January 2022

An Investigation Of The Relationship Between The Use Of Modern Digital Technologies, Language Learning Strategies, And Development Of Second Language Skills

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AN INVESTIGATION OF THE RELATIONSHIP BETWEEN THE USE OF MODERN DIGITAL TECHNOLOGIES, LANGUAGE LEARNING STRATEGIES, AND DEVELOPMENT OF SECOND LANGUAGE SKILLS

by

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Bachelor of Arts, Non-US University
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A Doctoral Dissertation

Submitted to the Graduate Faculty

of the

University of North Dakota

in partial fulfillment of the requirements

for the degree of

Doctor of Philosophy

Grand Forks, North Dakota

May
2022

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Degree: Doctor of Philosophy

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April 2022

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ACKNOWLEDGMENTS

On the way to another big academic accomplishment of my lifetime, a terminal degree in the area of learning technologies, I had a great blessing to be accepted to the institution that has a unique supportive atmosphere, ample research opportunities, and caring faculty and staff. That is why I would like to express feelings of sincere gratitude to the University of North Dakota as a School and my second Alma Mater. It was the welcoming aura of the School that I also had a chance to appreciate in the College of Education and Human Development and Teaching and Learning Program.

My words of deep acknowledgment also go to the dissertation committee members, who invested so much of their professional expertise, time, and willingness to make the contents of this writing coherent, well-grounded, and clear. The committee chair and academic advisor Dr. Woei Hung, Graduate Program Director Dr. Bonni Gourneau, instructional technology guru Dr. Lori Swinney, and expert in second language training Dr. Jane Berne successfully transmitted the University of North Dakota's spirit of care and respect during class time, collaborative research, and personal meetings.

I particularly would like to thank the staff, faculty, and Chair of the Department of Modern and Classical Languages and Literatures, Dr. Thyra Knapp, for their immense support during the data collection time. The caring spirit of the School manifested itself so vividly in my communication with every member of the Department.

ABSTRACT

Like many other areas of human knowledge, the field of language learning has undergone changes as a consequence of the application of digital technologies. Extensive exposure and anytime and anywhere access availability to data in a second or foreign language (L2) bring almost unlimited learning opportunities for digital age students, which affects their learning behaviors also known as language learning strategies (LLS). The purpose of the present study is to define preferred LLS patterns of digitally native L2 learners and to establish relationships between types of existing digital technologies, learners' demographic characteristics, and the use of learning strategies to support the development of specific language skills and aspects.

The setting for this study was made up by a medium-sized university in the northern U.S., particularly, its undergraduate student population enrolled in foreign language courses in the Department of Modern and Classical Languages and Literatures during the 2021 fall semester. They were asked to complete a survey that contained the original validated version of the Strategy Inventory for Language Learning (SILL) instrument (Oxford, 1990) and three additional sections disclosing the participants' demographics, technology use experience, and targeted language skills and aspects.

Both descriptive and inferential quantitative methods of data analysis were used in the study to elucidate the research questions. A number of analytic procedures using SPSS® Statistics software were performed to find out detailed statistic values of the research variables. Frequencies and descriptive statistics, analysis of correlations, extreme groupings *t*-tests to

explore the relationships between the subsets of categorical variables, and factor analysis of LLS domains were implemented to identify meaningful patterns of technology use in L2 learning.

Data from this study provide a view of how the Digital Natives themselves see their technology use and approaches to learning. Research conclusions based on obtained self-reported evidence allow us to make broader recommendations for changes in the L2 teaching methodology. They may also prevent instructors from making unsupported assumptions about their students' mastery of educational technology, and, thereby, from neglecting to teach students the skills they need for academic success.

Keywords: digital native learner, digital technology categories, language learning strategies, L2 language skills

CHAPTER I

INTRODUCTION

Learning and Language Learning in the Age of Digital Technologies

The twenty-first century is recognized globally as the age of digital technologies and knowledge (Mynbayeva et al., 2017). Learning in the age of digital technologies when much of communication interchange, knowledge dissemination, socialization, and ways of working take place through digital media may require new ways of thinking, of approaching the learning process and the strategies used, and choice of priorities to compensate for any information gaps (Shakarami et al., 2017). Such new skills require digital literacy which presupposes skills for decoding and interpreting the media to process verbal and non-verbal information received from the digital environment (Jones-Kavalier & Flannigan, 2006) as well as digital competence defined as a combination of information, skills, and attitudes for the safe and critical use of information technologies for efficient functioning in human activities (Jun & Fun, 2011). Today, possession of digital skills is considered a prerequisite for innovation, creativity, and efficiency in many industries that promote meaningful changes in addressing the subject knowledge and engaging students in learning (Coskun, 2015).

A change of communication techniques and widespread use of the internet have triggered the relational transformation between technology and pedagogy. Akinwamide & Aderada (2012) suggest that due to the digitalization of academic interactions and collaborations in the technologically advanced world teaching and learning processes are being "revolutionized" (p. 36), qualitatively promoting more logical and systematic reasoning than eliciting stereotyped informed decisions. From the pedagogical perspective, it means that a web-connected world introduces a flexible and a self-driven environment (Alonso et al., 2009; Goodyear, 2008; Hamid, 2002; Huang et al., 2007; Lester et al., 1999) for learners who are getting accustomed to

functioning in it, enabling them to be effective, competent, and critical students in the digital age (Hauge & Payton, 2010). These changes have triggered the transformation of student needs, making knowledge acquisition geographically unlimited and extending the path from traditional synchronous education to adaptive semi-synchronous and blended e-learning environments in which the student's role shifts from passive learning to taking responsibility for the learning process and self-assessment (Aslan et al, 2014).

Like many other areas of human knowledge, the field of language learning has undergone changes affected by the application of digital technologies. Overall, language teaching with technologies is considered to be more effective than traditional language instruction (Ürün, 2016). Chapelle (2009) underlined the power of technology as a medium for both supporting new kinds of language learning activities and challenging established language acquisition theories stating that technology "dramatically extends and changes the breadth and depth of exposure that learners can have with the target language and interactive events in which they have the opportunity for language focus" (p. 750).

Language learning has been going through conceptual transformations of teaching methods, approaches, and styles, which has led to appearance of several technologically impacted interdisciplinary fields such as Computer-Assisted Language Learning (CALL) and Intelligent Computer-Assisted Language Learning (iCaLL). The application of information and communication technologies to language education and the use of "rich media, interactive textbooks, complete online courses, and supplemental materials " (Expanding Evidence Approaches for Learning in a Digital World. U.S. Department of Education Office of Educational Technology Report, 2013, p. 63) that are actively used in language education gave

"vent" (Akinwamide & Aderada, 2012, p. 36) to new learning paradigms redefining the role of the teacher as well as repositioning the cognition level of the learners.

Problem Statement

Extensive research into the booming use of technologies for language learning (see, for example, a most recent comprehensive review by Shadiev and Yang, 2020) brings out two discreet areas that exhibit relationship: kinds of technologies and learning behaviors that they enable. The transformative nature of applying technology to education sparks several reasonable questions: once digital technologies affect every field of human learning, how might learning approaches of today's language learners be influenced by them? What "ubiquitous" (Prensky, 2001, p. 1) digital tools would be preferably utilized by them for language learning? What language learning goals and objectives are most efficiently supported by their preferred digitally-based practices?

The search for the answers to these questions guided the **rationale** for the present study which can be articulated as the assumption that extensive exposure and anytime and anywhere access availability to data in a second or foreign language (L2) may have an effect on the use of learning strategies and on the language learning process as a whole. Available digital resources offering L2 input, practice, and interaction are practically limitless, and already are integrated into the lives of present-day learners, often called Digital Natives (Prensky, 2001).

The research rationale drove the **purpose of the study** which is to determine whether and what kind of relationship exists between categories, or classes, of digital learning resources widely available through the use of computing devices and the Digital Natives' ways of managing their learning behaviors while mastering L2 skills and aspects, in other words, language learning strategies (LLS; Rubin, 1975; Oxford, 1990). The study purpose delineates a

number of **research goals** to be investigated: (1) the actual language learning digital technology use of the participants, (2) the extent to which they naturally apply them to language learning, (3) the extent to which they see these technologies as being productive or nonproductive for developing language skills and aspects, and (4) the relationships between patterns of technology use, learning habits and behaviors, and the productiveness of those behaviors.

Interest in the processes used by language learners for managing their technologically-enhanced learning emerged from a concern for defining the characteristics of effective learners and promoting learner-centered models of language teaching. It resulted in identifying a set of strategies that make language learners and learning more or less successful (Petrogiannis & Gavriilidou, 2015; Rose et al., 2018). In the field of L2 studies and educational psychology, it led to an extensive research attention to language learning strategies (LLS) in the last four decades (Ardasheva & Tretter, 2012; Hsiao & Oxford, 2002; Petrogiannis & Gavriilidou, 2015) as both a concept and instrument to define L2 learners' patterns of learning behaviors.

The use of technology-mediated language resources with an abundance of opportunities for input and output in digital formats beyond the classroom (e.g., participation in online chat rooms in a foreign language, interviewing foreign visitors, playing online language-based digital games, use of online resources (e.g. Ted Talks), watching movies, and so on) gives advantage to digital native L2 learners in exploring personally preferred LLS patterns (Richards, 2015). In foreign language learning contexts, the impact of e-learning modal affordances is that it makes the student the decision maker about the LLS choice (Aslan et al., 2014).

Delineating Language Learning Strategies as a Concept and the Instrument

LLS have been defined in a number of ways by various scholars in the field of second language acquisition and foreign language learning (Ranjan, 2019). The first taxonomy of

strategies, which considered learners' thoughts, actions, and social behaviors (Rubin, 1981), emerged in the early eighties. This research was followed by O'Malley et al.'s (1985) research with an attempt to review and organize cognitive and metacognitive strategies learners used to process novel information about a new language.

Oxford (1990) arrived at a definition of strategies as contextually-specific thoughts and actions that are both mental and physical. She describes LLS as "steps taken by learners to enhance their own learning" (p. 1) and claims that they refer to "specific actions, behaviors, steps or techniques that students use to improve their own progress in developing skills in a second or foreign language" (Oxford, 1999, p. 518) while facilitating the internalization, storage, retrieval, or use of a new language.

As a concept, LLS is adopted in the study to represent content blocks (domains) that participate in operationalizing L2 learners' abilities, attitudes, and preferences. In this meaning, LLS display the cognition level and particular learning practices understood as the "attitudes and behaviors that determine an individual's preferred way of learning" (Honey & Mumford, 1992, p. 1, as cited in Graf & Kinshuk, 2008, p. 306).

To collect the data about such behaviors and practices that would make a basis for research conclusions and inferences, an instrument to register relevant L2 learners' activities is needed. This instrument should be supposed to (1) take account of situationally, circumstantially, or environmentally exhibited language learning behaviors, (2) display the attitudes of language learners to the process of learning, (3) inform us of techniques and practical activities supported by modern technologies they think would be efficient in achieving their learning goals, and (4) provide an opportunity to attribute LLS to the technological factor rather than to other environmental circumstances, such as motivation or learning styles.

Most of the commonly known strategies instruments cover at least three conceptual domains: cognitive, metacognitive, and socioaffective (Hassan et al., 2005), with the latter divided sometimes in two. The three-block approach, in particular, is shared by O'Malley et al. (1985) and Chamot and O'Malley (1994). Cohen et al., (1996) identify four types of strategies covering the same conceptual areas: cognitive, metacognitive, social, and affective which represent, in the authors' opinion, only a subtype of strategies, namely, language learning strategies. Another subtype, language use strategies, is added into the instrument structure to draw the distinction between performance and communicative strategies.

By the late 1980s, the work of Oxford (1990) offered a developed multi-faceted Strategy Inventory for Language Learning (SILL), an inventory of strategies that classifies strategies according to their function (i.e., purpose or role) in a specific situation (Cohen, 2011; Oxford, 2017) and that could be used by teachers and researchers to assess learners' use of strategies. Throughout its thirty years of use, the SILL has proved to be a reliable instrument studied from various perspectives and examined in relation to other factors (see Benson & Gao, 2008), completed by more than ten thousand learners around the world, and translated into over 20 languages (Oxford, 2017).

The choice of the Oxford's SILL instrument was also prompted by the need to establish a background for comparison. Though the analysis of generational differences is not in the focus of the present study, the fact that the data provided by the SILL relates to what we already know about the learning strategies of "baby boomers" (Oblinger & Oblinger, 2005) may lead us to understanding how different the learning choices of learners constantly exposed to computer technologies are. One of several reasons the data from the present study might be compared to the data gained from the SILL research covered in the literature is to find out what aspects of

existing strategies are at the center of attention of today's language learners or even what possible new learning strategies are emerging out of unprecedented digital affordances (Shakarami et al., 2017).

Although in a technology-enhanced learning environment, as in any other kind of learning environment, individual learners play a central role (Graf & Kinshuk, 2008), a gap in the present-day research on technology-enhanced use of LLS with the above-mentioned SILL instrument is seen in the insufficiency of analysis of relationship between specific language learning behavior choices and digital affordances chosen by the Digital Natives to support them. Few researchers investigated correlations between the use of LLS and the types of digital technologies as learning media introduced together with the development of the internet (Rose et al., 2018; Shakarami et al., 2011; Solak & Cakir, 2015; Yeh, 2015). As Shakarami et al. (2017) noted, the research in the field has not concentrated specifically on the ways LLS are utilized by the digital age learners. Even in case some LLS research participants represented a technologically advanced learner, the research findings might be naturally biased as they also considered the influence of cultural or gender factors in ethnically specific EFL contexts (Chan, 2014; Shakarami et al., 2011; 2017; Solak & Cakir, 2015; Yeh, 2015; Yenphech, 2020).

