform a task or achieve a goal (Burton-Jones & Straub, 2006). Furthermore, as per the theory of effective use (Burton-Jones & Grange, 2013), effective use of Chrono is defined as using Chrono in

a way that helps accomplish the writing goals (or tasks), and thus involves utilizing its various features along with user experience perceptions (i.e., hedonic and pragmatic qualities) in ways that accomplish specific writing goals.

As illustrated in Figure 2, thus effective use here is conceptualized as being composed of two dimensions: one behavioral and one perceptual. In other words, effective use encompasses the use of different features (feature use) of Chrono as well as quality perceptions in terms of the hedonic and pragmatic qualities of Chrono (Burton-Jones & Straub, 2006; Burton-Jones & Grange, 2013).

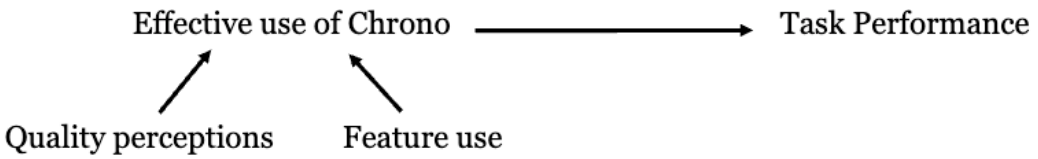

Figure 2: A contextualized model of effective use of Chrono and perceived progress performance

Applying Weber's (1997), and Burton-Jones and Grange's (2013) ideas on the conceptualization of a system, the system of Chrono can be considered from three structures: deep structure, surface structure, and physical structure. To be specific, deep structure conveys the meaning of writing progress improvement that offered by Chrono, and it relates to the extent to which the user is using the features of the system that support

the task's structure; Chrono provides user interface facilities, the surface structure (e.g., Chrono's UI and various features), allowing users to access the essence of Chrono; finally, Chrono also provides the machinery supporting the other structures, the physical structure, for instance, the networks and devices behind or support Chrono (Weber, 1997; Burton-Jones & Grange, 2013). As it was explained in the previous chapter, applying Hartson's (2003) ideas on the affordance theory, Chrono has two distinguished types of affordances. Chrono's diverse features can be framed as functional affordances, which help users to accomplish their writing goals and make progress. Because the perceptions of hedonic and pragmatic qualities conveyed by the system indirectly capture Chrono's cognitive affordances. The pragmatic and hedonic qualities of Chrono can be framed as cognitive affordances, which enable users to think or know the functions of features (Hartson, 2003).

In summary, this subsection investigates the effective use of Chrono as the interactions between the use dimension (includes the use of different features) of Chrono and (perceived) task performance.

3.2 Functional Affordances: Chrono's Features

Chrono is a time management and community writing web application, whose functional affordances manifest in various different features. Table 2 presents how this thesis distinguish different feature use in the context of Chrono. There are a total of ten different features. To clarify, the items pertaining to feature use are exclusively relevant due to the

different functionalities offered by the Chrono system's diverse features, each serving distinct purposes. Hence, these features can be distinguished into three dimensions, namely, writing support features, progress tracking features, and the writing mode feature. The writing mode feature is essential within Chrono as it enables users to initiate their writing sessions. Additional features complement this essential writing mode, offering further assistance to users during their writing process. More precisely, writing support features are tailored to assist users in gathering their writing notes and maintaining concentration on their tasks. Meanwhile, progress tracking features are designed to aid users in setting and monitoring their writing goals.

Table 2: Chrono's feature use

Chrono's Feature Use		
Names of Variables		**Features in Chrono**
Additional Features	Writing Support Features (t1)	· Pay attention to the pop-up suggestions when pressing the feature "*Enter the writing mode*" · Use the feature "*Write down an idea*" · Press the feature "*Leaving the tomato*" · Download the ideas noted in the session · Pay attention to the feature "*Objectives completed during the session*" · Pay attention to the map · Use the feature "*Chat*"
	Progress Tracking Features (t1)	· Use the feature "*Objectives*" · Pay attention to the number of "*Accomplished tomatoes*"
Essential Feature	Writing Mode Feature (t1)	· Press the feature "*Enter the writing mode*"

As shown in Figure 3, there are three Chrono's features, namely, "*Enter the writing mode*", "*Write down an idea*" and "*Objectives*". Figure 4 demonstrates the pop-up suggestions when a user press the feature "*Enter the writing mode*". In addition, Chrono's feature of "*Leaving the tomato*" can be seen in Figure 5. Figure 6 displays Chrono's other two features of "*Objectives completed during the session*" and "*Tomatoes completed*", as well as the feature that enables ideas to be noted during the session. Finally, Figure 7 shows Chrono's "*Chat*" feature along with a map that allows users to view real-time information about the number of people actively writing and their geographic positions. It is important to note that these figures (or screenshots) are all from the website of Chrono (Chrono, 2023).

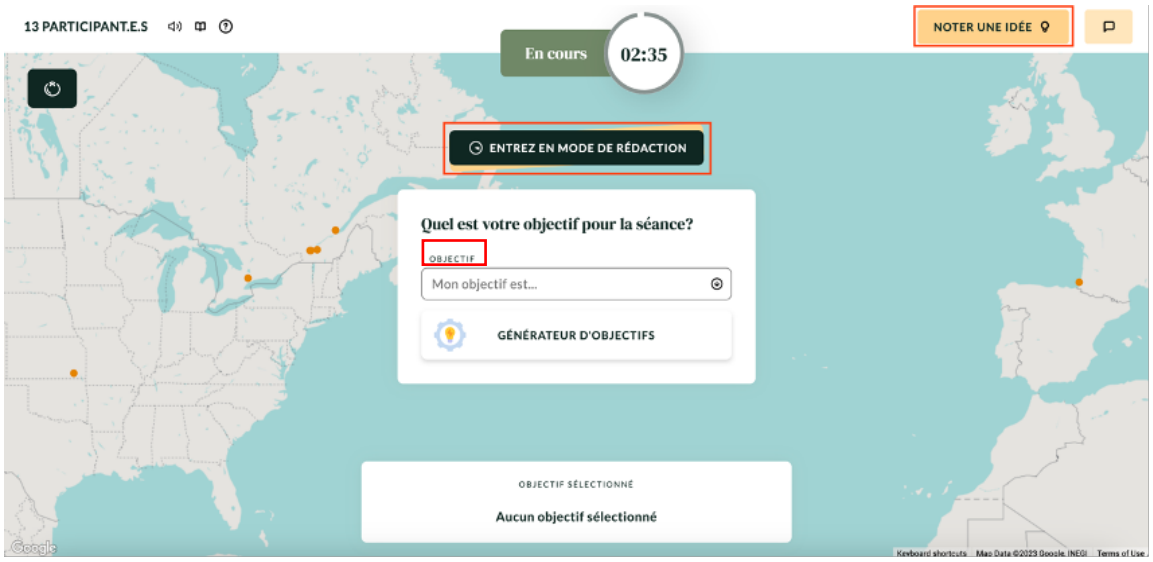

Figure 3: Chrono's features of *"Enter the writing mode", "Write down an idea"* and *"Objectives"*

Figure 4: The pop-up suggestions when pressing the feature "*Enter the writing mode*"

Figure 5: Chrono's feature of *"Leaving the tomato"*

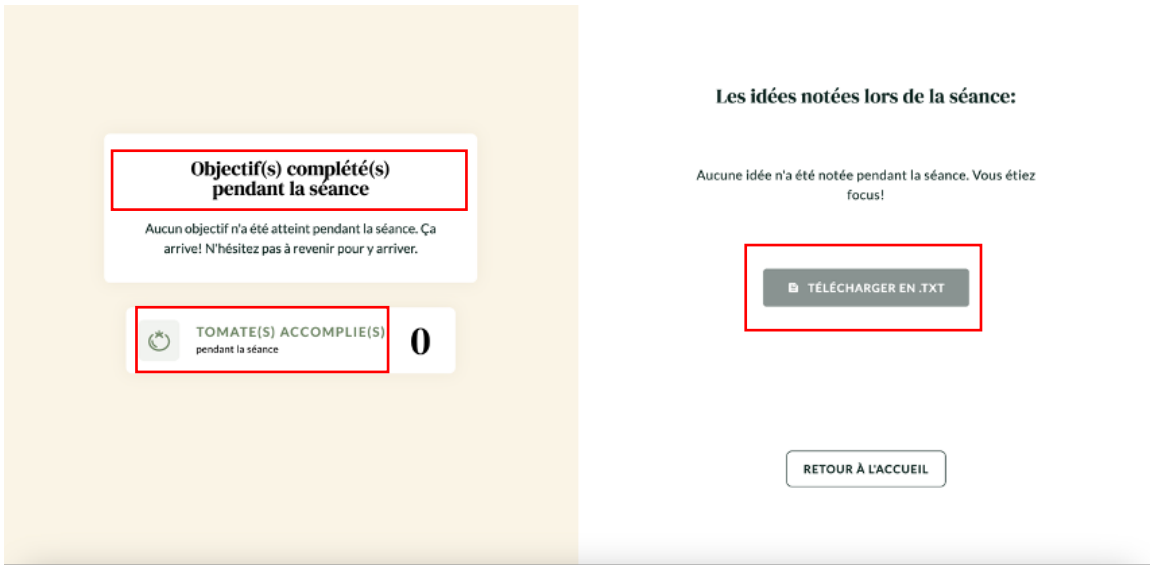

Figure 6: Chrono's features of *"Objectives completed during the session", "Tomatoes completed*", and the feature that allows users to download the ideas noted in the session