The **need** for the present study is to fill in the gap in our understanding of how the abundance of sophisticated computer information technologies and powerful digital learning availabilities modifies the use of L2 learning strategies by today's students. Another argument for the need of the study is that, as can be drawn from the literature, how the enormously great array of digital tools possibly influences and reshapes the language learning strategy use by the internet-equipped learners and how they support the development of language skills and acquisition of language aspects has not been investigated yet.

To summarize, the study addresses the possible connection between technology use and ways of learning a foreign language by asking digital native undergraduate students to report what variety of technologies they use, what language skills they predominantly develop with the technologies chosen, what their habits and typical behaviors are when learning topics that interest them, and how they assess the productiveness of their learning behaviors.

Language Learning Strategies and Self-Regulation Framework

It was noted that much research on modern digital technologies and language learning is not clearly grounded in theory (Wang & Vásquez, 2012). However, an attempt to provide a plausible theoretical background for teaching languages with technologies made by Chapelle led her to create a systemic representation of a variety of theoretical approaches to second language acquisition (SLA) as a response to the need to theorize the role of instruction in SLA (2009). However, neither of the four general approaches identified by the author (cognitive linguistic (Universal Grammar, autonomous induction theory, concept-oriented approach), psycholinguistic (processibility theory, input processing theory, interactionist theory), human learning (associative–cognitive CREED, skill acquisition theory), and language in social context (sociocultural, language socialization, conversation analysis, systemic–functional, complexity theory) (Chapelle, 2009) can be regarded as sufficient, if applied separately, to embrace a broad scope of learning opportunities brought forward by digital technologies.

An integration of existing approaches would make a stronger theoretical foundation for conceptualizing and studying L2 acquisition, but in this case, it would bring forward very many factors related to the whole language teaching process: environment, methodology, materials, equipment, management, evaluation, etc. which are only a few of the parameters considered in its design. As a result, we would be taken off the research topic. When such a process leaves the

boundaries of the traditional classroom, a new set of parameters included in the learning process (such as, elements of the digital environment, learners' actual behaviors etc.) need to be considered (Patiniotaki, 2016).

Today, the internet, technology, the media, and the use of a foreign language in face-to-face as well as virtual social networks provide greater opportunities for meaningful and authentic language use than are available in the classroom (Richards, 2014). This is another argument for not focusing the research attention on the teaching perspective of technology use while delivering a course in a foreign language. The purpose of this study is to highlight the opposite, the learning side of acquiring another language, on digital native L2 learners' choices, practices, and behaviors which suit their cognitive, psycholinguistic, and social needs. Once it is believed that bringing information and communication technology into language education leads to new learning designs (Akinwamide & Aderada, 2012), a framework that might have a relevant explanatory power for the present study should display a conceptual support for L2 Digital Natives' learning choices. It may be assumed that the consideration of the effects of digital learning technologies on LLS shifts their study to a different perspective related to the concept of learner independence, autonomy, and self-regulation also found as contributing factors in some popular learning models such as problem-based learning (PBL; see Hung et al., 2008) or inquiry learning (see Kali & Linn, 2008).

The theory of self-regulation (SRT; Pintrich, 2000; Tseng et al., 2006; Zimmerman, 1990) seems to be a theory that possesses the focus we look for. SRT as well as self-regulation as a construct has a long tradition in psychology and educational psychology. It was developed with the social cognitive theory of Albert Bandura as a concept of expanded "freedom of action [to] enable people to serve as causal contribution to their own life course by selecting, influencing,

and constructing their own circumstances" (Bandura, as cited in Zimmerman & Schunk, 2003, p. 446). Dörnyei (2005) defines self-regulation as "the degree to which individuals are active participants in their own learning" (p. 191). Compared to learning strategy, it is viewed as a more dynamic concept that highlights the learners' own "strategic efforts to manage their own achievement through specific beliefs and processes" (Zimmerman & Risemberg, 1997, p. 105). When applied to the process of academic learning, the notion of self-regulation represents a "multidimensional construct, including cognitive, metacognitive, motivational, behavioral, and environmental processes that learners can apply to enhance academic achievement" (Rose et al, 2018, p. 152).

Although self-regulation was not a construct theoretically developed to specifically explore second language acquisition (Rose et al., 2018), Oxford et al. (2014) point out several existing perspectives on self-regulation with sociocultural perspective among them. It is noted that the sociocultural concept of learner self-regulation comes initially from Vygotsky (1978) with the constructivist philosophy of learning based on the premise that individuals construct their knowledge through their interaction with the environment. Proceeding from sociocultural psychology, Oxford (2011b) delineated a range of sociocultural-interactive strategies for language learning (such as obtaining help, collaborating with others, transcending knowledge gaps when communicating with others etc.) thus integrating the notion of self-regulation into existing paradigms of strategies (Oxford, 2011).

Within the aforementioned general human learning theories, two perspectives, Ellis's associative-cognitive CREED framework (Ellis, 2006) and DeKeyser's skill acquisition theory (DeKeyser, 2015), also appear relevant to this study. The CREED framework relies on learners' recurring exposure to language examples while the skill acquisition theory relies on learning

through constant practice. Both factors support frequent language exposure and practice in a variety of ways that ultimately lead to better language learning (Shakarami et al., 2017).

These two factors, recurring exposure and constant practice, bring forward another concept that complements the self-regulation framework. It is the notion of modal affordances developed by Kress (2010) which makes up the ground of a theoretical framework in which modes have particularities and limitations in terms of affordances that offer different potentials for communication and meaning (Jin, 2017). Santos Costa and Xavier (2016) traced the origins of the term "affordance" to Gibson's (1979) studies and defined it as an opportunity at the agent's disposal to do an action independently of whether the agent makes use of it or not, as all possible actions the context offers. The key feature of modal affordance fitting the present research agenda is that it stresses the interactivity of the process between the individual and the environment, and the latter is a set of all potential "resources for actions available to the agent who needs to perceive their potentialities and initiate action" (p. 202).

Self-regulation, which stresses an independent learning process related to what, when, how, and where to learn (Efklides, 2011; Kellenberg et al., 2017), is one of the ways to explain the complexities of foreign language learning (Choi et al., 2018) including cognition, memory, affect, and behavior. Research shows that the use of self-regulated learning strategies is a significant predictor of foreign language achievement and has significant correlations with language achievement (Fukuda, 2018; Seker, 2016). Self-regulation skills are noted to be in correlation with reading comprehension (Al Asmari & Ismail, 2012), vocabulary learning (Mizumoto & Takeuchi, 2012; Gorgoz & Tican, 2019), writing (Teng & Zhang, 2016), listening (Vandergrift & Goh, 2012; Yabukoshi, 2018), and speaking competence (Uztosun, 2020).

Significant research demonstrating SRL's efficacy at improving foreign language learning (e.g. Andrade & Bunker, 2009; Andrade & Evans, 2013; Ma & Oxford, 2014; Oxford, 2011) is strongly supportive of a relationship between self-regulation and use of language learning strategies (Canbay, 2020). When used effectively on a regular basis, these strategies facilitate language learning by leading to deeper learning and higher performance in language skills (Seker, 2016).

The theoretical approach taken in this study follows the point of view that the theory of self-regulation with all its features and functionality related to constructivism, associative cognitivism, skill acquisition, and complemented by the concept of modal affordances has a reliable explanatory power regarding the relationship between dependent and independent variables of the study. Under this conceptual framework, the study of effects of modern digital technologies on the use of LLS and development of language skills by Net-generation learners is getting a credible conceptual "umbrella" to relate and explain existing patterns of the variation in overall strategy use, strategy use by SILL domains, at the individual item level, and digital language learning tools and content, supported language skills, and other accompanying demographic factors.

On the SILL domains end, the data from most recent systemic literature reviews of technology-enhanced language learning (Shadiev & Yang, 2020; Zhang & Zou, 2020) and extensive SILL research (Ardasheva & Tretter, 2013; Cohen & Griffiths, 2015; Hassan et al, 2005; Oxford et al., 2014) display a tendency in more extensive use of LLS domains related to constructivist approach in learning, compensation, social, and affective, quite possibly, at the expense of the memory domain. The traditionally dominating cognitive domain seems to be still broadly supported by the world wide web availabilities, while metacognitive domain which is

regarded as the one that needs more training and instruction (Hajar, 2019) may not find substantial support from the use of digital technologies.

On the other end, the tendencies in the use of L2 learning technologies noted in the literature testify that the areas of (1) access to language learning materials and (2) communication opportunities are the two functional areas where the operational load of digital technologies is most ensured and where L2 learners get the most support in acquiring L2 language skills and developing language aspects (Ürün, 2016). At the same time, the prevailing majority of language students would rather use digitally available resources from YouTube, TEFL websites, and similar channels than create their own designed technological materials or programs for language training (García Esteban, García Laborda, J., & Rábano Llamas, 2016).

These speculations also affected research argumentation of the study questions and logical assumptions further formulated as research questions. The latter will focus on four major research constituents: the L2 learner, types of commonly utilized digital technologies and tools, L2 language skills most supported by these technologies, and the functional load of LLS.

Research Questions

The research was guided by the following questions:

1. What learners' attributes display consistent correlations with the utilization of digital technologies in L2 learning?

2. What categories of digital learning technologies are engaged in L2 learning by undergraduate university students as the digital age learners?

3. What digital learning tools contribute most to supporting the development of L2 skills and aspects?

4. What tendencies in the use of language learning strategies are noted among the digital age L2 learners?

The four research questions explored in the study embrace major relationships between present-day L2 learners, digital language learning availabilities, language skills and aspects typically developed, and utilized learning behaviors representing established learning strategies. The answers to the research questions were based on quantitative analytics although some discussion points, implications, and conclusions could also be supported by assumptions and considerations that exceeded the research questions limits.

Definitions of Terms

Digital Natives, **Net generation**, **Net-Gener**, **GenZ** - naming conventions for several age groups of young adult individuals who have lived their entire lives or a great part of their lives being exposed to digital devices and internet.

Digital affordances – miscellaneous online and offline services and tools available via digital devices.

Heutagogy - a learner-centered educational theory founded on the principles of learner agency, self-efficacy, capability, metacognition, and reflection.

L2 – second or foreign language acquired in addition to one's native language.

Language aspects – widely recognized domains of language as a system which includes pronunciation, vocabulary, grammar (morphology and syntax), and style.

Language learning strategies (**LLS**) – particular actions taken by the learner to make learning easier, faster, more effective, and more transferable to new situations.

Language skills – traditionally recognized human natural language receptive (reading and listening) and expressive (writing and speaking) abilities.

Modal affordances - all possible actions and perceived opportunities for action that the environment provides to the learner to be at their disposal.

Self-regulation – the attitude when individuals are active participants in their own learning, a system of conscious personal management efforts that involve meta-cognitive guidance of one's own thoughts, behaviors, and feelings in the process of reaching goals.

Strategy Inventory for Language Learning (**SILL**) – A 50-item survey developed by Oxford to assess second or foreign language learners' efficiency in learning.

Benefits and Significance of the Study

The study of correlations between existing hi-tech digital language learning conveniences and Net-generation L2 learners' choices of learning behaviors will show the extent to which the utilization of digital technologies has become indispensable of the learning process per se. The data about digital native L2 learners' self-reported voluntary choices of learning activities will also expand teachers' methodological horizons for teaching with technologies, potentially impacting lesson planning, classroom activities, nature, and typology of course assignments, and level of students' independence in the learning process. The study also possesses **theoretical significance** which comes from the assumption that the findings may complement the theory of instructional design with reference to the sequence of instructional events (Gagne, 1977) for the Net-generation students, the development of instructional strategy, and the development and selection of instructional materials (Dick, Carey, & Carey, 2009).

Organization of the Dissertation

Chapter I introduces the context of the research topic, the rationale for the study and assertions for the research direction chosen, and the statement of the research problem. This background promotes further contextualization of the research topic, identifying gaps in what is

known about the problem from the literature and justifying the need for the present study. The chapter offers an overview of the research instrument and defines the research direction. It also includes the statements of the purpose of the study, theoretical framework, research questions and hypotheses, definitions of terms, benefits and significance of the study as well as its organization.

Chapter II includes a review of the literature related to the key research concepts relevant to the research: human learning, L2 learning and teaching, language learning strategies, the SILL inventory, digital technologies, Web 2.0, Net Generation learner and learning styles, and supporting theories for the research rationale, questions, and hypotheses. The review will provide an array of opinions and research methodologies relevant to the in-depth discussion of the research topic.

Chapter III describes the chosen quantitative methodology for data analysis and its applicability for developing answers to the research questions in this study. Details regarding methods, procedures, participant selection, data collection, and analysis are also provided.

Chapter IV offers a presentation of the research outcomes with regard to the theoretical assumptions from the literature and the study questions. Numerous cases of statistically significant correlations between the study variables and their subsets illustrate a complex nature of interactions among the research concepts.

Chapter V includes the findings summary and the researcher's interpretation and discussion of the quantitative data analysis. The chapter suggests answers to the research questions, the study summary, conclusions, limitations, and implications for practice as well as recommendations for future research.

CHAPTER II

LITERATURE REVIEW

The Research Problem from the Perspective of the Conceptual Framework

The rapid rate of development of technologies in all relevant to teaching and learning areas is constantly bringing out new evidence about aspects of learning, knowledge acquisition, and learning environments (Harasim, 2017). Language learning has also been affected by the new digital technology developments and affordabilities, and the generation of digital native L2 learners widely uses technologies to support their learning and develop better language skills. Language professionals, software developers, and language learners have a need to know what types of technologies are popular with the students, how technologies are incorporated into their daily learning practices, and to what extent Digital Natives' language learning behaviors may be shaped by them.

This literature review is intended to support the rationale and the research purpose for this study, the aim of which is to profile university-level students' preferences and identify patterns in the use of language learning strategies based on their association with particular types of digital learning technologies used for language learning. A broad variety of opinions and published study reports will underline the relevancy of the research agenda to testify that technologies impel learners' strategy preferences in some way and that technologies are a factor in developing language skills and aspects.

Self-Regulated Learning and Heutagogy

As indicated throughout the introduction chapter, it is the learners', namely the Digital Native L2 learners', perspective that is chosen as a directional consideration for the study. It is the learners' broad scope of learning opportunities, choices, practices, behaviors, their cognitive,

psycholinguistic, and social claims that need to be equally aligned to one underlying theoretical framework to make up a balanced research foundation. The self-regulation theory (SRT) representing a multidimensional construct, including the learners' cognitive, metacognitive, motivational, behavioral, and environmental processes was initially applied to the present study of digitally-supported L2 learning behaviors.

Self-regulation connotes that individuals consciously attempt to handle behavior in an effort to mediate outcomes (Baumeister & Vohs, 2007; Garrin, 2014) displaying the capacity to moderate the thoughts and emotions that govern human behavior (Leventhal et al., 1984). Self-regulation has direct linkages to motivation (Bandura, 1991), autonomy (Ryan & Deci, 2006), and competence which are the primary determinants of several "self"-directed theories, self-efficacy (Bandura, 1997), self-determination (Ryan & Deci, 2000), and self-regulation (Leventhal et al., 1984). Other determinants (e.g., mastery, confidence, willpower) also display conceptual proximity between and compatibility with the personality skills identified by each theory. (Garrin, 2014) posits that like self-efficacy and self-determination skills, enhanced self-regulation abilities (acknowledged personal standards, internalized motivations, and engendered willpower) could potentially facilitate aspects of the behavior-change process leading to an enhanced capacity and willingness to endure challenges.

Baumeister and Vohs (2007) define self-regulation as the capacity of human organisms to override and alter their responses. They point out that it greatly increases the flexibility and adaptability of human behavior, enabling people to adjust intended actions to a broad spectrum of their situational needs. Modern digital technologies allow their users to exercise quite different approaches to making their learning successful that range from old-fashioned behavioristic practices to cognitivist and constructivist. In turn, these self-regulatory practices may require

from the Digital Natives utilization of different personal traits and skills ranging from collaborative practices to follow the constructivist way of learning to autonomy to comply with cognitivism and behaviorism.

The consideration of self-regulation in psychological literature is markedly related to the concept of autonomy which, as a term, literally refers to "being regulated by the self" (Ryan & Deci, 2006, p. 1557). As a quality of regulation, autonomy is described through integrative processing of possibilities and matching them with sensibilities, needs, and constraints (Ryan and Deci (2006). Autonomy is also a valid factor of another "self" theory, self-determination, in which the focus is on an intrinsic, self-sustaining form of motivation that is influenced by internal stimuli (Deci & Ryan, 1985; Ryan & Deci, 2000) and which presupposes some relative unity underlying one's actions, congruent and endorsed by the whole self, that assents to external influences or inputs (Ryan & Deci, 2006). In both cases, and irrespective of which theory may have better explanatory power, autonomy is an attribute of theories that explain and contribute to understanding behavior change. However, to avoid confusion and crossing the border line between the two aforementioned theories and abandoning the area of self-regulation, which is our ultimate research framework, autonomy may be viewed in this context as a connecting element of a broader theoretical continuum that explains how learning in a digitally-rich environment is taking place.

The digital native learner's ability to self-regulate learning in the environment of digital affordances is, in fact, a recognition of the emergent nature of learning, involvement of the learner in the design of activities, assessment, and in collaborative and individual learning. These features of a modern digitally rich learning environment reiterate with heutagogy, a learning theory of self-determination developed by Hase and Kenyon (2000) twenty years ago. It was

noted that the theory was built “on the shoulders of giants of educational theory and practice” (Hase, 2016, p. 1) in constructivism and humanism. Blaschke (2018) describes heutagogy as a learner-centered educational theory founded on the principles of learner agency, self-efficacy, capability, metacognition, and reflection. Cochrane et al. (2013) stated that education in a post-web 2.0 world requires a pedagogical shift from instructivist (teacher-directed) pedagogy to student-negotiated and student-directed one. In combination with today’s technologies, as Blaschke (2018) points out, heutagogy obtains expository power to develop learning environments with potential to equip learners with the necessary skills for a lifetime of learning.

On the broader theoretical continuum we alluded to earlier in this section, heutagogy can be seen as a far-right progression of pedagogical approaches from teacher-directed pedagogy to student-centered andragogy and finally to student-directed heutagogy (Luckin et al., 2010), and as an extension to andragogy that could also been referred to as a potential theory for online and distance education (Agonács & Matos, 2019). What one of the founders of heutagogy, Stewart Hase, points out about its relation to e-learning is the awareness that there can be a much greater attention to sense-making (understanding, application, transfer) rather than to delivery of content per se, that the content is readily available, and that the learner is seen as a collaborator in their own learning (Hase, 2016).

To summarize, self-regulation theory (SRT) as a constituting framework for this study postulates active learning agency, learner-oriented focus, compliance with a variety of learning theories, models, and engagement approaches, and utilization of digital affordances. From this perspective, the SRT is located on the progression line between andragogy and heutagogy, gravitating to the latter. From the perspective of its functionality for investigating the research questions and hypotheses, its pertinence to constructivism as a dominant theory of learning,

associative cognitivism, skill acquisition, and attribution to the recurrency of exposure to modal affordances ensures the chosen framework a sufficient explanatory power regarding the relationship between the dependent and independent variables of the study.

A Brief History of Theories and Models of Human Learning

The last century brought forth many theories about human learning. Starting in the early 1900s, a plethora of literature on psychological theories of learning, educational instructional design, and technologies that support and enhance learning has been published. Within general human learning theories, the three major theories of learning widely discussed and accepted in language leaning are behaviorism, cognitivism, and constructivism, cognitive and social (Hung, 2001; Woolfolk Hoy, Davis, & Anderman, 2013). The major differences among these theories lie more in the miscellaneous interpretations they offer than in the definition of the concepts *per se*. The identifying domains that distinguish each learning theory from the others cover mechanisms and factors of learning, the role of memory, transfer, and pedagogical implications (Schunk, 1991). The use of technology in language learning is believed to manifest the applicability of all known learning theories and education methods related to them (Ürün, 2016), so highlighting the principal points of the three abovementioned theories would benefit grasping the relationship between general human learning and learning with digital technologies.

Behavioral theories of learning stress observable, empirical, and measurable changes in behaviors, skills, and habits (Harasim, 2017). Learning in behaviorism is seen as a change in behavior brought about by experience, with virtually no concern for the mental or internal processes of thinking (Woolfolk, Davis, & Anderman, 2013). The key elements are the stimulus, the response, and the association between the two. Of primary concern is how the association between the stimulus and response is made, strengthened, and maintained.

Driscoll (2005) and Ormrod (2008) point out that in behaviorism (1) learning takes place when a predictable connection is established between a cue in the environment (stimulus), a behavior (response), and a consequence (reinforcement), (2) learning is a gradual strengthening of the learned relationship between cue and behavior, driven by a pattern of consequences which, with enough practice, cause a strong link between the presentation of the cue and the paired behavior, (3) the learner must practice the new behavior repeatedly until it becomes automatic, and (4) effective use of reinforcement (punishment and reward) is essential.

Behaviorists attempt to prescribe strategies that are most useful for building and strengthening stimulus-response associations (Winn, 1990), including the use of instructional cues, practice, and reinforcement. Ertmer and Newby (2013) define these prescriptions as generally reliable and effective in facilitating learning that involves discriminations (recalling facts), generalizations (defining and illustrating concepts), associations (applying explanations), and chaining (automatically performing a specified procedure). However, it is generally agreed that behavioral principles cannot adequately explain the acquisition of higher-level skills or those that require a greater depth of processing (e.g., language development, problem solving, inference generating, critical thinking) (Schunk, 1991).

Many of the basic assumptions and characteristics of behaviorism are embedded in current instructional design practices. Behaviorism was used as the basis for designing many of the early audio-visual materials and gave rise to many related teaching strategies, first teaching machines and programmed texts. More recent examples include principles utilized within computer-assisted instruction (CAI) and mastery learning (Richey, Klein, & Tracey, 2011). By emphasizing the ability to deconstruct the steps of learning and stressing the importance of practice and reinforcement, behaviorism had a great influence on the field of instructional design

and educational technologies (Harasim, 2017). The contributions of behaviorism to the field of instructional design and technologies are widely accepted and acknowledged.

Behaviorism, as the earliest theory of learning, offered a simple explanation of the learning process which was viewed in terms of reflexive and/or reinforced behavior as a response to a stimulus. Theories in behaviorism were popular up through the 1920's when Jean Piaget began studying thoughts, language, and intelligence as well as how these change through the course of human development and aging (Webb, 1980). Behaviorism was not able to explain most social behaviors (Harasim, 2017), and this inability that was rooted in its extreme rejection of the mind was a major limitation of behaviorism.

The cognitive learning theory emerged as an extension of and a reaction to the behaviorist theory. Cognitive psychologists argued that the link between stimulus and response was not straightforward and that mental states revealed in thinking, imaginations, and conceptualization constitute human learning and determine how we think, act, learn concepts, and solve problems (Harasim, 2017; Woolfolk Hoy et al, 2013).

The potential and the problems related to the concepts of learning, thinking, decision making, remembering, creating, and problem-solving were comprehensively explored by a growing number of researchers (Ausubel, 1963; Bruner, Goodnow, & Austin 1956; Toepfer, 1971). How information is remembered and processed, as well as how individuals use their knowledge to regulate their thinking, obtained key importance in this research paradigm.

From the 1970s to the 2000s, cognitivism developed approaches to study how knowledge is represented in the mind and how it is remembered. Remembering and forgetting became major topics for investigation in cognitive psychology in the 1970s and 1980s, and the information processing model of memory dominated research. Later, in the 1990s and on to today, cognitive

theories have again added concerns about knowledge acquisition and metacognition to the information processing focus on memory.

Cognitive theories stress the acquisition of knowledge and internal mental structures and, as such, are closer to the rationalist end of the epistemology continuum (Bower & Hilgard, 1981). Cognitive theories focus on the conceptualization of the learning processes and explain the issues of how information is received, organized, stored, and retrieved by the mind. Learning is concerned not so much with what learners do but with what they know and how they come to acquire it (Jonassen, 1991b). Knowledge acquisition is described as a mental activity that entails internal coding and structuring by the learner. The learner is viewed as an active participant of the learning process.

Cognitivism, like behaviorism, emphasizes the role that environmental conditions play in facilitating learning. Instructional explanations, demonstrations, illustrative examples and matched non-examples are all considered to be instrumental in guiding student learning. Similarly, emphasis is placed on the role of practice with corrective feedback. However, the "active" nature of the learner is perceived quite differently. The cognitive approach is focused on the mental processes in the mind of the learner that facilitate a response while the processes of mental planning, goal-setting, and organizational strategies are acknowledged (Shuell, 1986).

Cognitive theories claim that neither environmental nor instructional components alone can account for all the learning that results from an instructional situation. Additional key elements include the way that learners attend to, code, transform, rehearse, store, and retrieve information. Though learners' thoughts, beliefs, attitudes, and values are also considered to be influential in the learning process, the real focus of the cognitive approach is on changing the learner by encouraging him/her to use appropriate learning strategies (Ertmer & Newby, 2013).

According to cognitive theories, transfer is a function of how information is stored in memory (Schunk, 1991). Transfer occurs when a learner understands how to apply knowledge in different contexts. Prior knowledge is used to establish boundary constraints for identifying the similarities and differences of new information. Both the knowledge itself and the uses of that knowledge should be stored in memory, but the learner must also believe that the knowledge is useful in a given situation before he will activate it (Ertmer & Newby, 2013).

Cognitive theories are usually considered more appropriate for explaining complex forms of learning (reasoning, problem-solving, information-processing) than are those of a more behavioral perspective (Schunk, 1991). In other words, behaviorists would focus on the design of the environment to optimize transfer, while cognitivists would stress efficient processing strategies. A behaviorist uses feedback (reinforcement) to modify behavior in the desired direction, while cognitivists make use of feedback (knowledge of results) to guide and support accurate mental connections (Thompson, Simonson, & Hargrave, 1992).

Specific cognitive assumptions or principles that have direct relevance to learning include (1) emphasis on the active involvement of the learner in the learning process (learner control through self-planning, monitoring, and revising techniques), (2) use of cognitive task analysis procedures to identify and illustrate prerequisite relationships, (3) emphasis on organizing and sequencing information to facilitate optimal processing (use of cognitive strategies such as outlining, summaries, synthesizers, advance organizers, etc.), and (4) creation of learning environments that allow and encourage students to make analogies and connections with previously learned material (Ertmer & Newby, 2013).

In the second half of the 20th century, a number of cognitive theorists began to adopt a more experience integrative approach to learning and understanding in which knowledge is

produced and meaning formed on the bases of individual experiences. Knowledge was viewed as a function of how an individual creates meaning from personal experiences (Jonassen, 1991b). Like most other learning theories, constructivism has multiple roots in the philosophical and psychological viewpoints of this century, specifically in the works of Piaget, Bruner, and Goodman (Perkins, 1991).

Constructivist learning theory, like behaviorism and cognitivism, is not a unified whole. It is represented by a range of standpoints based on two or more distinct positions with common characteristics (Harasim, 2017). The major theorists of constructivism were Piaget (Webb, 1980) and Vygotsky (Vygotsky, 1978) whose views on learning gave rise to two constructivist approaches, cognitive and social. Cognitive constructivism emerged from Piaget's research on the stages of human development in the process of the construction of progressively complex logical propositions (Harasim, 2017). Social constructivism emerged from the works of Vygotsky who focused on what and how people learn from one another. This theory utilized such concepts as observational learning, imitation, and modeling (Ormrod, 2008).