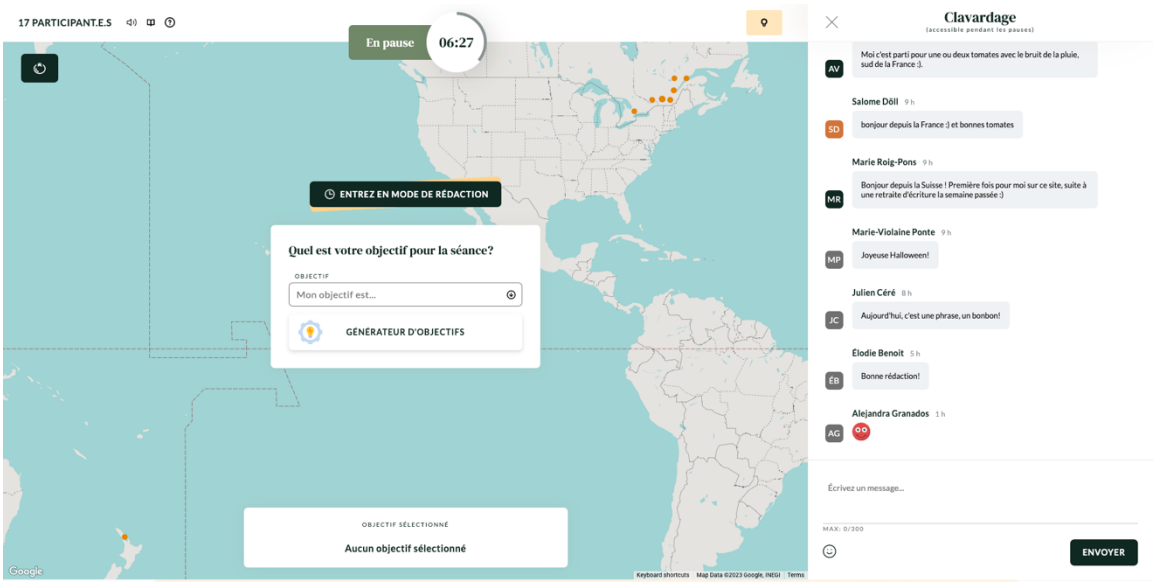

Figure 7: Chrono's features of *"Chat"* and the map

Similar to other research (e.g., Sun, 2012), this study investigates the use of diverse features. Sun (2012) indicates that FIU includes the content and the spirit of features. In the case of Chrono, the content of FIU refers to three different dimensions of features (i.e., writing support features, progress tracking features, and the writing mode feature); and the spirit of FIU refers to the way (e.g., separately, or together) that these features are used to accomplish a user's writing goals. In addition, according to Sun (2012), different feature also has their own intents, which can be convinced as its spirit. However, this thesis is interested in studying features' content rather than spirit.

According to Sun's (2012) insights on the four types of ASU behaviors (i.e., trying new features, feature substituting, feature combining, and feature repurposing), users employ Chrono to accomplish their writing goals, they perform various ASU behaviors probably to different extents. Multiple ASU types can coexist within a specific context. Within the context of Chrono, users may selectively mix features (e.g., writing support features, progress tracking features, and the writing mode feature) and employ different combinations of these features; sometimes features may be repurposed, substituted, or even used in a novel way. The complexity involved in using various features in distinct ways to achieve a goal indicates the need for a configurational approach to comprehend effective IT use at the feature level.

3.3 Cognitive Affordances: Quality Perceptions of Chrono's User Experience

UX has emerged as a comprehensive concept that provides a holistic perspective on users' interactions with a given IT. In addition to IT use at the feature level (feature use), this thesis also focuses on assessing the user experience of Chrono, specifically emphasizing two primary quality perceptions: hedonic quality and pragmatic quality, grounded in UX research. According to Hartson (2003), the cognitive affordances of Chrono manifest in its hedonic and pragmatic qualities. With regards to the dimension of pragmatic (instrumental) quality, it has to do with the writing assignments and goals a user has for Chrono (Schrepp et al., 2017). In contrast, the dimension of hedonic (non-instrumental) quality is associated with pleasure or fun while using Chrono (Schrepp et al., 2017).

3.4 Perceived Progress Performance in Chrono

As the task is a crucial component of effective IT use, the idea of task performance is contextualized to the context of Chrono, and thus involves perceived progress performance. This thesis defines perceived progress performance as the extent to which an individual perceives they are accomplishing their tasks and attaining their writing goals (Meister, 1986; Sonnentag & Frese, 2002; Burton-Jones & Straub, 2006). Perceived progress performance evaluates a user's short-term writing performance, focusing on effectiveness in goal achievement. As described by Campbell (1990) and Beal et al. (2003), effectiveness is the outcome orientation of the performance. Perceived progress performance examines the extent to which a user's task outcomes align with their prescribed writing goals while utilizing Chrono. Given that Chrono is designed as a time management and writing

community web application, the way that measure users' perceived progress performance needs to consider this fact; thus, as per Burton-Jones & Straub (2006), time management, writing productivity, and daily goal achievement are three dimensions included in perceived progress performance.

3.5 Exploratory Analysis and Configurational Approach

This research takes an exploratory approach to identifying and understanding the different combinations of the use of the different dimensions of features (i.e., writing support features, progress tracking features, and the writing mode feature) and UX perceptions (i.e., hedonic and pragmatic qualities) capable of attaining high perceived progress performance. This exploratory approach, also known as exploratory research and exploratory analysis, is a valuable approach to gain initial insights into a topic, generate hypotheses, and unveil patterns or trends (Swedberg, 2020). Exploratory studies come in two forms: the first is to research a topic that has not been explored before, while the second is to delve into an existing topic to generate new ideas and hypotheses, although without the ability to fully verify them (Swedberg, 2020). Accordingly, an exploratory study can serve two primary purposes. One is to enhance the knowledge and understanding of a little-known topic that needs to be better known, and the other one is to generate new and interesting hypotheses about a topic that is already known (Swedberg, 2020). Although there is a great wealth of literature on IT use, most of it has primarily taken a variance approach; thus, it does not offer insights into the diverse roles that each element can potentially play. In this thesis thus, it is particularly useful to employ exploratory research in situations as there is limited

prior knowledge about the subject in its distinct context (i.e., understanding the diverse combinations of Chrono's feature use and users' quality perceptions of UX contributing to good performance).

Therefore, the research model is based on configurational thinking, which differs from the predominant variance theory approach. Variance-based approaches (e.g., correlation, regression) assume that relations among variables are linear. In variance approaches, relations between variables are modeled independently by an arrow, and thus, variance approaches are suitable for investigating outcome changes in dependent variables due to predictor ones (Ortiz de Guinea & Webster, 2017). However, they cannot explain the changes in the system's elements and the interplay of these elements that lead to a given outcome (Wilden et al., 2016; Ortiz de Guinea & Raymond, 2020). As a result, while variance approaches evaluate the net impact of each independent variable on a dependent one, the configurational approach evaluates the different and non-linear ways in which independent variables can combine effectively to equally achieve the same level of the outcome (Ortiz de Guinea & Raymond, 2020).