Constructivism is a theory that equates creating meaning from experience to learning (Bednar et al., 1991). Even though constructivism is closely related to cognitivism (both regard learning as a mental activity), it distinguishes itself from traditional cognitive theories in a number of ways. Most cognitive psychologists think of the mind as a reference tool to the real world while constructivists believe that the mind processes input from the world to produce its own unique reality (Jonassen, 1991a). The mind is believed to be the source of meaning altogether with individual, direct experiences with the environment that are considered critical.

Constructivists do not share with cognitivists and behaviorists the belief that knowledge is mind-independent and can be transmitted to a learner. Ertmer and Newby (2013) explain this

by stating that constructivists do not deny the existence of the real world but contend that what we know of the world stems from our own interpretations of our experiences. Humans create meaning as opposed to acquiring it. Learners do not transfer knowledge from the external world into their memories, rather they build personal interpretations of the world based on individual experiences and interactions. Thus, the internal representation of knowledge is constantly open to change, and it emerges in contexts within which it is relevant (Bednar et al., 1991).

Both learner and environmental factors are critical in constructivism, as it is the specific interaction between these two variables that creates knowledge. Constructivists argue that behavior is situationally determined (Jonassen, 1991a). Just as the learning of new vocabulary is enhanced by exposure and subsequent interaction with those words in context (as opposed to learning their meanings from a dictionary), likewise it is essential that content knowledge be contextualized. It is critical that learning occur in realistic settings and that the selected learning tasks be relevant to the students' lived experience. The emphasis is not on retrieving static knowledge structures, but on providing learners with the means to create situation-specific understandings by referring to prior knowledge from diverse sources appropriate to the problem rather than the recall of prepackaged schemata (Driscoll, 2005).

Regarding knowledge transfer, the constructivist position assumes that transfer can be facilitated by performing authentic tasks in meaningful contexts. Since understanding is shaped by experience, the authenticity of the experience becomes critical to the individual's ability to use ideas (Brown et al., 1989). An essential concept in the constructivist view is that learning always takes place in a context and that the context forms an inexorable link with the knowledge embedded in it (Bednar et al., 1991).

Some of the specific strategies utilized by constructivists include situating tasks in real-world contexts, use of cognitive apprenticeships (modeling and coaching a student toward expert performance), presentation of multiple perspectives (collaborative learning to develop and share alternative views), social negotiation (debate, discussion, evidence giving), use of examples as real "slices of life," reflective awareness, and providing considerable guidance on the use of constructive processes (Ertmer & Newby, 2013).

As Schuh and Barab (2008) state, there is no conventional positivistic way to prove that one theory is better than another. Within each, they add, discussion about their merits has much room. Although learning theories represent particular worldviews and are associated with somewhat established instructional methods and practices, alignments between them may not be consistent. Today, with the support of powerful computer technologies, digital native learners bring changes to that alignment and actively create their own learning practices outside the classroom contributing to the rise of educationally relevant theories of learning (Mayer, 2003).

Learning is a complex process, and there is no single best explanation of this process though each one offers more or less useful explanations depending on what is to be explained (Woolfolk Hoy, Davis, & Anderman, 2013). Theories of learning are a "dynamic and fluid part of knowledge, improving with new research and … technologies that emerge and transform intellectual horizons" (Harasim, 2017, p. 10). By the present moment, such developments make some of the earlier writings outdated (Semple, 2000), nonetheless, learning theories remain very important in reflecting the thinking of the time, the historical diversity of approaches, and the complexity of conceptualized problems.

The Learner through the Prism of Learning Theories

The use of technology in education establishes favorable prerequisites for creating an optimal "true synthetic learning environment" (Cannon-Bowers & Bowers, 2008, p. 318) for learning; however, factors to be considered in the matter involve not only the technology and the subject matter but also the learner characteristics and pedagogical principles. Distinctive interaction of the three learning theories with the learners' individual differences, as it may be deducted from existing research, is yet to be established. Graf and Kinshuk (2008) reasonably note that people prefer to learn in many different ways and have different cognitive abilities that influence effective learning. Reasoning ability, information processing speed, associative learning skills, and metacognition are typically mentioned as important abilities but the working memory capacity usually comes first on the list (Graf & Kinshuk, 2008, p. 309).

In behaviorism, the learner is characterized as being reactive to conditions in the environment as opposed to taking an active role in discovering the environment. Both learner and environmental factors are considered important by behaviorists; however, it is the environmental conditions that receive the greatest emphasis. This approach to student learning was developed in educational psychology from the perspective of the response strengthening view of learning which suggests that educational technology should employ sustained instructional methods such as drill-and-practice, in which the student performs the same skills over and over, receiving feedback on each trial (Mayer, 2003).

In cognitivism, learning is supported through a mechanism of a series of cognitive processes that are applied to mental representations resulting in the transformation of the latter. This manifests the view of learning as knowledge acquisition and it is based on the information-

processing view of learning that stresses that learning occurs when a learner processes information that is presented (Mayer, 2003).

Constructivist learning is viewed as knowledge construction because learners purposefully create, apply, and coordinate their own cognitive processes while acquiring their own knowledge (Mayer, 1999c). Some major types of constructivism are individually mediated cognitive constructivism, socially mediated cognitive constructivism, social constructivism, and radical constructivism (Mayer, 2003). It is today's dominant theory of learning that promotes the idea that learning occurs when learners actively try to make sense of the processed notions and concepts. The mechanism underlying this model of learning is the building of mental structures through the strategic application of cognitive processes. This is an outstanding learner-centered approach in which digitally-based learning activities such as simulations or multimedia presentations guide the learners in their efforts at acquiring knowledge (Mayer, 2003).

Driscoll (2005) believes that there is “no single constructivist theory of instruction” (p. 386). Ontologically, constructivism can be viewed as a collection of such earlier approaches as discovery learning, embodied cognition, situated cognition, cognitive flexibility theory, and some others (Driscoll, 2005). To combine the findings of many learning theories, Driscoll and Schott proposed a Universal Constructive Instructional Theory (UCIT), which will be prescriptive, systemic, wholistic, and humane (Driscoll, 2005). On its basis, they proposed an approach to devising “situated instructional theories” (p. 414) which embeds overall goals, a dynamic interchange of the learner, learning task, and the environment, and situated constraints. The UCIT authors invited anyone to give the process a try; however, as any theory needs a period of testing to be accepted by the scholars, this theory is, supposedly, still in the trial process.

Digital Age Learner: Digital Divide and Digital Use Divide

For over a decade there has been a widespread discussion on the relationship between a new generation of learners and the new forms of networked and digital technology (Jones & Hosein, 2010). This new generation has been given different names, such as Millennials (Howe & Strauss, 1991; 2000; 2003), Net Generation (Oblinger & Oblinger, 2005; Tapscott, 1998; 2009) or Net-Geners (Shakarami et al., 2017), Digital Natives (Palfrey & Gasser, 2008; Prensky, 2001), and Generation Z or GenZ, describing the youngest as of today (Dimock, 2019; Munsch, 2021). The latter has become a popular naming convention for this group (ages 24 and under in 2021) and is the largest age cohort in United States society today with 86.4 million members versus the next largest group of Millennials with 71.8 million members (Munsch, 2021).

A variety of start dates and age ranges of the generation was provided by the aforementioned authors to determine its exact timespan, but today, twenty years into the third millennium, it seems secondary and nonessential for the present research to discuss the generation's particularly specific chronology and signifying names. Of greater importance is the acknowledgement of the idea that traditional school and college-level students today are much likely to belong to this "digital" generation just by the fact of their birth, their learning priorities, and learning habits. From the chronological perspective, they may be called Millennials, whereas in relation to the technologies they live with – they are, in essence, Digital Natives, Net-Geners, and GenZes, and they all represent the Net-Generation. The two terms, Digital Natives and Net-Geners, will be interchangeably used in this study as best fitting to instantly convey the seme of their belonging to the digital technology era.

The Digital Natives and Net-Geners are described as learners who naturally take "the instantaneity of hypertext, downloaded music, phones in their pockets, a library on their laptops,

beamed messages and instant messaging" (Prensky, 2001, p. 3), and who have been networked most of their lifetime. They are said "to require rapid access and quick rewards, to be impatient with linear thinking and to display a capacity for multi-tasking and collaboration" (Jones & Hosein, 2010, p. 44). This suggests that the new generation of university students possesses a variety of features that, on the one hand, do not make them a homogeneous generational grouping, and, on the other, may influence their engagement with technology. Jones and Hosein (2010) point out demography (e.g., gender and age) and context (e.g., mode of study and frequency of use) as influential factors in the student population's relation to new technologies. If that is the case, then it becomes crucial to find out whether this rather established relation, in its turn, influences the learning approaches students naturally choose to support their learning most efficiently. Overall, we agree with Thompson (2013) who noted that technology use is an influence on students but is not a deterministic factor.

A popular claim argues that Digital Natives and Net-Geners have a distinctive set of individual characteristics, habits, and behaviors that include preference for speed, nonlinear processing, multitasking, and social learning, allegedly developed through immersion in digital technology during childhood and adolescence when neural plasticity is high (Prensky, 2001a, 2001b; Rosen, 2010). In physiology, neural plasticity implies a process in which conditioning of specific skills leads to the development and strengthening of the neural circuits activated in performing those skills, while neural circuits that are not stimulated eventually degrade (Kleim & Jones, 2008).

Some researchers (Prensky, 2001b; Small & Vorgan, 2008) claim that digital immersion, gaming, and use of other digital technologies can profoundly affect the development of the Net-Geners' young, highly plastic brains, overdeveloping certain regions of the brain while

neglecting others. While developing superior visual skills, hand-eye coordination, and the ability to monitor multiple processes and react quickly to unexpected events, the authors say, that digital occupation appears to suppress activity in the frontal lobe responsible for planning, abstract thinking, and perspective-taking.

Other researchers (Blakemore & Choudhury, 2006; Smith, 2011) point out that neural plasticity is involved in any process of learning, not just learning from technology, thus cautioning against the use of neural plasticity as an argument to support the assertion that the digital natives are different from previous generations as our knowledge of neural plasticity alone is not enough to explain learning (Bruer, 1998). Whether neural plasticity substantially modifies certain behaviors that affect the way the Digital Natives process information and manage their learning or not at all, the mere existence of neural plasticity is a reason for concern that immersion in digital technology from a young age *could* (italic by Thompson, 2013) alter some parts of the brain structure (Thompson, 2013).

In an attempt to avoid making sweeping generational statements, we have to take into consideration the notion of learning styles that make up an important factor in language learning. They can be described in several commonly adopted learning style indicators and models based on different dichotomies and dimensions. Commonly mentioned are the Myers-Briggs Type Indicator, Kolb's learning style model, Honey and Mumford's model, and Felder-Silverman model that rely on a central role of individual learners in a technology-enhanced learning environment (Graf & Kinshuk, 2008).

However, for the present study, the aforementioned opinions and assumptions are just a matter for consideration rather than an assertion upon which to build a solid research argument and make conclusions about Digital Natives' generational distinctions. As Reeves and Oh (2008)

point out, for the most part, the research on cognitive, affective, and psychomotor differences between generations is based on small, highly selective surveys, and that factor contributes to some controversial results about learning engagement among today's students and other social groups. For example, a comparison of university students' technology use shows small differences between users under and over age 25 and even between younger people who embraced all types of technology and older people who seemed to avoid it (Kennedy, Dalgarno, et al. , 2008; Kennedy, Judd, et al., 2008). Guo et al. (2008) who studied self-perceptions of information technology competence among university students from 20 to over 40 years of age found no significant differences between age groups either.

For the same reason, the learning style concept (e.g., Briggs-Myers, 1962; Honey & Munford, 1982; Kolb, 1984) which might help to disclose some learning habits of the Digital Natives does not seem to offer a strong explanatory background to analyze learning behaviors of the Net generation and validate generational differences. Many researchers of learners' learning styles point out a distinct lack of empirical support to make conclusions about such interactions (Baumgartner, Lee, Birden, & Flowers, 2003; Rogowsky, Calhoun, & Tallal, 2015; Lodge, Hansen, & Cottrell, 2016; Mazo, 2017; Koppenol-Gonzalez, Bouwmeester, & Vermunt, 2018).

To be incorporated into an educational environment, any of these or other classifying approaches of learners' differences (Gardner, 1983; Jonassen & Grabowski, 1993) need to be based on the information about the cognitive and psychological characteristics of learners, which, in its turn, needs to be collected through tests, surveys, questionnaires, or observations. In a situation when the impact of digital technologies on the Net-generation learners' strategy preferences is the research focus, and not vice versa, the shift to the learners' style factor would deflect the study from its focus without revealing much of the target information. It would be

more efficient to take a deductive approach and to infer this kind of information from the analysis of their preferred everyday learning behaviors and practices in the learning process, thus making them the research focus.

Today's technologies offer high-quality learning resources, such as visualization, simulation, games, interactivity, intelligent tutoring, collaboration, assessment, and feedback (Expanding Evidence Approaches for Learning in a Digital World. U.S. Department of Education Office of Educational Technology Report, 2013, p. 7). With significant increase of internet access in schools, libraries, and homes, the traditional "digital divide" referring to the gap in the internet access (Culp et al., 2005; McConnaughey et al., 1995) stopped being a dividing issue. However, a digital use divide, as the National Education Technology Plan Update indicates, "continues to exist between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption" (U.S. Department of Education, Office of Educational Technology, 2017, p. 7). Another dividing factor may be referred to the fact that digital information resources can be presented in a variety of forms (text, audio, video, image, animation, and other) and thus may match or mismatch the learners' preferred ways of processing information.

Although quite a few new models and environments for teaching and learning appeared, such as blended learning, e-learning, ubiquitous learning, or incidental learning, which are more adapted to learners' needs and limitations, and in which focus is put the on learners and a more autonomous way of learning (Pareja-Lora et al., 2016), they did not lead immediately to the innovative use of digital technologies. It was noted that the digital use divide exists between the use of technology to transform ways of learning and completion of the same old types of activities, but now with a digital medium, regardless of the formality of the learning setting and

socio-economic characteristics of the communities (Fishman et al., 2016; Valadez & Durán, 2007; Warschauer, 2012).

The difference in the digital use among the Digital Natives might be the factor of research interest in considering their technology use patterns. Studies suggest that while use of digital technology for basic communication is common among Digital Natives, very few create text, audio or video content (Thompson, 2013). Kennedy et al. (2010) looked at the technology use patterns of students from three Australian universities and found that only 14% of them could be classified as "power users" who used a wide variety of technologies frequently. The remaining groups used a restricted range of technologies (basic mobile phone features and web use) with very few using technology for gaming and multimedia content creation.

The observations on the digital use divide make it reasonable to add a question on the use frequency in the survey as the study of multivariate correlations between frequency, LLS, and language skills supported may bring about relevant research findings. Also, the comparison of high and low-frequency groups of users may reveal potential generalizations about Digital Natives on the basis of inferential data analysis.

Technologies in the Field of Language Learning

The development of powerful digital instructional technologies supported by educationally relevant theories of learning gives way to a great variety of exciting opportunities (Mayer, 2003). Technologies allow learners and teachers to employ techniques that go beyond the parameters of campus-based educational setting. A great deal of resources can be placed within easy reach of learners, individual and group work can be done in their own time, at their own pace and place, and what is no less important is they are becoming widely available, accessible, and affordable (Naidu, 2008). Many researchers also note that one of the most important accomplishments of using computer technologies is that they change the way teachers

teach and students learn in specific content areas and across them (Dawson et al., 2008; Gilakjani, 2014), urging students to gain knowledge individually and to acquire responsible behaviors (Drayton et al., 2010).

The application of information and communication technologies to language teaching and learning gave birth to an approach incorporating a wide range of teaching techniques and activities that employ computers in the teaching and learning of a new language. Initially, it was called Computer-Assisted Language Learning (CALL), behaviorist and communicative, and later it obtained other names as well, such as integrative Computer-Assisted Language Learning (iCALL; Bax, 2003; Warschauer, 1996), intelligent Computer-Assisted Language Learning (ICALL), and Mobile-Assisted Language Learning (MALL) with each stage corresponding to the prevailing theory of learning, dominant pedagogical approach, and technology level (Warschauer, 2004).

Behaviorist CALL typically utilizes repetitive drill-and-practice language drills while communicative CALL laid emphasis on production of original utterances and assisting the students at using the target language effectively for communicative purposes based on skills like speaking and writing (Jones & Fortescue, 1987). At the time when communicative teaching started to give way to a more interaction-based view with emphasis on the use of language in authentic social contexts (Warschauer & Healey, 1998), the integrative CALL (Warschauer, 1996) brought to life learner-directed task-based, project-based, and content-based approaches to immerse them into authentic environments via utilizing several skills of language learning and use.

In the sub-context of language e-learning, the current trend is Technology Enhanced Language Learning (TELL), CALL and iCALL, where the computer is just a means for learning,

allowing for open, creative, collaborative practices with and through computers (Vazquez Calvo & Cassany, 2016). A new TELL research field is becoming very active to analyze, explain, and promote expanding functionalities of digital language learning tools. With an unprecedented increase in the use of language learning applications, sophisticated software, and open-source language learning platforms, technologic affordances generate an abundance of new TELL practices (Chen et al., 2020) which amend our understanding of language education (Marijuan & Sanz, 2017) and learning.

Self-regulatory learning engages students' active participation in learning and attributes them to being autonomously involved in planning, monitoring, and assessing their learning from the metacognitive, motivational, and behavioral perspectives (Mohammadzadeh & Sarkhosh, 2018; Zimmerman, 2000,). Support of such a variety of learning functionalities would get much benefit from modern technologies, so students need to take advantage of the utilization of the whole spectrum of digital technologies present at their disposal. There is no established classification of technologies for language learning, so finding out which existing technologies today are supportive of focused learning of four language skills and basic language aspects is our next goal.

Categories of modern digital technologies

Technologies are constantly changing, and in the last two or three decades especially rapidly, so the inventory of technologies is growing together with changes brought about by the progress in the field. Some ten years ago the types of most influential technology tools utilized in educational settings were said to include internet tools and resources (such as e-mail and Web browsers), Web 2.0 tools, the so-called general productivity tools (word processors, spreadsheets, etc.), interactive whiteboards, and portable digital devices (Wurster, 2009). They

were adopted to serve the learners' needs throughout every knowledge field including language teaching and learning.

Thompson (2013) utilized a more expanded digital technology classification that included eight positions: *Rapid Communication Technology* (text messaging on a cell phone, checking, updating, or commenting on Facebook, making a voice call on a cell phone, chatting in real-time on a computer, and using several technologies at one time), *Multimedia Creation* – creating a digital image, uploading a digital image to a file sharing site, creating or editing a video, uploading a video to a file-sharing site, and creating an audio file, *Active Web Reading and Writing* – reading, writing, and commenting on blog entries, creating or maintaining a website, reading long detailed web pages, and reading entertainment web pages, *Gaming* – playing strategy games on computer, playing action games alone or with others, and playing puzzle games (e.g., Tetris), *Web Resource Use* – using the web to explore a topic in depth, using the web to look up a fact, watching a video online, and listening to music online, *Collaborative Web Tool Use* – annotating a web page, using a social bookmarking site, using a shared document on the web (e.g., Google docs), and contributing to a wiki, *Productivity Tool Use* using word processors, spreadsheets, databases, and presentation tools, *Microblogging* – updating or reading a microblogging site such as Twitter. Although *Book Reading for enjoyment or learning* was also included as factor nine, the author mentions that this factor does not pertain to digital technology like the other eight factors, and it entered the list as a comparison between the use of older and newer digital technology (Thompson, 2013).

DeKeyser (2007b) stresses that technologies dramatically impact the breadth and depth of L2 learners' exposure to the target language and interactive activities in which they have the opportunity for language focus. The operational load of digital technologies in language teaching

ensures three functional areas: (1) access to materials, (2) communication opportunities, and (3) motivation (Ürün, 2016). The first two are the areas where the L2 learners get the most support in acquiring L2 language skills and developing language aspects. Motivation is an acknowledged factor in general human learning as well as in language learning. However, although technologies are generally said to enhance learners' motivation and involvement, to foster autonomy and responsibility, and to provide better quality of learning and make language learning more affective, active, and satisfied (Ürün, 2016), motivation as an attitudinal characteristic in language learning seems to have little relevance to the classification principles of L2 technologies, and, thus, will not be considered as constituting factor.

Comprehensible access to engaging, authentic, and culturally specific materials in the target language is crucial for successful language learning (especially for listening and reading input). The principles to provide better access to linguistic and cultural materials can be promoted by improving access efficiency through digital multimedia technologies, increasing authenticity using video and the internet, augmenting comprehensibility through learner control and multimedia (Zhao, 2003). Available research results show, however, that most students (94%) prefer to use traditional resources (flashcards, songs, and realia) with the help of technology (YouTube, TEFL websites, etc.) rather than creating their own designed technological materials or programs for language training (García Esteban, García Laborda, J., & Rábano Llamas, 2016) supporting the idea of the digital use divide.

Another essential condition for successful L2 learning is engagement of learners in authentic interaction in the target language. Over the past decade, mass access to the internet, the development of new types of electronic devices, applications, and platforms, and the spread of social networking, has made language learners be globally connected. Under such conditions, L2

learners and users can now access a wealth of language material online and also take part in online activities of communities of interest which produce and share their own content and experiences (Zanoni, 2016), promoting learners' self-regulation and autonomy and expanding learning opportunities.

The term Web 2.0 (O'Reilly, 2005) was introduced to represent a peculiar use of the web where users in addition to being consumers of the available digital products become active participants in the production and sharing of content. Web 2.0 is meaningfully composed of tools and services that facilitate communication, promote interaction and cooperation among users, allowing the creation of web communities where each individual is user and author at the same time. There is a plethora of Web 2.0 resources that support oral and written communication in a foreign language.

Zanoni, (2016) assumes that this internet transformation has also changed learning models and environments. The term e-learning 2.0 (Downes, 2005) is now used with regard to a variety of formal and informal modes and practices related to the use of the web for such type of learning. Digital e-learning serves the needs of both individual learners and communities of experts which may aggregate and interact spontaneously to find solutions for specific issues. In the e-learning environment, L2 learners' communicative competence will be displayed through some peculiar skills to utilize situationally accessible L2 technology aids, such as online bilingual dictionaries, grammar checkers, or audio closed captioning and to switch between appropriate linguistic choices and technologies in face-to-face, remote, written, and oral modes (DeKeyser, 2007b).

As of today, in their systemic review of research developments in the language learning field, Zhang and Zou (2020) offered a comprehensive analysis of modern technologies for

second or foreign language learning. They distinguish five main types of cutting-edge technologies suitable for L2 learning: mobile learning, multimedia, socialized learning, text-to-speech and speech-to-text recognition, and game-based learning. The most utilized purposes that were noted to support the process of language acquisition were: promoting practices, delivering instructional content, facilitating interactions, and restructuring teaching approaches (Zhang et al., 2020).

This classification covers technologies studied in peer-reviewed publications within the last four years (2016-2020), and these are the most up-to-date technical innovations for language learning. They make a state-of-the-art extension of language learning tools developed earlier, so the five-type inventory needs some expansion and, likely, rearrangement to include a wider range of utilized digital language learning availabilities. A brief analysis might be helpful to establish a range for their differentiation.

The first consideration about this typology is that the categories making it are based on different grounds. From the perspective of language learning functionality, devices such as smartphones, tablets, digital pens, and wearable devices like smartwatches, augmented and virtual reality glasses that the authors refer to the type of mobile learning (Zhang & Zou, 2020) could be assigned to the multimedia group by their essential functional characteristics aimed at supporting the development of language skills and aspects. Mobility as a classifying semantic feature represents here a device type itself used as a technological medium (DeKeyser, 2007b) rather than a functionally loaded language learning application. Similar considerations arise while taking a closer look at speech/text recognition as an assistive software converting audio content into graphic form rather than a separate language learning technology type. It seems it could be either included into the multimedia type or make another type of assistive technologies.

Multimedia type of technology serves to support several methodological and psychological constraints in L2 learning: the more input channels are used for delivering the information the more learning occurs as that helps to evade or lessen the overload of the working (short-term) memory (Mayer, 2003). In this context, Mayer (2003) attributes several multimedia use effects (contiguity, coherence, modality, and redundancy) to the efficiency of knowledge construction which is sensitive to the use of specific combinations of presentation modes (verbal, image, music, sound, animation etc.).

A relatively recent, highly efficient, but not yet much common technological trend in digital language learning is the use of intelligent language tutoring systems (ILTS). Grounded within ICALL and intelligent tutoring systems (ITS) approach (e.g., AutoTutor; Graesser et al., 2004), ITS is able to support conversations with humans in natural language to achieve learning gains across multiple domains (e.g., computer literacy, physics, critical thinking). The AutoTutor was not designed specifically to support language learning, but the idea of using artificial intelligence for the purpose of foreign language learning was implemented in another ILTS project, German Tutor (e-Tutor). A description of its functionalities should give us a grasp of the unique potential of such systems at the same time making us realistic in terms of their broad application.

German Tutor (Heift, 2016) was first published in 2001, significantly upgraded in 2003, and further expanded in 2009 to utilize a complex architecture that integrated multiple servers and several programming languages. At the same time, these upgrades involved rewriting some of the initial computer codes to achieve a wider coverage of language phenomena and to provide additional learning tools, extension of activity types to target the learners' pronunciation, vocabulary skills, listening/reading comprehension, cultural knowledge, and writing skills. In

addition to extending the learning content, several learning tools (e.g., dictionaries, vocabulary flashcards), multimedia (authentic pictures, cultural information), extensive help pages (e.g., activity types, grammatical terminology), and system usability (e.g., displays, navigation) were added. Artificial intelligence techniques made linguistic features of content texts more salient to help students develop awareness of the language and of language learning pedagogy implementation in the regular language learning classroom.

By today, the ILTS German Tutor functionality is exceptionally inclusive allowing students to practice chapter-related vocabulary and grammar, listening and reading comprehension, culture and writing, and pronunciation units with audio recordings of native speakers to accomplish different learning goals. Activities like filling in the missing sounds, morphological inflections, vocabulary units, translation tasks, reading comprehension, knowledge of culture, and writing on the chapter theme are crowned with the powerful capacity of ICALL systems to generate error-specific feedback to learners and to keep their profiles.

A glimpse of an ILTS process development and capabilities shows that such systems are extremely laborious, they take years to develop, need very many computer and language professionals to populate the system with relevant materials, and need constant updates and tech service. Obviously, they must be very expensive and that should affect their market availability resulting in affordability limited to big institutions or commercial firms. For this reason they will unlikely be available for the majority of digital native students, so we do not plan to include ILTS as a digital language learning category into the present research survey list.

Shadiev and Yang (2020) note that technologies for language learning and instruction are developing fast, new technologies emerge, some become outdated, so keeping a frequent track of applications and changes and review of earlier, present, and future practices is needed. In their

review of technology use in language learning and teaching (Shadiev & Yang, 2020), twenty-three kinds of technologies were mentioned in almost four hundred articles published between 2014 and 2020. For our purposes, we will disregard technologies no longer in use, concentrating instead on those still in use and new, the number of which totals under twenty in the review.