This means that, in contrast to variance approaches, configurational approaches allow for equifinality and causal asymmetry (Ortiz de Guinea & Raymond, 2020; Fiss, 2011). As per complexity theory (Pappas et al., 2016; Woodside, 2014) and configurational theory (Fiss et al., 2013), equifinality describes the possibility that the same outcome of interest could be reached through different paths and from diverse starting positions (Fiss, 2011; Gresov

& Drazin 1997; Ortiz de Guinea & Raymond, 2020). In addition, causal asymmetry involves the possibility that leading to the presence of an outcome of interest may be quite different from those leading to the absence of the outcome (Fiss, 2011; Ragin, 2008). Therefore, through the application of a configurational approach, this thesis can identify multiple different configurations that might equally result in high performance and where the same element might play different causal roles (e.g., enabler or inhibitor). Furthermore, within the context of Chrono, the configurational approach involves a systems perspective in which the three different elements (i.e., use of different features, hedonic quality, and pragmatic quality) are viewed in holistic fashion (Ortiz de Guinea & Raymond, 2020).

3.6 Research Model

The complexity of effective IT use (conceptualized herein as use of Chrono's features and quality perceptions of UX) suggests that a configurational approach to study perceived progress performance could be theoretically and practically useful. To conceptualize these asymmetric relations, this thesis proposes an exploratory theoretical model, based on configurational theory. The model presented in Figure 6 captures such configurational thinking and includes the key research constructs. As it is shown in the figure, the model is longitudinal, meaning that it explores "predictors" at one point of time, and performance at a later time. More specifically, the research model reflects the idea that different configurations of feature use (additional and essential features) as well as quality

perceptions of UX (hedonic and pragmatic qualities) at one time (t1) may lead to perceived progress performance at a later time (t2).

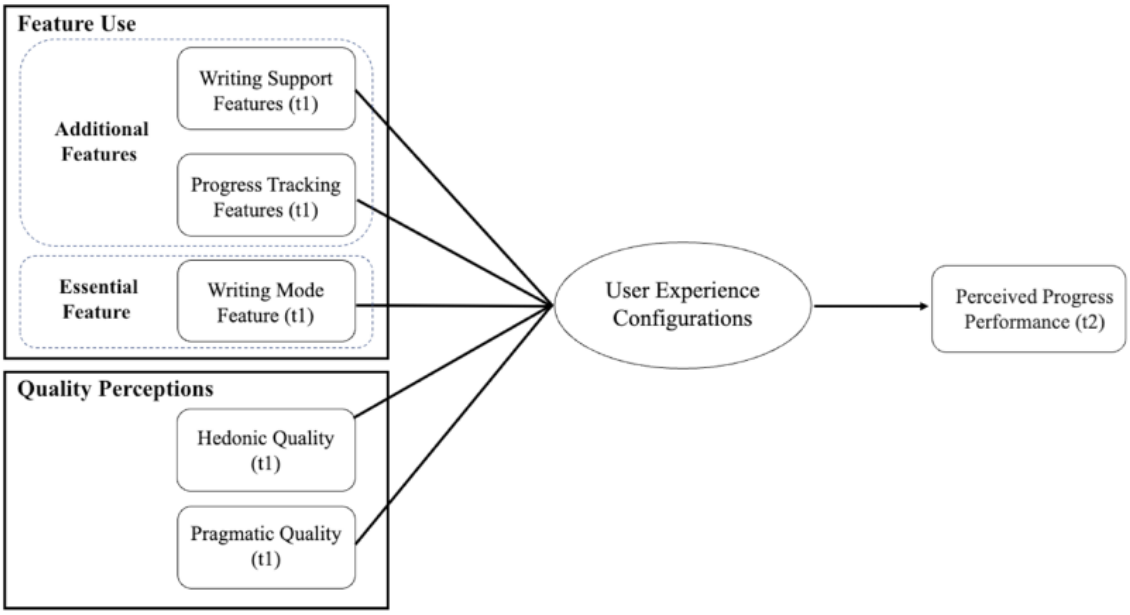

Figure 8: Configurational model of perceived progress performance

3.7 Conclusion

This chapter advances an exploratory and configurational theoretical framework that encompass feature usage, user experience quality perceptions, and performance within the context of Chrono. To arrive at it, it compares the configurational approach with the variance approach, emphasizing the importance of employing the configurational approach to identify and comprehend the patterns of different elements in relation to the same outcome. This theoretical approach aligns well with the objective of the thesis and allows

to uncover diverse configurations that enable users to achieve high progress performance in the specific context of Chrono.

Chapter 4: Methodology

4.1 Longitudinal Survey and Data Collection

In order to study the diverse ways in which feature usage in Chrono and users' perceptions of its Chrono's UX quality, aiming to attain high perceived progress performance, this research employs a longitudinal survey-based data collection approach. The self-reported data of users' beliefs and behaviors was longitudinally collected via the administration of online questionnaires. One reason to use longitudinal data is to separate antecedents from their outcomes; so that if they relate to each other, it is not because they are captured at the same time. The survey research method is chosen because, when properly conducted and controlled, it delivers well-structured data that can be later analyzed in a relatively accurate fashion. Moreover, the study's inclusion criteria encompass individuals who correspond to Chrono's target demographic. Specifically, those proficient in both speaking and reading French, capable of accessing Chrono via digital devices, and capable of using Chrono for writing tasks during their study participation.

For the recruitment strategy, a convenience and voluntary sampling method was employed. It is crucial to emphasize that the community language of Thèsez-vous (Chrono) is French. The measures included in the survey were translated to French using a double-blind translation. Furthermore, the language utilized throughout the data collection process (e.g.,

follow-up emails, recruitment messages, and questionnaires) is exclusively French. Recruitment messages were posted through three leading platforms: the chat zone of Chrono, class group chats, and the Facebook group of Thèsez-vous (i.e., Thèsez-vous Ensemble). People who were interested in this study would be invited to fill out their email addresses in the recruitment survey by Qualtrics (https://www.qualtrics.com).

It is worth noting that at the beginning of the data collection phase, this research planned to longitudinally collect three waves of surveys; however, due to the sample sizes being lower than anticipated – as it will be explained later – this research finally utilized the data from the first two questionnaires for the data analysis.

When the data collection started, questionnaires were administered via e-mails to participants at three different points in time within three weeks. The interval between sending questionnaires was one week. The first wave (t1) of the questionnaire was administered shortly after the launch of Chrono; after a week, the second wave (t2) was sent to participants who completed the first questionnaire; and after another week, the third wave (t3) was administered to participants who filled out the second questionnaire. The users consented to participate in this research via an information letter that outlined the purpose of the study and provided a hyperlink to the first online survey form. The first questionnaire collected participants' demographic information, feature use and their quality perceptions (i.e., hedonic quality and pragmatic quality) of Chrono. In the second questionnaire (t2) and third questionnaire (t3), the survey content was same, which focalized on the self-reported assessment of perceived progress performance.

In addition, it is critical to state that a pretest of the questionnaires took place before starting data collection. A total of 9 researchers and students participated in the pretest. Based on the pretest, some fine-tuning changes were implemented in the questionnaires to ensure all the questions were easy to understand for the participants. Moreover, as an incentive, all respondents were informed that each time they completed a questionnaire, they would have an opportunity to register in a drawing of e-gift cards prize from Les libraires.com.

4.2 Sample

A total of sixty-two (62) participants completed the first questionnaire; and forty-one (41) participants filled out the first and second questionnaires. A total of thirty-three (33) respondents participated in all three-round questionnaires of data collection. It is important to note, however, that the data analysis only employed a total of forty-one (41) participants who completed both the first and second waves of questionnaires and discarded the third wave due to its lower sample size. The limited responses may be attributed to the longitudinal nature of this study, which risked experiencing panel (participants) attrition.

Thus, the final research sample to be analyzed was composed of a total of forty-one (41) participants. The demographic characteristics are as follows: Their age ranges between 26

and 55 (the median age is 32) and comprises three (3) men, thirty-five (35) women, and two (2) non-binarities, with one (1) person not disclosing their gender. Their level of education corresponds precisely to the target population of the Thèsez-vous community, with twenty-four (24) respondents being Ph.D. students, sixteen (16) respondents having already earned a master's degree, and one (1) post-doctoral student. The research received ethical approval from the Research Ethics Board (REB) at HEC Montréal.

4.3 Measures

The different dimensions of feature use and quality perceptions, as per their contextualization in the Chrono context (Table 3), were measured at t1; and the outcome perceived progress performance was measured at t2.

Table 3: Research variables

Research Variables		
Feature Use	Additional Features	Writing Support Features (t1)
		Progress Tracking Features (t1)
	Essential Feature	Writing Mode Feature (t1)
Quality Perceptions	Hedonic Quality (t1)	
	Pragmatic Quality (t1)	
Outcome	Perceived Progress Performance (t2)	

With respect to feature use, three distinct measures were employed to capture the frequency of use of Chrono's various features with the same approach as Burton-Jones & Straub (2006), with a 7-point scale from 1 ("never") to 7 ("every day"). The use of the essential writing mode feature was measured by one item. As per additional features, seven (7) items measured the use of writing support features, and two (2) items captured the use of progress tracking features. To evaluate the two dimensions of quality perceptions (pragmatic and hedonic quality), Schrepp et al.'s (2017) pre-validated scale of the short version of the user experience questionnaire (UEQ) was adopted. The measure of pragmatic quality was composed of four items that capture the instrumentality of certain features intended to help users attain their writing goals. The second dimension of quality perceptions, hedonic quality, was measured by four items capturing the qualities that related to pleasure.

Finally, consistent with the performance measurement literature (e.g., Meister, 1986; Sonnentag & Frese, 2002; Campbell, 1990), this thesis measures individual perceived progress performance as an assessment of individual writing progress in terms of effectiveness, i.e., the degree to which it meets the writing task goals. Thus, perceived progress performance was measured with three items capturing time management, writing productivity, and daily goal achievement, following the work of Burton-Jones & Straub (2006), with a 7-point Likert scale anchored from 1 ("strongly disagree") to 7 ("strongly agree"). The questionnaire items used to measure the research variables are included in Appendix A.

Chapter 5: Analyses and Results

This chapter consists of two parts. The first part focuses on the psychometric properties of measures. The second part includes the configurational analysis (i.e., fuzzy-set qualitative comparative analysis) and the interpretation of results.

5.1 Properties of Measures

Given that, building upon the effective use literature, this thesis contextualized IT feature use with different dimensions accounting for the specific context of Chrono, an exploratory factor analysis (EFA) was first conducted on the ten (10) items measuring the frequency of use of the different Chrono features (see Table 4). EFA allows to evaluate whether the theoretical dimensions of the features hold empirically.

5.1.1 Exploratory Factor Analysis

According to Arrindell and Van der Ende (1985), EFA can be used to determine the factor and factor loading of measured variables, and to confirm what is expected on the basic or pre-established theory. In this study, an EFA was performed using a principal component analysis and the varimax rotation method with SPSS. As can be seen from the Table 4, three key factors were extracted. The thresholds used in this thesis for factor loading cut-offs is 0.70 (MacCallum et al., 1999, 2001). The factor loadings above 0.70 appear in bold

in Table 4. More precisely, for the first column (dimension), there are four factor loadings of use items exceeding 0.70, namely, t1_Feature_Q2, t1_Feature_Q6, t1_Feature_Q8, and t1_Feature_Q9. For the second dimension, there are two use items, namely, t1_Feature_Q4 and t1_Feature_Q10. The third dimension has only one item that its value is above 0.70, t1_Feature_Q1. As Table 4 shows, the highlighted items that load above 0.70 in their reflective factors, also have low loadings on the other remaining factors. For example, for t1_Feature_Q1, its factor loading on the third dimension is 0.844, higher than 0.70; by comparison, its loadings on the first and second dimensions are low (i.e., below 0.50).

Table 4: Exploratory factor analysis: rotated varimax component matrix

Use Items	Features in Chrono	Factors		
		1	2	3
t1_Feature_Q1	Q1: Press "*Enter the writing mode*"	0.077	0.384	**0.844**
t1_Feature_Q2	Q2: Pay attention to the pop-up suggestions when pressing "*Enter the writing mode*"	**0.793**	0.411	-0.074
t1_Feature_Q3 *	Q3: Pay attention to the map	-0.092	0.274	-0.645
t1_Feature_Q4	Q4: Use the feature "*Objectives*"	0.180	**0.820**	-0.072
t1_Feature_Q5 *	Q5: Use the feature "*Chat*"	0.507	-0.412	0.190
t1_Feature_Q6	Q6: Use the feature "*Write down an idea*"	**0.925**	0.118	0.106
t1_Feature_Q7 *	Q7: Press the feature "*Leaving the tomato*"	0.686	0.126	0.442
t1_Feature_Q8	Q8: Download the ideas noted in the session	**0.945**	0.051	0.036
t1_Feature_Q9	Q9: Pay attention to the "*Objectives completed during the session*"	**0.709**	0.556	0.132
t1_Feature_Q10	Q10: Pay attention to the number of "*Accomplished tomatoes* "	0.162	**0.857**	0.133

* *Note.* Three items (t1_Feature_Q3, t1_Feature_Q5, and t1_Feature_Q7) were not kept for the main configurational analysis that follow because they loaded below the 0.70 cut-off in the factor analysis.

As conceptualized, three dimensions were identified by EFA. Dimension 1 includes items t1_Feature_Q2, t1_Feature_Q6, t1_Feature_Q8 and t1_Feature_Q9, which correspond to writing support measures. Dimension 2 comprises items t1_Feature_Q4 and t1_Feature_Q10, corresponding to progress tracking features. Dimension 3 includes item t1_Feature_Q1, which captures the writing mode feature. This corresponds to the contextualized feature use with different dimensions, explained in chapter 3, except for these three use items: t1_Feature_Q3, t1_Feature_Q5, and t1_Feature_Q7 (removed due to the low factor loadings).

5.1.2 Reliability and Validity of the Measures

Table 5: Reliability and intercorrelations of the research variables

Variable	Reliability	Intercorrelations					
	α	1.	2.	3.	4.	5.	6.
1.Writing Support Features (t1)	.924	-					
2.Progress Tracking Features(t1)	.737	.475	-				
3.Writing Mode Feature (t1)	- -	-.005	.256	-			
4.Hedonic Quality (t1)	.743	.121	.396	.443	-		
5.Pragmatic Quality (t1)	.811	-.001	.283	.451	.622	-	
6.Perceived Progress Performance (t2)	.906	.068	.183	.311	.068	.424	-

Note.

α Cronbach's alpha reliability coefficient

Table 5 presents the reliability and intercorrelations of all research variables. Reliability is concerned with the ability of an instrument to measure consistently (Tavakol et al., 2008). The reliability of the measures was assessed using Cronbach's alpha coefficient, while intercorrelations show the statistical associations or relationships between different

measures or variables as an identification of discriminant validity. The Cronbach's alphas show acceptable indices of internal consistency of all variables as they exceed the cut-off threshold of 0.70 (Pappas et al., 2016). More specifically, the variable writing support features comprises four (4) items, with a Cronbach's alpha of 0.924. Progress tracking features include two (2) items, with a Cronbach's alpha of 0.737. For the variable writing mode feature, there is a single item, and Cronbach's alpha thus is not applicable. In addition, hedonic quality is composed of four (4) items with a Cronbach's alpha of 0.743. The variable pragmatic quality initially consisted of four (4) items that yielded a Cronbach's alpha of - 0.135. Thus, one item of the pragmatic quality measure was removed from further analysis. As a result, the revised Cronbach's alpha for this variable is 0.811, indicating that the removal of that item significantly improved the overall reliability of the scale. Finally, the variable perceived progress performance has three (3) items and demonstrates a Cronbach's alpha of 0.906.

Finally, as shown in Table 5, all the intercorrelations between the variables of interest are lower than 0.50 demonstrating discriminant validity, except for a correlation of 0.622 between pragmatic quality and hedonic quality, which makes sense since the two are somewhat intertwined as dimensions of the user experience as developed by Schrepp et al.'s (2017).

5.2 Configurational Analysis

Once the reliability and validity of the measures were established, a configurational analysis of the exploratory research model was performed to identify different configurations of distinct use of different features, hedonic quality, and pragmatic quality that could equally result in good progress performance. To do so, a fuzzy-set qualitative comparative analysis (fsQCA) technique was employed to conduct configurational analysis and identify such configurations, as fsQCA assumes complex and nonlinear causality (Fiss, 2011) and allows for equifinality and causal asymmetry (Liu et al., 2017; Ortiz de Guinea & Raymond, 2020; Fiss, 2011). Moreover, this tool is useful for various types of data, and it can be applied across a wide range of sample sizes, from very small (less than 50 cases) to very large (thousands of cases) (Pappas & Woodside, 2021).

In a nutshell, employing fsQCA facilitates configurational analysis and aligns with the research objective and question of this thesis. It offers a comprehensive way of analyzing the interconnections and dependencies among various components within a configuration and the context in which the configuration operates. In addition, fsQCA utilizes Boolean algebra to identify different combinations of conditions equally capable of attaining the same (Ragin, 2000, 2008).