It is worth providing a list of these technological types with the intent of finding out whether they overlap and whether they could be re-grouped based on their functionality in supporting language targets: skills and aspects. The still in use technologies mentioned were as follows: games, corpus, automated feedback, social networking, instant messaging, virtual reality, websites and digital resources, speech recognition, collaborative writing, electronic gloss or annotation, intelligent tutoring systems, and electronic dictionary. Among new technologies, online video, e-books, voice recording, augmented reality, clickers, robots, and wearable devices were listed as having usability in language learning and teaching.

Further notes need to be made to finalize the list of language learning technologies to avoid overlap, achieve better language learning target matching, and to make it more manageable in a survey context. Here are some. Corpus as a collection of speeches, conversations, writings, etc. that students use to study may fall under the digital resource type, social networking usually offers instant messaging service, and both may contribute to collaborative writing, virtual reality is rather a medium than a language skill supporting resource, electronic gloss like closed captioning is a software integrated functionality allowing text, audio, pictures, or video animations to annotate the target content. Functionally close to the last group are speech recognition, voice recording, and online video. E-books, electronic textbooks, may also be viewed as digital resources, online dictionaries may be classified as digital references alongside with online encyclopedias. Technologies like clickers, robots, wearable devices, or augmented

reality seem to have the least impact in the field of language learning. This fact is reflected in the table of technology use provided by the authors, so these technologies should not be considered for the research survey inclusion.

Although such technology categories as adaptive computer-based systems, multimedia, hypertext and hypermedia, interactive simulation, intelligent tutoring systems, inquiry-based information retrieved, animated pedagogical agents, virtual environments, games, and computer-supportive collaborative learning (Graesser, Chipman, & King, 2008, p. 218) make up a broad basis for classification, some learning availabilities from the list also seem relevant to the field of L2 learning. From L2 methodological and pedagogical perspectives, it seems reasonable to distinguish in the present study the following widely adopted digital tools: online course textbooks, online references, digital learning resources, language learning websites, audio/video platforms, collaboration platforms, social and news media (Wang & Vásquez, 2012; Zanoni, 2016) as well as the aforementioned games, tutoring systems, and assistive technologies.

Language learning strategies (LLS)

The origins of language learning strategies trace back to Rubin's (1975) publication in which the author contemplated the factors that contributed to L2 acquisition success differential in students. Noticeable variations in L2 learners' linguistic accomplishments are common knowledge among teaching professionals and the broader public, but the author paid attention to learners' individuality factors from the perspective of how language learners manage their own language learning. Insightful examination of L2 learners' observable behaviors (such as, e.g., asking for help or seeking out a conversation partner) and unobservable mental operations (such as, e.g., selective attention) allowed her to delineate techniques or devices which successful learners might use to acquire language material which were then called strategies (Rubin, 1975).

The initial list of strategies which comprised learners' thoughts, actions, and social behaviors (Rubin, 1981) was further developed by O'Malley et al.'s (1985) predominantly cognitive and metacognitive taxonomy that focused on strategies learners used to process novel information about a new language. The development of the SILL instrument, Strategy Inventory for Language Learning, by Oxford (1990) marked the beginning of the enthusiastic, prolific, multi-aspectual, and systemic LLS research era which had continued for over three decades. Oxford's fundamental work marked the beginning of a boom in strategy research (Rose et al, 2018), and for more than four decades it has received considerable attention in the research literature (e.g., Cohen & Griffiths, 2015; Dörnyei & Ryan, 2015; Oxford, 2017).

Since the mid-2000s the LLS field has been discussing some issues about its theoretical background and potential replacement with the notion of self-regulation (Dörnyei, 2005; Tseng, Dörnyei, & Schmitt, 2006), conceptualization of strategies and definitional fuzziness (Macaro, 2006), and measurement approaches (Woodrow, 2005). By now, the developments that followed the discussions have only strengthened the LLS field with the conceptual refinement of applicable theoretical frameworks, greater definitional clarity, and ideas to apply qualitative measures to data analysis. Several systematic reviews of the LLS research that were published recently (Cohen & Griffiths, 2015; Rose et al., 2017; Wray & Hajar, 2015) exhibit overall support of the fundamental assets of the SILL instrument and the strategy concept as a whole along with the enduring appeal of LLS in the eyes of scholars (Cohen & Wang, 2018).

Out of three variables the LLS author and research pioneer mentioned as important contributing L2 acquisition factors: aptitude, motivation, and opportunity, the latter has a direct relevance to the research questions and hypotheses of the present study. In our context, Rubin's "opportunity" is manifested by the modern digital affordances which expose the learners to the

L2 language environment inside and outside the classroom and provide practically limitless opportunities for language training activities and communication practice in many different social situations to get a proper feel for the context.

Throughout the years of the LLS investigation, a relatively large number of strategies learners employ have been offered for consideration and described, and several strategy categorization schemas have been proposed and applied in both research and language classroom settings (Ardasheva & Tretter, 2013). L2 learners' learning behaviors have been categorized in various ways and from different perspectives while the most popular way to classify strategies has been according to their function in a specific situation (Cohen, 2011; Oxford, 2017). LLS were differentiated according to language learning vs. language use (Cohen et al., 1996), receptive vs. expressive language skill areas that they deal with, or in terms of specific language or culture (Cohen & Wang, 2018; Ranjan & Philominraj, 2019). Strategies have been examined in relation to L2 learners' proficiency level (Hsiao, & Oxford, 2002 Oxford et al., 2014), a number of demographic variables such as age, gender (Nyikos, 2008), learners' characteristics such as motivation and learning styles (Griffiths, 2008a; Oxford, 2011b; Oxford & Lee, 2007).

According to Hassan et al. (2005), the majority of existing strategy conceptions included three categories: metacognitive (such as advance preparation, analyzing needs, comparing, expressing beliefs, prioritizing, setting short-term aims, monitoring, evaluating), cognitive (including defining, inferencing, keeping a diary, listening for gist, predicting, reading aloud, skimming, translation), and affective/social (discussing, joining a group, channeling positive or negative reactions into behaviors), which were also represented as a taxonomy of four categories, with the latter divided into social and affective (Cohen, 2011). However, with the development of the SILL instrument (Oxford, 1990), the six main domains: memory, cognitive,

metacognitive, compensation, social, and affective, became most recognized as factor areas in L2 learning. In terms of practical behaviors, they are manifested through learners' active engagement, use of various memorization techniques, monitoring of language production, communication practice in L2 language, making connections to prior linguistic knowledge, and asking questions for clarification (Chamot, 2001). Cohen and Wang (2018) suggested that a lasting, sustained interest to LLS, a "fascination with strategies" (p.169), was grounded in practical values of the concept: the more strategic language learners' efforts are the more success they can achieve in their language learning.

SILL Domains

Just the mere distribution of the survey items shows that the SILL taxonomy was considerably influenced by cognitive theory, being focused mainly on the attribution of cognitive (14 items), metacognitive (9 items), and memory (9 items) strategies to effective L2 learning. Less, but equal (6 items each) attention has been paid to the significance of social, attitudinal, and cooperative factors in which a language learner is placed. Drawing on cognitive psychological theories has long been rooted in the seemingly justified recognition of importance of cognition in learning, but this focus could have led to some conceptual strategy issues related, for example, to defining strategy limits while delineating simultaneously occurring cognitive, behavioral, or affective traits (Cohen & Wang, 2018; Wray & Hajar, 2015).

The recently suggested sociocultural standpoint in understanding learners' use of LLS (Gao, 2010) considers them to be mediated by the contextual conditions in which learners are engaged. Socially oriented theoretical perspectives (e.g., Gao, 2013; Palfreyman, 2011; Parks & Raymond, 2004; Norton & Toohey, 2011) stress that language learning is a culturally and historically situated social process in which learners are active creators of their linguistic and

non-linguistic identity. Strategy use in language learning from this viewpoint is often seen as the outcome of a complex dynamic interaction between shifting contextual conditions and learners themselves, underlying their past language learning experiences (Wray & Hajar, 2015). Together with the advantages of reaching foreign language contexts using technology-mediated language resources beyond the classroom (Richards, 2015), digital native L2 learners may be expected to utilize other than cognitively oriented LLS more extensively than ever.

Memory is treated differently within each learning theory. It is not typically addressed by behaviorists but is given a prominent role in cognitivism. Although the acquisition of "habits" is discussed in behaviorism, little attention is given as to how these habits are stored or recalled for future use. The use of periodic practice or review serves to maintain a learner's readiness to respond (Schunk, 1991), so behaviorists are more concerned with demonstrating functional relationships. However, when it comes to explaining a specific behavior, both behaviorism and cognitivism can be considered as being hypothetical.

Of many models of memory, Mahadevan et al. (2002) point out two most favored memory systems, short-term memory (STM) or working memory and long-term memory (LTM). The authors further develop the dual-code hypothesis which is based on the assumption that the working memory consists of two separate components, one concerned with verbal materials and the other with non-verbal. According to this hypothesis, cognitive load is reduced when both channels are activated, thus better learning can take place while, on the contrary, an additional cognitive load is imposed through presenting text-based content in both written and audio formats thus having a negative effect on learning (Kalyuga et al., 1999; Mayer, 1997).

Available digital technologies offer modern L2 learners an extremely rich choice of input modalities to support such behaviors as grouping, imagery, rhyming, and reviewing in a

structured way (Green & Oxford, 1995) that ensure memory efficiency while learning a language and to move the concept of learning for the Digital Natives beyond the rote memorization of facts and procedures toward learning as a process of knowledge creation (Gilakjani, 2014). Applying memory strategies should promote keeping the level of the working memory capacity up to its natural optimal level (7+/- 2; Miller, 1956; Yngve, 1956) without overload, thus preventing potential memory deficiencies affecting natural language use (e.g., comprehension or production).We expect that the SILL memory domain will exhibit from low to mid Digital Natives' usage and medium relationship to the acquisition of language skills and utilization of digital technologies.

Cognition is defined in the Oxford dictionary as the mental actions or processes involved in acquiring, maintaining, and understanding knowledge through thought, experience, and the senses (English Oxford Dictionary, 2019), and is described by Licht, Hull, and Ballantyne (2014) as a mental activity associated with obtaining, converting, and using knowledge. Judging by the definition, learning cannot take place away from cognition, so effective cognitive strategies will always remain an important contributing factor in any approach to learning, with technologies or no. In terms of behaviors, Green and Oxford (1995) define them as reasoning, analyzing, summarizing, and practicing (including but not limited to active use of the language). Being responsible for the manipulation and transformation of the learning materials (Dörnyei, 2005), cognitive activities have always been included into all known strategies classifications and related to L2 learners' proficiency (Hajar, 2019). We expect that the SILL cognitive domain will exhibit high Digital Natives' usage and strong relationship to the acquisition of language skills and utilization of digital technologies.

Compensation strategies are language problem-solving techniques represented by a variety of mental or physical behaviors aimed at resolving any language learning problems they encounter (Oxford, 1990). In practical behaviors, compensation of language gaps by other means takes place through guessing meanings from context and using synonyms and gestures to convey meaning (Green & Oxford, 1995), and is divided into guessing intelligently and overcoming limitations in speaking and writing (Oxford, 1990). Guessing compensatory techniques are carried out either by linguistic (e.g., by applying morphological grammatical knowledge) or non-linguistic (e.g., context, situation, interlocutor, register) means, and gaps in speaking and writing are compensated by such techniques as code switching, getting help, mimics/gestures and body movement, coining words, adjusting or avoiding messaging. Shakarami et al. (2017) report from mid to high usage of compensation strategies by the Net-Geners as well as some compensatory behaviors modifications.

Due to unprecedented levels of development and utilization of digital communication media, use of specific graphic communication symbols etc., we expect noticeably greater usage of compensation strategies by Digital Natives. However, it is not yet clear if the original SILL compensation items will match the Net generation users' description of behaviors.

Metacognitive strategies are defined as higher-order strategies aimed at analyzing, monitoring, evaluating, and organizing one's own learning process (Wray & Hajar, 2015). Metacognition is often considered to be the "highest level of mental activity, involving knowledge, awareness, and control of one's lower-level cognitive skills, operations and strategies" (Kozulin, 2005, p. 2, as cited in Wray & Hajar, 2015). Currently, cognitive theories of learning focus increasingly on metacognition and self-regulation of learning (Pintrich, 2002) to the degree that metacognitive knowledge, or the understanding of our own thought patterns, was

added as a fourth dimension to the revised Bloom's taxonomy (Woolfolk Hoy, Davis, & Anderman, 2013). Oxford (1996), Perry et al. (2018), and Rubin (2005) pointed out that more attention should be drawn to the metacognitive strategies to enable learners to think about their own thinking, identify their own learning goals, and effectively manage their choice of LLSs. This ability makes their thinking detectable, and this, in turn, can cause them to have greater awareness and management of their learning and response to successes and failures in learning (Anderson 2012, 170).

Commonly mentioned examples of metacognitive behaviors (selecting attention to language input, arranging appropriate physical conditions for learning, planning the learning activity in advance such as reviewing previously covered language materials, or checking one's speaking or writing performance) and those addressed in the SILL instrument let us expect that the SILL metacognitive domain will exhibit from mid to high Digital Natives' usage and strong relationship to the acquisition of language skills and utilization of digital technologies. However, although being positively related to L2 learners' proficiency (Hajar, 2019), metacognitive skills as higher-order abilities require assistance or strategy instruction to be developed. Such assistance may include efforts offered by teachers or obtained as tips in textbooks or on websites for the purpose of helping learners gain a greater awareness of their LLS choices, and then develop this repertoire to accomplish their learning goals (Cohen, 2008).

Affective strategies involve control of the emotional conditions and experiences, strategies for anxiety reduction, self-encouragement, and self-reward (Green & Oxford, 1995). High affective strategies use is reported by more proficient learners than by less, (Hajar, 2019). however, as digital age language learners are more self-directed and can determine the types and arrangement of tasks they choose to work on and disregard tasks they do not consider useful for

the development of their target language abilities (Shakarami et al., p. 237), less achieving learners may also display high use of some affective strategies, e.g., reduction of anxiety. We can expect that the SILL affective strategies domain will exhibit high use by the Digital Native L2 learners; however, there is a potential chance of technological anxiety for less experienced internet users of some innovative applications.