5.2.1 Calibration

In fsQCA, variables need to be calibrated to form fuzzy sets with values ranging from 0 to 1 to express different degree of membership into the set (Ragin, 2000,2008). This is done

by specifying three membership thresholds: fully in, representing a full membership in a fuzzy set; fully out, representing the cut-off for full non-membership in a fuzzy set; and cross-over, representing the point of maximum ambiguity (Pappas & Woodside, 2021).

While calibrating research variables, this thesis established three membership thresholds, based on percentiles, as recommended in the fsQCA literature (Dul, 2016; Plewa et al., 2016). That is, this research sets the top quartile value (the 75th percentile) across cases as the threshold for full membership, the median (the 50th percentile) as the cross-over point, and the bottom quartile value (the 25th percentile) as the threshold for full non-membership. To determine values in the dataset that correspond to the 75th, 50th, and 25th percentiles, percentiles were employed through SPSS. It is worth noting (in Table 6) that, however, for the research variable writing mode feature, since the 50th percentile was 7.00, equal to the value for the fully in (the 75th percentile), the middle point between 7.00 and 6.0 (fully out) was selected as the value for maximum ambiguity (crossover).

Table 6: Calibrations and descriptive statistics of the research variables

Configurational element [range]	*Fuzzy Set Calibrations* [a]						
	Fully in	Crossover	Fully out	Mean	SD	Max	Min
Writing Support Features (t1) [1-7]	6.50	5.00	4.00	5.00	1.48	7.00	1.00
Progress Tracking Features(t1) [1-7]	7.00	6.00	5.00	5.57	1.47	7.00	1.00
Writing Mode Feature (t1) [1-7]	7.00 [c]	6.50 [b]	6.00	6.32	1.16	7.00	3.00
Hedonic Quality (t1) [1-7]	6.25	5.75	5.00	5.66	0.84	7.00	3.75
Pragmatic Quality (t1) [1-7]	5.50	5.25	4.75	5.09	0.44	5.50	4.00
Perceived Progress Performance (t2) [1-7]	6.33	5.67	5.00	5.61	1.12	7.00	2.67

Note.

a: Calibration thresholds: [fully in= top quartile, crossover=median, fully out=bottom quartile].

b, c: Given that 50th percentile was 7.00 and thus, equal to the value for the fully in (75th percentile), the middle point between 7.00 and 6.00 (fully out) was chosen as the value for maximum uncertainty (cross-over).

Presented in Table 6 are the descriptive statistics and fuzzy set calibration thresholds for the causal variables or elements forming the configurations and for the outcome variables. After identifying the three threshold values for each research variable, a nonlinear stepwise logistic function embedded in the fsQCA software was used to translate all cases of these variables into a fuzzy set (Liu et al., 2017; Ragin & Davey, 2017; Ragin, 2008; Thiem, 2014).

5.2.2 Necessity Analysis

The necessity analysis is usually the first step to perform in fsQCA software (Ragin, 2000), which identifies whether any of the causal conditions is a necessary (or indispensable condition for the presence or absence of high perceived progress performance (i.e., high or not high perceived progress performance), respectively (Pappas, 2018). Specifically, Table 7 presents the results of necessity analysis for the presence of high perceived progress performance. Table 8 presents the results of necessity analysis for the absence of high perceived progress performance. A condition is necessary when its consistency score is above 0.9 (Schneider & Wagemann, 2012; Schneider et al., 2010). Consistency evaluates the extent to which cases that are members in a condition also show membership in the outcome (Ragin et al., 2006). That is, consistency allows one to evaluate whether a given configuration is consistently associated with an outcome (e.g., users achieving high progress performance) (Park et al., 2020).

Table 7: Analysis of necessary elements for the presence of high progress performance

Configurational element	High Perceived Progress Performance (t2)	
	Consistency	Coverage
Writing Support Features (t1)	0.530	0.620
Writing Mode Feature (t1)	0.801	0.701
Progress Tracking Features(t1)	0.600	0.744
Pragmatic Quality (t1)	0.725	0.832
Hedonic Quality (t1)	0.677	0.726

Table 8: Analysis of necessary elements for the absence of high progress performance

Configurational element	~High Perceived Progress Performance (t2)	
	Consistency	Coverage
Writing Support Features (t1)	0.540	0.466
Writing Mode Feature (t1)	0.515	0.333
Progress Tracking Features(t1)	0.365	0.335
Pragmatic Quality (t1)	0.305	0.258
Hedonic Quality (t1)	0.448	0.354

As shown in Table 7 and Table 8, with regards to the presence of high perceived progress performance, consistency values range from 0.530 to 0.801; and for the negation of high perceived progress performance, consistency values range between 0.305 and 0.540. Here, the terms of absence and negation (indicated by '~') can be used interchangeably (Fiss, 2011; Pappas, 2018). The consistency scores indicate that none of the causal conditions exceed 0.9. That is, no single element was found to be individually necessary for reaching high or not high perceived progress performance (Schneider & Wagemann, 2012; Schneider et al., 2010).

5.2.3 Sufficiency Analysis

After calibrating all research variables, the subsequent step is to generate the truth table and run the fuzzy-set algorithm. It is at this point that the fsQCA technique initiates its configurational analysis. The truth table computes all possible configurations (or combinations) that may occur, producing 2^k rows, with k representing the number of outcome predictors, and each row representing every possible combination (Pappas et al., 2016; Pappas & Woodside, 2021). The truth table is then sorted and refined by frequency and consistency (Pappas et al., 2017; Ragin, 2008; Pappas & Woodside, 2021), where frequency represents the number of observations for each possible configuration (Pappas et al., 2017, 2019) and consistency describes "the degree to which cases correspond to the set-theoretic relationships expressed in a solution" (Fiss, 2011, p. 402). According to Pappas & Woodside (2021), a higher frequency threshold means that each configuration pertains to more cases in the sample, but reduces the percentage (i.e., coverage) of the explained (by the retained configurations) sample. Conversely, a lower frequency threshold increases the coverage of the sample, while each combination refers to a smaller number of cases in the sample (Pappas & Woodside, 2021). Given that the research sample of this thesis is relatively small (i.e., samples smaller than 150 cases), the recommended frequency threshold is 2 (Fiss, 2011; Ragin, 2006); hence, the frequency threshold was set here at 2, and all configurations with a smaller frequency were removed for further analysis. Furthermore, the final step while working on the truth table is to use the consistency thresholds to choose 1 or 0 defining if a combination explains the outcome or not.

According to Ragin (2006), Liu et al. (2017), and Ragin (2008), in general, the minimum recommended threshold of consistency for solutions should not be less than 0.75; thus, this study applied the recommended threshold of 0.75 for consistency. Consequently, for configurations above the consistency threshold, the outcome variable was set at 1 (because these configurations are the ones that fully explain the outcome) and for the rest was set at 0 (Pappas, 2018; Pappas et al., 2019). It is important to note that the results show good properties, and the consistency of results (all calculated solutions in this thesis) is above the guideline of 0.81 threshold.

Sufficiency analysis aims to check whether there are configurations (that is, combinations of causal conditions) that are sufficient for the outcome (Ragin, 2000, 2008). FsQCA computes three solutions, namely complex solution, parsimonious solution, and intermediate solution (Pappas, 2018; Pappas & Woodside, 2021). The complex solution represents all possible configurations of conditions when traditional logical operations are applied (Pappas et al., 2019; Pappas & Woodside, 2021). The number of identified configurations and complex solutions generally can be very large; and thus, the complex solution is further simplified into parsimonious and intermediate solutions (Mendel & Korjani, 2012; Pappas & Woodside, 2021). The parsimonious solution yields the "core" conditions (the most important conditions or elements) that cannot be left out from any configuration (Fiss, 2011; Pappas et al., 2019; Pappas & Woodside, 2021). Apart from that, the intermediate solution is obtained when performing counterfactual analysis on the complex and parsimonious solutions (Liu et al., 2017; Pappas & Woodside, 2021; Pappas et al., 2019; Ragin, 2008). The conditions that are not part of the parsimonious solution

but are part of the intermediate solution are called “peripheral” conditions or elements (Fiss, 2011; Pappas et al., 2019; Pappas & Woodside, 2021). Peripheral elements indicate a weaker relationship with the outcome, whereas core elements indicate a stronger one (Fiss, 2011).

To interpret the resulting solutions, a combination of the parsimonious and intermediate solutions allows for a more detailed and aggregated view of the findings (Fiss, 2011; Pappas et al., 2016; Pappas & Woodside, 2021; Ortiz de Guinea & Raymond, 2020). This requires one to identify the conditions of the parsimonious solution and that also appear in the intermediate solution, bringing about combined solutions that clearly present all core and peripheral elements (Fiss, 2011; Pappas et al., 2016). Moreover, it is crucial to approach the interpretation of configurations holistically. Theoretically, holistic interpretation provides a broader understanding of complex relationships and patterns that may remain hidden when examining individual components in isolation (El Sawy et al., 2010; Woodside, 2017; Ortiz de Guinea & Raymond, 2020). Furthermore, it provides a comprehensive understanding of the context in which Chrono operates. From a practical perspective, a holistic view enables researchers to recognize that an element may be vital for producing the desired outcome in one configuration but irrelevant or even counterproductive in another (Ortiz de Guinea & Raymond, 2020). In the context of Chrono, this approach helps identify opportunities for improving and optimizing Chrono's features, which may not be evident when assessing individual features in isolation.

Before delving into the interpretation of resulting configurations, the used notation for the solution tables needs to be illustrated. Typically, the presence of a condition is indicated with a black circle (●) and the absence/negation of a condition is indicated with a crossed-out circle (⊗). Also, blank spaces represent an immaterial condition, i.e., a 'don't care' situation in which the condition may be either present or absent without altering the outcome. Note here that large circles represent core conditions, small circles indicate peripheral ones (Fiss, 2011; Ragin et al., 2006).

The following paragraphs illustrate the results of the principal analysis, encompassing two sufficiency analyses: causal configurations for the presence of high perceived progress performance and causal configurations absence of high perceived progress performance.

Table 9 shows the fsQCA analysis of the user experience quality perceptions and feature use at t1, leading to high perceived progress performance at t2, which results in a solution with four equifinal configurations. Within this analysis, the raw coverage, or the proportion of cases (in terms of fuzzy membership value) that can be described by each configuration is between 0.109 to 0.366 (Ragin, 2000; Ortiz de Guinea & Raymond, 2020). The unique coverage, or the proportion of cases (in terms of fuzzy membership value) that can be described by a configuration appearing in a solution set but cannot be described by any other configuration from the set is between 0.032 to 0.268 (Ragin, 2000); Ortiz de Guinea & Raymond, 2020). The consistency values (to see whether there is a condition or variable that by itself is necessary or sufficient for the outcome) are above 0.81 for all configurations (Ragin et al., 2006). Moreover, the overall solution consistency is 0.934, and the overall

solution coverage, or the proportion of cases (in terms of fuzzy membership value) that can be described by at least one configuration in a solution set, is 0.609 (Ragin, 2000).

Table 9: Causal configurations for the presence of high progress performance

Configurational element			**High Perceived Progress Performance (t2)**			
			HP1	**HP2**	**HP3**	**HP4**
Feature Use	Additional Features	Writing Support Features (t1)		●	⊗	⊗
		Progress Tracking Features (t1)	●	●	⊗	●
	Essential Feature	Writing Mode Feature (t1)	●	●	●	⊗
Hedonic Quality (t1)			•	•	⊗	•
Pragmatic Quality (t1)			⊗		●	●
Conditions tested						
Consistency			0.817	0.917	0.989	0.940
Raw coverage			0.131	0.366	0.182	0.109
Unique coverage			0.032	0.268	0.129	0.070
Overall solution coverage			0.609			
Overall solution consistency			0.934			

Note.

● : Presence of a core condition *• : Presence of a peripheral condition*

⊗ : Absence of a core condition *⊗ : Absence of a peripheral condition*

Blank: 'don not care'

The first configuration, HP1, reaching high perceived progress performance at t2 is defined by specific conditions at t1. These conditions include high hedonic quality (peripheral condition), low pragmatic quality, and the use of writing mode feature and progress

tracking features (core conditions), with or without the use of writing support features (immaterial condition). The second configuration, HP2, shares similarities with the first one, as it is characterized by high hedonic quality (peripheral condition) and the use of writing mode feature (core conditions). Nevertheless, HP2 differs from HP1 in that it involves the use of all additional features (core conditions). The third configuration, HP3, is characterized by low hedonic quality and high pragmatic quality and the use of writing mode feature (core conditions), along with the absence of the use of the additional features (peripheral conditions). Moreover, the fourth configuration, HP4, involves high pragmatic quality (peripheral condition), high hedonic qualities, and the use of progress tracking features (core conditions), without the use of writing mode feature and writing support features.

From a holistic perspective, concerning HP1, combined with a lack of pragmatic quality, high hedonic quality and the use of writing mode and progress tracking features are sufficient to yield high perceived progress performance, regardless of whether writing support features are used. As per HP2, achieving high perceived progress performance is guaranteed when there is a combination of high hedonic quality and the use of both essential and additional features. In the case of HP3, the use of the essential writing mode feature, along with high pragmatic quality, is sufficient to bring about high perceived progress performance, when the other features (i.e., writing support and progress tracking features) are not used and hedonic quality is in absence. Regarding HP4, with the use of progress tracking features, high pragmatic and hedonic qualities are sufficient to attain high perceived performance, although writing mode and writing support features are not in use.

These results point to equifinality, meaning that there are four different ways in which users can equally achieving high perceived progress performance with Chrono (Ortiz de Guinea & Raymond, 2020).

Furthermore, to gain additional knowledge, this study computed configurations for the absence of high perceived progress performance (see Table 10). Just like before, a necessity analysis was first performed to identify if any of the causal conditions was a necessary condition for the absence of high perceived progress performance. As shown in Table 8, none of the consistency scores of the causal conditions are above 0.9. Hence, to achieve not high perceived progress performance, no single condition stands as a sole necessity.

Table 10: Causal configurations for the absence of high progress performance

Configurational element			**Not High Perceived Progress Performance (t2)**
			NHP1
Feature Use	Additional Features	Writing Support Features (t1)	●
		Progress Tracking Features (t1)	
	Essential Feature	Writing Mode Feature (t1)	⊗
Hedonic Quality (t1)			⊗
Pragmatic Quality (t1)			⊗
Conditions tested			
Consistency			0.910
Raw coverage			0.332
Unique coverage			0.332
Overall solution coverage			0.332
Overall solution consistency			0.910

Note.

● *: Presence of a core condition* ● *: Presence of a peripheral condition*

⊗ *: Absence of a core condition* ⊗ *: Absence of a peripheral condition*

Blank: 'don not care'

With respect to the absence of high perceived progress performance at t2, Table 10 presents the sufficiency analysis that yields one configurational result. With regards to the outcome, the raw coverage is from 0.332. The unique coverage is between 0.332. In addition, the overall solution consistency is 0.910, and the overall solution coverage is 0.332. The configuration NHP1, is characterized by using the writing support features (core condition) itself, without high pragmatic and hedonic qualities (peripheral conditions) and the absence of the use of writing mode feature (core condition), and regardless of whether the use of progress tracking features is at a high or low level (immaterial condition). That is, it appears that the exclusive use of writing support features cannot achieve high perceived progress performance.

Up until this point, this study has examined the different configurations capable of achieving high perceived progress performance and those incapable of achieving it. The configurations presented in Tables 9 and 10 provide support for causal asymmetry, implying that the configurations responsible for reaching high perceived progress performance may differ from those leading to the absence of this outcome (Fiss, 2011; Ragin, 2008; Ortiz de Guinea & Raymond, 2020). In addition, they also show that the causal role of each element is not fixed; it may vary across multiple configurations,

depending on its interdependencies with other elements in the configurations (Fiss, 2011; Ragin & Fiss 2008, 2017); an element may be essential for producing the outcome of interest in one configuration but may be irrelevant or even counterproductive in another configuration (Meyer et al. 1993; Park et al., 2020; Ortiz de Guinea & Raymond, 2020).

5.2.4 Post Hoc Analysis

While percentiles classify each participant's responses in relation to the others', calibrating based on means can make results comparable across studies. Given the exploratory nature of this research, and the fact that the fsQCA literature also employs the mean as a calibration anchor (instead of percentiles), this thesis recalibrated the data and conducted post hoc analysis. The post hoc analysis presents fsQCA analysis with the mean-based calibration, following the process that explained in the earlier paragraphs. It would be interesting to unveil the configurations that may result in above-average perceived progress performance. Table 11 shows the recalibrations and descriptive statistics of the same research variables. The full membership threshold was fixed at the value of mean (across cases) plus one (if mean is above 6, then 7 would be used as threshold for full membership); the full non-membership threshold was fixed at the value of mean minus one; and the cross-over point was fixed at the value of mean.