Social strategies involve interpersonal behaviors aimed at increasing the amount of L2 communication, such as, for example, asking questions, initiating interaction with native speakers, cooperating with peers, or becoming culturally aware (Green & Oxford, 1995). With the "social turn" in education (Block, 2003), language acquisition research has shifted the dominance of cognitive norms and assumptions by arguing that language learning cannot be perceived solely as the product of individualistic mental process. LLS use started to be explored from sociocultural language learning perspectives, a variety of approaches to learning that underline the prominence of environmental, social, and cultural processes in mediating learners' cognitive and metacognitive processes (Hajar, 2019, p. 44). With the rise of social media, online communication platforms, and social networking sites for language sharing, the learning targets of social strategies are reached much easier, so we expect that the SILL social strategies domain will exhibit high use by the Digital Native L2 learners.

Rubin (1981) and Oxford (1990) do not apply an explicit differentiation of the six aforementioned strategies only on the basis of learning or use. They also put forward a differentiation between direct (cognitive, memory, and compensation) and indirect (metacognitive, social, and affective) strategies which brings out an additional notional perspective on the LLS. According to this perspective, six basic lower-level domains can be also classified as first-order strategies or categories, and the two upper-level groups as second-order

categories. This differentiation becomes useful when the best-suiting instructional approach is being considered in designing and implementing a learning activity for the target audience.

The Net generation L2 learners have comprehensive opportunities to support their language learning strategies and approaches to learning with digital technologies. Either downloaded computer applications or web-based "cloud" services can satisfy the needs of any type of learner and offer learning activities based on any kind of learning theory, whether behaviorist, cognitive, and constructivist. Examples of such might include practicing standard responses for students with little previous academic success and motivation, learning disabilities, childhood autism, or high levels of anxiety which fall within the behaviorist perspective; tools to support the learners' existing mental structures, analogical reasoning, framing, outlining, mnemonics, concept mapping, or advanced organizers which align the cognitive emphasis, and development of more complex learning tasks involving problem solving, critical thinking, and classification which are associated with constructivism.

As LLS and TELL are contrasted against the behaviorist-cognitivist-constructivist continuum, the focus of learning shifts from the passive transfer of isolated language facts to the active application of L2 skills and aspects. Both cognitivists and constructivists view the learner as being actively involved in the learning process, yet the constructivists look at the learner as more than just an active processor of information; the learner elaborates upon and interprets the given information (Duffy & Jonassen, 1991). The digital support of LLS makes a solid foundation for language learners to construct meaning, to effectively monitor, evaluate, and update those constructions and to align and design experiences so that authentic, relevant contexts can be experienced (Ertmer & Newby, 2013).

CHAPTER III

METHODS

Problem Statement and Research Questions

The scope of the present study comprises the investigation of several correlated constituents that involve, according to the study rationale, the L2 learner, categories of digital technologies, language skills and aspects supported, and language learning behaviors, or strategies, associated with them. The estimation of the extent of these correlations and identification of factors that lead to establishing correlational patterns between the constituents provided us with the data needed to make grounded conclusions about the research topic.

In more specific terms, this research is aimed at profiling university-level students' preferences and identifying correlational patterns in the use of language learning strategies based on their association with particular categories of digital learning technologies applicable for language learning. The research agenda also included the collection of data to determine whether, in turn, the technologies impel learners' strategy preferences in any way and if the technologies are a factor in developing specific language skills and aspects. In order to address the intricate nature of the subject matter, this research study utilized a quantitative method to investigate the directionality of relationships and point out cases of statistically significant relationships between a digital age L2 learner, modern computer- and internet-based L2 learning availabilities, and the learners' arrangements of approaches to their own learning and, thus, of learning strategies to accommodate and support their L2 learning goals. The research was based on the analysis of the most relevant to the research topic self-reported data although the discussion arguments and conclusions were also supported by some collateral observations

involving the analysis of factors disclosing the learners' established, preferred, or just developing learning practices.

Research Questions

As mentioned in the introductory section, the research line-up was guided by the following questions:

1. What learners' attributes display consistent correlations with the utilization of digital technologies in L2 learning?

2. What categories of digital learning technologies are engaged in L2 learning by undergraduate university students as the digital age learners?

3. What digital learning tools contribute most to supporting the development of L2 skills and aspects?

4. What tendencies in the use of language learning strategies are noted among the digital age L2 learners?

The questions explored in the study embrace major relationship pathways between the research constituents conforming to the four questionnaire scales. The latter reflect the respondents' attitudes to and habits in L2 learning, usage preferences of digital language learning availabilities, their opinions about the supportive role of technologies in developing language skills, and utilized learning behaviors representing established learning strategies.

Research questions that are focused on investigating connections, generalizability, or magnitude of effects are typically addressed by quantitative methodologies (Creswell & Clark, 2011), so, a non-experimental, correlational study design in which no independent variable is experimentally manipulated (Hutchinson, 2004, p. 285) is expected to provide sufficient correlation information between a number of variables under natural conditions (Ross, Morrison,

& Lowther, 2010). In correlational research designs, the degree of association between two or more variables is described and measured to find out if they influence each other (Creswell, 2012). Generational differences are regarded as a weak researchable variable (Reeves & Oh, 2008), that is why the research approach used in the study was not utilized to compare the ways of learning a foreign or second language typical of different generations.

The study's variables for this research explicate a broad variety of the participants' personal and demographic characteristics, classification of openly available digital technologies utilized by them in L2 learning, levels of perceived technological support for the development of language skills and aspects, and L2 learning strategies used. The research design is set up to assess relationships between available technologies and learning behaviors by exploring how specific classes of digital technologies correlate with LLS domains and supposedly modify Digital Natives' preferences in the use of learning techniques. Potentially promising in expanding the research outcomes spectrum might be application of analytic procedures to find out factor loadings of strategy items and what new aspects of already existing strategies or what possible new strategies are on the digital affordances array of the current Net-Generation language learners.

Setting and participants

The setting for this study was made up by the University of North Dakota face-to-face and online students, particularly, its undergraduate population enrolled in L2 courses in the Department of Modern and Classical Languages during the 2021 Fall semester. A criterion-based convenience cluster sampling method (Hinkle, Wiersma, & Jurs, 2003) was utilized in the study in which whole groups of students studying a foreign language of the Indo-European language family as their major or minor were selected as the survey respondents. The survey list of

languages included Romance (Spanish and French), Germanic (German and Norwegian), and Classical (Latin) languages as target options. The premise of keeping Latin on the survey list of language variables was that it could be of particular linguistic and methodological interest to additionally compare and register digital technology usage trends in mastering a language of limited communicative utilization. Overall, 327 respondents attempted the survey, 26 survey responses were left in progress and a week later they were automatically recorded though not completed, and two recorded as "not wishing to participate", thus bringing the total number of completed and analyzed responses to 299.

Procedure

Typically, the description of the survey methods includes research purposes, populations and samples, survey tools and statistical techniques (Creswell, 2014). Following this established practice, the research purposes, study subjects, and relevant data analysis availabilities were delineated. The survey was administered online via Qualtrics to the whole population of UND students taking a L2 language to collect data about the participants' demographics, personal technology usage choices of particular classes of supportive digital learning technologies and Web 2.0 tools, and to quantitatively point out the degree of technological support of L2 skills development and the application of specific LLS in the process of language acquisition as digital age learners.

Twenty seven on-campus and online synchronous L2 class sections (100% of all classes available for addressing personally) were visited by the principal investigator (PI) to introduce the survey, explain the research purpose, disclose the benefits of the study, and to request students' participation. Students were informed about the survey electronically by their instructors who posted the invitation letter on Blackboard a day in advance. The instructors

typically distributed the survey link right before the class visit so that the students could attempt the survey in the PI presence in case any questions related to the survey arise. Students' questions were not very frequent, mostly of technical origin to inquire about Qualtrics navigation. Online asynchronous students were informed of the survey opportunity by their instructors through posting the invitation letter and the survey link simultaneously on Blackboard or sending it by email. Additionally considered data collection opportunities of snow-ball sampling via social media survey link sharing to address anyone who presumably meets the sampling selection criteria by age and is a learner of a foreign or second language were dismissed later due to high survey response and as bringing potentially inaccurate data.

The survey landing page was an electronic Study Information Sheet (SIS) based on the University's approved Institutional Review Board (IRB) protocol. The SIS described the purpose of the study, procedure and duration, potential risks for participants, benefits of the study, and compensation terms. It also contained the statements of confidentiality, contact information of the PI, the study academic advisor, and the UND Counseling Center. Due to the nature of the study design, the participants did not have to sign any consent forms, but they were provided with a skip logic option to immediately stop the survey after reading the Information Sheet if they choose not to participate.

Instrument

The questionnaire offered to the respondents contained four sections, or Scales, each aimed at collecting specific information about the four research components: the learner, digital technology categories, L2 skills and aspects, and language learning strategies used. The data collected introduced first-hand students' experiences as evidence for and the subject matter of the study variables related to the research questions. 12 categorical variables with 41 subsets

made up Scale 1 and 70 ordinal variables with identical five-point Likert scale template were organized into three Scales to elicit responses from the participants. This type of response was chosen to measure items from Scales 2, 3, and 4 on supposition that it allows a wider range of possible scores and increases available statistical analyses (Frost, 2020, p. 53). Scales 1, 2, and 3 were made up by the PI while Scale 4 was a borrowed authentic, validated, and reliable strategy questionnaire designed by Oxford (1990).

Scale 1: The Learner

It disclosed personal demographic attributes and study preferences of the participants: their gender, age, academic status (year of study), language learned, proficiency, mode of study, study preferences, affiliation with professional communities in the target language, preferred type of digital device, frequency of digital tools usage, and estimation of resources availability and their overall effectiveness. The questions for the section were selected by the PI on the basis of the literature review findings.

Scale 2: Technologies

Adjusting the literature review data about commonly available digital resources that are aimed at developing L2 language skills, the following ten types of technologies, in our opinion, best expose the ubiquitous nature of digital language learning resources and exhibit the strongest relatedness to supporting the development of various linguistic skills. Bearing in mind that the study survey addresses university students, (1) online e-textbooks may open the list to be followed by (2) online reference sources, (3) language practice websites (online training exercises, quizzes, tests etc.), (4) online learning resources (OLR), i.e. specific tools/aids (spelling and grammar checkers), (5) assistive technologies (speech recognition, text-to-speech conversion, closed captioning/subtitles, computer assisted translation), (6) social and news

media, (7) audio/video sharing platforms, (8) collaborative writing tools, (9) games, with (10) intelligent tutoring systems closing the Technology Scale item list.

The introduction of the technological section is intended to get one of the key data for obtaining answers to research questions. Alongside with the SILL section, it is another pivotal source of the research data. It will help to make connections between the use of widely distinguished and rather universal classes of digital technologies and all other survey sections: L2 skills (reading, writing, listening, and speaking) and aspects (pronunciation, vocabulary, grammar, and style) developed and the SILL.

Scale 3: L2 Skills and Aspects

The L 2 skills and aspects section presents a list of commonly distinguished language skills and aspects. Using the 5-point scale from “little” to “much”, the respondents were requested to assess how efficiently in their opinion the language skills and aspects were supported by the digital technologies the used. Elicited responses allowed identification of cross-scale patterns and presentation of the results in the ranking order.

Scale 4: LLS

One of the most efficient and comprehensive ways to assess frequency of language learning strategy use is a questionnaire (Petrogiannis & Gavriilidou, 2015). Currently, the most frequently employed screening instrument around the world is the six-factor Strategy Inventory for Language Learning (SILL) developed by Oxford in the early 1990s. It consists of fifty individually measured items and reflects several established cognitive and affective learning theories concerning declarative and procedural knowledge, schema building, metacognition, motivation, emotions, and attitudes in the learning process (Oxford, 2011; Gunning, Oxford, 2014). The instrument’s question typology seems to successfully reveal its interaction with

actions a language learner typically undertakes in a learning situation that may or may not require the learners' conscious awareness of behavior choices made. The actions, or strategies, are combinable in clusters or chains and have cognitive, emotional, and social roles.

As a self-report instrument, SILL (version 7.0) is designed to capture strategy use in: (a) memory (e.g., "I think of relationships between what I already know and new things I learn in the second language", 9 items); (b) cognitive (e.g., " I say or write new second language words several times", 14 items); (c) compensation (e.g., "To understand unfamiliar second language words, I make guesses", 6 items); (d) metacognitive (e.g., "I pay attention when someone is speaking second language", 9 items); (e) affective (e.g., "I encourage myself to speak second language even when I am afraid of making a mistake", 6 items); and (f) social (e.g., "I ask second language speakers to correct me when I talk", 6 items). The participants were requested to state how true, in their opinion, the survey statements were using a 5-point Likert-scale, ranging from the lowest point (1) "Never or almost never true of me" through "usually or somewhat true" to the highest (5) " Always or almost always true of me".

SILL is currently considered the most comprehensive strategy inventory with the average reliability coefficients (Cronbach's alphas) reported in studies ranging from .67 to .95 (Ardasheva & Tretter, 2013). Oxford and Burry-Stock (1995) conclude that validity of the SILL rests on its stable predictive and correlative links with language performance (course grades, standardized test scores, ratings of proficiency) and sensory preferences. Other researchers established that Oxford's taxonomy provided the most consistent account for student data (Ardasheva & Tretter, 2013; Hsiao & Oxford, 2002). The instrument reliability was also identified as high across many demographic variables.