Table 11: Recalibrations and descriptive statistics of the research variables

Configurational element [range]	*Fuzzy Set Calibrations* [a]						
	Fully in	Crossover	Fully out	Mean	SD	Max	Min
Writing Support Features (t1) [1-7]	6.00	5.00	4.00	5.00	1.48	7.00	1.00
Progress Tracking Features(t1) [1-7]	6.57	5.57	4.57	5.57	1.47	7.00	1.00
Writing Mode Feature (t1) [1-7]	7.00	6.32	5.32	6.32	1.16	7.00	3.00
Hedonic Quality (t1) [1-7]	6.66	5.66	4.66	5.66	0.84	7.00	3.75
Pragmatic Quality (t1) [1-7]	6.09	5.09	4.09	5.09	0.44	5.50	4.00
Perceived Progress Performance (t2) [1-7]	6.61	5.61	4.61	5.61	1.12	7.00	2.67

Note.

a: Calibration thresholds: [fully in= mean+1 (if mean>6, then 7), crossover=mean, fully out=mean−1].

As it can be seen from the results of necessity analysis (in Table 12), for the presence of above average perceived progress performance, consistency scores range from 0.564 to 0.832, which are below 0.9. That is, no single element, alone, can be considered necessary for achieving above average perceived progress performance (Schneider & Wagemann, 2012; Schneider et al., 2010).

Table 12: Analysis of necessary elements for the post hoc analysis

Configurational element	Above-average Perceived Progress Performance (t2)	
	Consistency	Coverage
Writing Support Features (t1)	0.564	0.641
Progress Tracking Features (t1)	0.709	0.724
Writing Mode Feature (t1)	0.832	0.707
Pragmatic Quality (t1)	0.772	0.833
Hedonic Quality (t1)	0.697	0.758

Table 13 reveals configurations capable of attaining above-average perceived progress performance at t2. This additional analysis yields a solution with four equifinal

configurations on users' perceived progress performance at above-average level. With regards to the analysis results, the raw coverage is from 0.164 to 0.396. The unique coverage is between 0.038 and 0.158. The consistency values, or the extent to which a given configuration is a sufficient condition for the outcome, are above 0.920 for all configurations (Ragin et al., 2006). The overall solution consistency is 0.935, and the overall solution coverage is 0.699. The first configuration, AHP1, is characterized by high pragmatic quality, low hedonic quality (core conditions), the absence of using writing support features and the presence of using the writing mode feature (peripheral conditions), with or without the use of progress tracking features (immaterial condition). The second configuration, AHP2, involves high hedonic and pragmatic qualities, the use of progress tracking features, along with the absence of the use of writing mode feature, regardless of writing support features (core conditions). Moreover, the third configuration, AHP3, involves high hedonic quality and the use of both essential feature (peripheral condition) and additional features (i.e., writing support and progress tracking features), and regardless of pragmatic quality (immaterial condition). Finally, the fourth configuration, AHP4, is similar to the second in that it is characterized by high pragmatic and hedonic qualities (core conditions). However, AHP4 is different from AHP2 in that there is also the presence of using writing mode and writing support features.

Table 13: Causal configurations for the presence of above average progress performance

Configurational element			Above-average High Perceived Progress Performance (t2)			
			AHP1	AHP2	AHP3	AHP4
Feature Use	Additional Features	Writing Support Features (t1)	⊗		●	●
		Progress Tracking Features (t1)		●	●	
	Essential Feature	Writing Mode Feature (t1)	•	⊗	•	•
Hedonic Quality (t1)			⊗	●	●	●
Pragmatic Quality (t1)			●	●		●
Conditions tested						
Consistency			0.983	0.946	0.927	0.957
Raw coverage			0.254	0.164	0.386	0.396
Unique coverage			0.158	0.086	0.042	0.038
Overall solution coverage			0.699			
Overall solution consistency			0.935			

Note.

● *: Presence of a core condition* • *: Presence of a peripheral condition*

⊗ *: Absence of a core condition* ⊗ *: Absence of a peripheral condition*

Blank: 'don not care'

From a holistic view, according to AHP1, pragmatic quality and the use of writing mode feature are sufficient to reach above average progress performance, without hedonic quality and the use of writing support features. Regarding AHP2 and AHP4, high hedonic and pragmatic qualities are required to combine with the use of writing mode and writing support features to be capable of attaining above-average perceived progress performance. When the use of the essential writing mode feature is absence, high hedonic and pragmatic qualities need to combine with the use of progress tracking features to yield the same

results. In case of AHP3, using both essential and additional features are not sufficient for attaining above-average perceived progress performance, without hedonic quality.

Interestingly, the principal analysis is further supported by the post hoc analysis, as the results align with those of the principal analysis. There are three main results from the analyses. Firstly, when the use of additional features and hedonic quality are absent, pragmatic quality and the use of writing mode feature are important for achieving above average and even high level of performance (i.e., HP3, AHP1). Secondly, when the essential writing mode feature and additional features (i.e., writing support and progress tracking features) are used, the presence of hedonic quality is the key to reaching both above average and high perceived progress performance (i.e., HP2, AHP3). Finally, when progress tracking features are utilized, and the writing mode feature is not in use, without the essential writing mode feature, high hedonic and pragmatic qualities are sufficient to achieve above average performance. Building on this, even in the absence of writing support features, high perceived performance can still be achieved (i.e., HP4, AHP2).

All in all, in the specific context of Chrono, this chapter describes how the fsQCA was used to perform configurational analysis, addressing the research question of this study. Consequently, this thesis has yielded various configurations concerning the use of three dimensions of features, pragmatic quality, and hedonic quality – each equally capable of achieving perceived performance at the high (not high or above average) level.

Chapter 6: Discussion and Conclusion

This final chapter provides an overview of the results and insights obtained through configurational analysis with respect to the research objective and question of this thesis. Additionally, this section also discusses implications for research and practice, limitations of the study, and avenues for future research.

6.1 Summary of Findings

The purpose of this exploratory research was to identify, in the context of Chrono, various combinations of use of different features (i.e., writing mode feature, writing support features, and progress tracking features) and UX quality perceptions (i.e., hedonic and pragmatic qualities) could equally result in attaining high performance. In doing so, this thesis examined the antecedents of IT use by problematizing the research gap within the existing literature and offered a richer conceptualization of IT use (that includes the use of different features and hedonic and pragmatic qualities). Meanwhile, it adopted configurational approaches to capture, understand, and explain the complexity within Chrono's use. In contrast to traditional studies that employ variance-based methods, the configurational analysis allows for equifinality and causal asymmetry (Ortiz de Guinea & Webster, 2013; Fiss, 2011). Thus, from a configurational approach and by employing the fsQCA technique, this research provides a comprehensive perspective for understanding diverse configurations of the use of different features, hedonic quality, and pragmatic

quality equally leading to a high (and above-average) level of writing performance (Fiss, 2011).

Overall, there are three main findings concerning how both above-average and high perceived progress performance is achieved: (1) the exclusive use of both essential and additional features is not sufficient to reach good performance (i.e., above-average and high perceived progress performance); (2) when excluding the utilization of the three feature dimensions, the presence of perceptions related to hedonic and pragmatic qualities alone does not suffice either to reach above-average (or high) performance; and (3) high pragmatic quality, in combination with the use of the essential feature, is sufficient to result in a high level of perceived progress performance.

6.2 Implications for Research

This study and its results have several theoretical implications that contribute to the literature on IT use. As noted earlier, this thesis pointed out the main limitations of the past literature in IT use. First, traditional research applies superficial conceptualizations of use (Benbasat & Barki, 2007; DeLone & McLean 2003), primarily explaining whether an individual will use (or continue to use) a given IT (e.g., Bhattacherjee, 2001; Bhattacherjee & Premkumar, 2004). For this reason, most past research treats IT use as a black box and cannot describe what happens during the utilization of an IT (Ortiz de Guinea & Webster, 2013). To fill this research gap and building upon on the literature on IT use and the theory of effective use (Burton-Jones & Grange, 2013), this study developed a configurational and

richer conceptualization of effective IT use, consisting of the use of different features and the quality perceptions of user experience. Second, most prior research also overlooks the fact that a given IT comprises multiple features (Sun, 2012) and fails to investigate the performance impacts derived their use. To address this research gap, this thesis additionally differentiated IT use among distinct features and took a configurational approach, exploring the different ways in which users attain performance while employing Chrono to accomplish a writing-related task (or goal). Overall, within the context of Chrono, this thesis delves into the importance of considering both feature usage and user experiences (i.e., perceptions) when investigating the impacts of IT use on performance.

In addition, this thesis offers alternative approaches to variance approaches predominantly employed in the IT use literature. Specifically, this study employed configurational approaches and offered a systems perspective in investigating effective IT use and its impacts on performance. Different from variance approaches, configurational approaches allow for equifinality and causal asymmetry (Ortiz de Guinea & Raymond, 2020; Fiss, 2011). One can explore different configurations that equally lead to an outcome of interest (e.g., high task performance) and where the same element might play different causal roles (Ortiz de Guinea & Raymond, 2020). To conduct the configurational analysis, the fsQCA technique was applied to examine the asymmetric relationships among the research variables. Instead of identifying the unique contribution of each variable for performance, this method allows to identify complex configurations of variables equally capable of achieving high performance. In other words, this study can be instrumental in understanding how different aspects of the user experience – behavioral and perceptual –

can be integrated for reaching an outcome of interest and the differential benefits they extract from using the given IT (Jasperson et al., 2005; Sun, 2012; Burton-Jones & Straub, 2006).

6.3 Implications for Practice

In addition to the theoretical implications, this thesis also offers practical implications. This subsection describes the practical implications from three perspectives and the findings of this study would be generalizable to instrumental settings where adoption is not mandatory. First, from the point of view of Chrono, this thesis brings useful insights in the ways of using Chrono effectively at the feature level, with taking user experience into consideration. The research findings highlight the importance of combining the use of Chrono's diverse features (e.g., writing mode feature, progress tracking features, and writing support features) and its pragmatic and hedonic qualities (UX quality perceptions) for users in reaching good performance. Given equifinality and causal asymmetry, this thesis offers multiple different configurations of research variables that are equifinal in attaining above average and high writing performance (Ortiz de Guinea & Raymond, 2020). It also provides the configuration resulting in not high writing performance (NHP1), which involves the use of one feature (i.e., writing support features), in isolation, without the use of the essential writing mode and UX quality perceptions. These findings can contribute to Chrono's ongoing development. Managers should prioritize investing in strategies that encourage users to utilize features aligned with their writing tasks and goals. For instance, the development of ethical digital nudging mechanisms, as proposed by Jesse

& Jannach (2021) and Schneider et al. (2018), could guide users towards employing diverse feature combinations to achieve higher task performance and it also could help users avoid configurations associated to the absence of high performance.

From the point view of user experience, this study incorporated hedonic quality and pragmatic quality into the investigation of effective IT use, which adds value to the study of IT feature use behaviors. Moreover, this thesis assessed the user experience of Chrono, examining how users perceive and value the web application. From the perspective of the users of Chrono, the results show that one could modify the way his or her use of Chrono (e.g., using different features together in a different way) by selectively utilizing its features to benefit from the fit between the writing task (goal) and Chrono's features. Finally, the findings could be beneficial for new Chrono users, since this study offers alternative ways in which to increase task performance or avoid reducing it. By understanding the differences between the elements that explain high, above average, and not high writing progress performance, users can identify different types of IT use combinations (or patterns).

6.4 Limitations and Future Research

It is important to evaluate the study's results and contributions in light of its limitations. First, this thesis has limitations with respect to the size of the sample. The number of samples is limited, related to the nature of the longitudinal survey method. Future research could conduct a similar study with a greater sample size. Another limitation lies in the

generalization of the results. Chrono, as a time management and community writing web application, is a specific context and the results of this thesis may not be generalizable to other contexts, like in an organization where the use of a given IT might be compulsory. Future research could further investigate feature use in instrumental settings where adoption is mandatory. Finally, there are limitations stemming from the employment of the fsQCA analytical method. Decisions regarding the calibration and other aspects (e.g., choosing consistency and frequency thresholds) of the research measures could affect the results (Glaesser & Cooper, 2014; Skaaning, 2011; Raymond et al., 2020; Ortiz de Guinea & Raymond, 2020). Therefore, as recommended in the fsQCA guidelines, the calibration for principal analysis relied on percentiles, and post hoc analysis used an alternative mean-based calibration (Dul, 2016; Plewa et al., 2016). Moreover, a recommended frequency threshold of 2 was employed due to the small sample size (as the samples are smaller than 150 cases) (Fiss, 2011; Ragin, 2006). A recommended consistency threshold of 0.75 was employed, following guidelines of fsQCA (Liu et al., 2017; Ragin, 2008; Pappas, 2018). Still, it is important to note that different consistency thresholds might affect results (Ortiz de Guinea & Raymond, 2020; Raymond et al., 2020). Finally, future research could apply a similar approach by further conceptualizing and operationalizing richer IT use patterns covering additional different dimensions, such as emotions, cognitions, and behaviors (e.g., Ortiz de Guinea & Webster, 2013).

6.5 Conclusion

In conclusion, this study has taken a configurational approach to uncover different sets of equifinal causal configurations of distinct feature use and UX quality perceptions and that result in the presence and absence of high levels of progress performance. This exploratory research represents an effort to (1) conceptualize effective IT use as different configurations of the use of different features, hedonic quality, and pragmatic quality, (2) examine how these configurations relate to short-term performance (i.e., effectiveness), and (3) provide an understanding of how different features in combination with UX quality perceptions affect performance in the specific context of Chrono.

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Appendix

Appendix A: Overview of Operationalization of Research Variables

Constructs & Sources	Items of Measures		Scales
	English	French	
Feature Use (Adapted from Burton-Jones & Straub, 2006)	· Over the past week, I have been paying attention to the pop-up suggestions when I press the feature "*Enter the writing mode*" · Over the past week, I have used the feature "*Write down an idea*" · During the last week, I pressed the feature "*Leaving the tomato*" · In the past week, I have downloaded the ideas noted in the session · During the last week, I paid attention to the feature "*Objectives completed during the session*" · During the past week, I have been using the "*Chat*" · During the last week, I have been paying attention to the map · During the last week, I used the feature "*Objectives*" · Over the past week, I have been paying	· Au cours de la dernière semaine, j'ai porté attention aux suggestions qui apparaissent quand j'appuie sur « Entrez en mode rédaction » · Au cours de la dernière semaine, j'ai utilisé le « Noter une idée » · Au cours de la dernière semaine, j'ai appuyé sur « Quitter la tomate » · Au cours de la dernière semaine, j'ai téléchargé les idées notées lors de la séance · Au cours de la dernière semaine, j'ai porté attention aux « Objectifs complétés pendant la séance » · Au cours de la dernière semaine, j'ai utilisé le « Clavardage » · Au cours de la dernière semaine, j'ai porté attention à / interagit avec la carte géographique · Au cours de la dernière semaine, j'ai utilisé la fonction « Objectifs » · Au cours de la dernière semaine, j'ai porté attention au nombre de « Tomates accomplies »	7-Point Scale (Note: From "Never/ Jamais" to "Every day/ 7 jours")

	attention to the number of "*Accomplished tomatoes*" · Over the past week, I have been pressing "*Enter the writing mode*"	· Au cours de la dernière semaine, j'ai appuyé sur "Entrez en mode rédaction"	
Pragmatic Quality (Scherpp et al., 2017)	The Chrono application is... · Clear [1] to Confusion [7] · Inefficient [1] to Efficient [7] · Complicated [1] to Easy [7] · Obstructive [1] to Supportive [7]	L'application Chrono est... · Claire [1] to Confuse [7] · Inefficace [1] to Efficace [7] · Compliquée [1] to Simple [7] · Nuisible [1] to Aidante [7]	7-Point Scale (Note: [4] indicates "neutral")
Hedonic Quality (Scherpp et al., 2017)	The Chrono application is... · Boring [1] to Exciting [7] · Not interesting [1] to Interesting [7] · Conventional [1] to Inventive [7] · Usual [1] to Leading Edge [7]	L'application Chrono est... · Ennuyante [1] - Excitante [7] · Pas du tout intéressante [1] to Intéressante [7] · Conventionnelle [1] to Novatrice [7] · Habituelle [1] to Avant-gardiste [7]	7-Point Scale (Note: [4] indicates "neutral")
Perceived Progress Performance (Adapted from Burton-Jones & Straub, 2006)	Please indicate your level of agreement with the following: (1) Using Chrono improves my time management (2) Using Chrono increases my writing productivity (3) Using Chrono helps me attain my daily goals	Veuillez indiquer votre niveau d'accord avec les éléments suivants: (1) L'utilisation de Chrono améliore ma gestion du temps (2) L'utilisation de Chrono augmente ma productivité en matière d'écriture (3) L'utilisation de Chrono m'aide à atteindre mes objectifs quotidiens	7-Point Likert Scale (Note: From "Strongly disagree/ Très fortement en désaccord" to "Strongly agree/ Très fortement d'accord")