Data analyses

Both descriptive and inferential methods of data analysis were employed in the study to obtain answers to the research questions. Descriptive statistics on our variables were obtained prior to doing inferential statistical analyses which were aimed at allowing us to make predictions and generalizations. Correlation is one of typical analytic approaches in correlational design (Devlin, 2018), so several correlational analytic procedures using SPSS®Statistics (version 28) software were performed on variables from all measuring Scales.

As a statistical test, correlation determines the tendency or patterns in the common variance of research variables (Creswell, 20120, exactly what is needed to investigate the research questions. Frequencies and descriptive statistics (percentage, range, means, standard deviations, skewness, kurtoses, and rank) were computed for all sections of the survey and for each individual item to avoid violating any test assumptions made by the individual tests. High- and low-frequency use cases were also determined for each Technology, L2 skills, and LLS Scale item.

Once these parameters of the four Scales were established, a series of multivariate correlations was performed to investigate relationships between the individual scale items of the four research Scales. The cross-tabulation SPSS tool was applied to investigate correlations not only between the variables, but between their numerous subsets as well to find out a deeper correlational panorama and even minute statistically significant cases of relationship. To go further with generalizing sample results, *t*-testing and exploratory factor analysis were used to identify statistically significant correlational patterns between the Scales items and to find out factor loadings across all six SILL first-order categories (memory, cognitive, compensation,

metacognitive, affective, and social strategies) and the two second-order categories (direct and indirect strategies). An alpha level of .05 was set up as the criterion for significant findings.

The directions and expanse of data collection and analysis were aimed at getting as much information about the four scales' predictor and outcome variables as possible thus obtaining reliable statistical grounds to frame answers to the research questions. The data magnitude also allowed us to put forward substantiated research implications and delineate the guidelines for future research.

CHAPTER IV

FINDINGS

The Digital Age Learner in the L2 Learning Environment

To reach the research purpose and goals and obtain answers to the research questions, the quantitative approach consisting of measuring the study variables descriptively and then assessing statistical relationships between them using inferential methodology was utilized. Such analytic protocols serve well in cases, like this one, when the task to establish causal relationships is not on the research agenda and when the correlational research strategy allows the researcher to find out relevant descriptive values of the variables and make predictions about the directions of their correlations (Price et al., 2014).

None of the study variables has been manipulated by the researcher, and this may indicate that the achieved results are more likely to reflect existing real-world relationships manifested in the research assertions thus adding strength to its external validity. Along with this, high likelihood of the correlational strategy used in this study to build strong directional predictions (Price et al., 2014) brings potential credit to the study results and the subsequent discussion conclusions. To introduce the study outcomes in the present chapter, relevant statistic findings were organized into two blocks with a focus on the descriptive and inferential analytic approaches undertaken.

Frequencies and descriptive statistics obtained via SPSS® Statistics analytics yielded a vast spectrum of discreet factors that supplement research variables from all four Scales. The presentation of obtained descriptive values will start with the depiction of L2 learners' attributes and study items usage practices and will be followed by cross-tabulation analysis of the Scales items that allowed us to identify statistically significant correlational cases in a variety of their subsets.

The Learner: Demographics and Personal Preferences

All 299 recorded participants responded to the question about their gender revealing the following numbers: 173 females (57.9%), 123 males (41.1%), prefer not to say/other – 3 (1%). For further data processing, two biggest gender groups, females and males, would be the two most representative categorical variables for reliable inferential statistical analysis involving the factor of gender differences. So, to establish all possible correlations between gender and other study variables (items, scales, or constructs), only these two gender groups were considered.

By age, L2 students under 20 made more than half of all respondents, - 158 (52.8%), 118 (39.5%) were from 20 to 25 years old, 5 (1.7%) students were from 25 to 30, and 18 (6%) students were over 30. Overall, the majority of students, 276 (92.3%), represented the "Under 25" age group which gives us the ground to consider them as digital age learners, or, more specifically, Digital Native (Prensky, 2001) or Net-generation (Oblinger & Oblinger, 2005) L2 learners. Such age demography may be of benefit for supporting in part the research rationale, making some conclusive statements, and for accomplishing some research purposes.

Out of 299 respondents, 112 (37.5%) students were freshmen, 77 (25.8%) were sophomores, 55 (18.4%) – juniors, 42 (14%) - seniors, and 13 (4.3%) were self-paced. Overall, 286 (95.7%) students were undergraduates although not spread evenly between the years of study. The students' status could be to some extent considered as a relevant factor for finding responses to the study questions, but rather not by itself, as status, at the same time, may be related to age or even proficiency level variables. In any event, these demographics provide us with some suppositions for the discussion of the study results.

L2 distribution among respondents showed a substantial prevalence of Spanish (63.3%), followed by German (17%), Norwegian (10.4%), French (6.6%), and Latin (2.1%). On the one

hand, there is obvious skewness to one language that may influence the research outcomes, on the other, whether a student studying a more "popular" foreign language uses language learning practices very different from a student studying a less commonly studied foreign language is questionable. The only different language here is Latin, a language that has not been used for public communication for several centuries, so the lowest percentage of its learners is not at all surprising.

Respondents' language proficiency was self-assessed, and, presumably, not based on course grades or standardized testing. Elementary (45.2%) and intermediate (47.5%) language proficiency levels clearly dominated over advanced (7.4%), and this differentiation may present a predicting power for this study as a factor that was mentioned in the literature as having significant correlation with the use of technologies for learning (Jones & Hosein, 2010).

Students taking face-to-face classes made the majority (65.2%) of the respondents, while online (17.7%) and hybrid (17.1%) study formats were shared almost equally by the remaining respondents (34.8%). The study mode is expected to be an important categorical variable to examine correlational patterns with variables from other scales and constructs because the mode dominance may determine the choice of language learning practices and, as a result, the use of L2 strategies.

The majority of undergraduates (64.1%) indicated a preference to study individually, while 35.95% of them indicated a preference for group study as their learning style. Although one of the study directions was to disregard the latter to remain concentrated more on investigating individual choices of technological affordances and L2 strategies, correlational and inferential testing of this variable might provide statistical support for arguments that constituted the study rationale.

The question about involvement in social media in the language learned was answered negatively by the overwhelming majority of respondents (84.3%) with only 15.7% affiliated. The frequency displayed was surprising and, to some extent, even disturbing as it presented a sharp L2 social media usage contrast compared to the overall 84% usage of social media by young adults from 18 to 29 in the United States (Social Media, 2021). It might also have a discouraging effect on the researcher's attempts to appeal to efficiency of communicative language teaching approaches used today and support constructivist views on learning, and on language learning, in particular.

Students today use a variety of digital gadgets to support communication and learning, that is why on the survey they were not asked to choose just one device they used for L2 learning but were offered to rank three devices most utilized. The participants' device use frequencies showed that computers were ranked first by 89.5% (tablets – 9.3%, cell phones – 1.2%), cell phones were ranked second by 75.4% (tablets – 22.2%, computers – 2.4%), and tablets ranked third by 68.5% (cell phones – 23.4%, computers – 8.1%).

The question about frequency of the Internet usage for L2 learning brought the following results: 28.8% used it several times a day, 24.7% once a day, and 46.5% several times a week which actually means not daily. At the same time, 89.6% of survey respondents estimated L2 digital learning resources availability as rich and sufficient (30.4% and 59.2% respectively) with only 31 (10.4%) respondents who estimated them as scarce. These frequencies generally interact with the responses to the last question on this scale about the participants' perceptions of overall effect of digital technologies on their learning. The overwhelming majority of the respondents (80.9%) determined that there was effect, with 16.4 % not sure, and 2.7% not establishing any

effect of digital technologies on their L2 learning. The summary of demographic profiles of UND undergraduate L2 students is presented in Table 1:

Table 1.
Frequencies and Descriptive Statistics of Participants' Demographic Profiles

Variable / Statistic	N	%	Range
Gender Total	299	100	1-4
M / F / Other / Undisclosed	123 / 173 / 1/ 2	41.1 / 57.9 / .33 / .67	
Age Group Total	299		1-4
< 20 / 20-25 / 25-30 / 30+	158 / 118 / 5/ 18	52.8 / 39.5 / 1.7 / 6	
Status Total	299	100	1-5
Freshmen / Sophomore	112 / 77	37.5 / 25.8	
Junior / Senior / Self-paced	55 / 41 / 13	18.4 / 14 / 4.3	
L2 Total	289	100	1-6
Spanish / German / Norwegian	183 / 49 / 30	63.3 / 17 / 10.4	
French / Latin / Other	19 / 6 / 2	6.6 / 2.1 / .6	
L2 Proficiency Total	299	100	1-3
Elem / Intermediate / Advanced	135 / 142 / 22	45.2 / 47.5 / 7.4	
Study Mode Total	299	100	1-3
Face-to-face / Online / Hybrid	195 / 53 / 51	65.2 / 17.7 / 17.1	
Learning Style Total	298	100	1-2
Individually / In a Group	191 / 107	64.1 / 35.9	
L2 Social Media Total	299	100	1-2
Yes / No	47 / 252	15.7 / 84.3	
Device Preference Total	248	100	1-3, ranked
Computer / Cell / Tablet	222 / 187 / 170	89.5 / 75.4 / 68.5	1 / 2 / 3
Use Frequency Total	299	100	1-3
Several weekly/daily/several daily	139 / 74 / 86	46.5 / 24.7 / 28.8	
Net Resources Total	299	100	1-3
Scarce / Sufficient / Rich	31 / 177 / 91	10.4 / 59.2 / 30.4	
Perceived Effect Total	299	100	1-3
Yes / No / Not sure	242 / 8 / 49	80.9	

Technology Use Practices of L2 Learners

The coverage of technological learning availabilities was made up by a ten-item 5-point Likert scale questionnaire with 1 –"Never or almost never use", 2 – "Usually do not use", 3 – "Somewhat use", 4 – "Usually use", and 5 – "Always or almost always use". To ensure adequate technology scale item name recognition, they were supported by descriptive representations (examples of resources or tools) that together provided the participants with a generalized understanding of their functionality and particular widely adopted utilizations as prototypes.

Online books (including online L2 course textbooks, Tech scale item 1) were used in the range of "somewhat" to "always" by 73.2% of respondents, 12.7% usually did not use, and 14% - never used (M = 3.39, SD = 1.37, ranked 4/10). *Online reference sources* (Tech scale item 2) were used by 88% of the respondents ("somewhat" - 25.8%, "usually" - 35.1%, "always" – 27.1%) with only 12% who usually or never used (M = 3.75, SD = 1.04, ranked 1/10).

Availabilities of *language learning websites* (Tech scale item 3) were explored by 81.9% of respondents ("somewhat" - 26.8%, "usually" - 28.4%, "always" – 26.8%) with 18.1% who usually or never used (M = 3.56, SD = 1.2, ranked 2/10). Close usage numbers were obtained for *online learning resources* (Tech scale item 4): 79.2% used them in some form, while 20.8% did not (M = 3.52, SD = 1.2, ranked 3/10).

The class of *assistive learning technologies* (Tech scale item 5) exhibited less usage by L2 learners: 67.6% of respondents used them while almost one third (32.4%) did not (M = 3.04, SD = 1.23, ranked 5/10). While this type of technologies is known through its wide functionality in other digital device types and use contexts, which can explain relatively high usage scores, the scores for the utilization of *news and social media in L2* (Tech scale item 6) displayed a substantially low usage level (29.5%) (M = 2.1, SD = 1.15, ranked 9/10).

Moderate score was registered for *audio and video platforms* usage (Tech scale item 7) - 56.4% ("somewhat" - 28.5%, "usually" – 16.8%, "always" – 11.1%) which was less than initially expected (M = 2.77, SD = 1.25, ranked 6/10) and *collaboration platforms* (Tech scale item 8) – 41.8% (M = 2.33, SD = 1.24, ranked 7/10). The lowest technological usage frequencies were exhibited for *learning games* (Tech scale item 9) – 37.1% (M = 2.27, SD = 1.2, ranked 8/10) and *intelligent tutoring systems* (Tech scale item 10) – 23.4% (M = 1.82, SD = 1.08, ranked 10/10).

The summary of technological use preferences of UND undergraduate students majoring or minoring in an L2 is presented in Table 2:

Table 2.
Frequencies and Descriptive Statistics of Technological Use Preferences

Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"Use" %	Rank
Tech 2, e-references	299	3.75	1.04	1-5	- .555	- .287	88	1
Tech 3, L2 websites	299	3.56	1.2	1-5	- .527	- .558	81.9	2
Tech 4, e-resources	298	3.52	1.2	1-5	- .529	- .612	79.2	3
Tech 1, e-books	299	3.39	1.37	1-5	- .426	- 1.032	73.2	4
Tech 5, assist. tools	299	3.04	1.23	1-5	- .132	- .900	67.6	5
Tech 7, audio/video	298	2.77	1.25	1-5	.215	- .895	56.4	6
Tech 8, collab. plat.	299	2.33	1.24	1-5	.603	- .593	41.8	7
Tech 9, games	299	2.27	1.2	1-5	.650	- .595	37.1	8
Tech 6, social med.	298	2.09	1.15	1-5	.926	- .042	29.5	9
Tech 10, intel syst.	299	1.82	1.08	1-5	1.211	- .592	23.4	10

Development of Language Skills and Aspects

The Language survey section consisted of eight items explicating four commonly distinguished language skills and four aspects. The same type 5-point Likert scale questionnaire with 1 –"Little", 2 – "Below average", 3 –"Average", 4 – "Above average", and 5 – "Much" served to collect answers to two questions to evaluate efficiency of digital technologies used in supporting and developing language skills and language aspects.

Reading skills were said to be developed in the range from *average* to *much* by 92% of respondents with 37.5 % for *above average* and 22.4% for *much*. The *below average* to *little* interval was chosen by 8% of the respondents.

Writing was determined to be developed in the range from *average* to *much* by 83.9% of the respondents, with 29.8 % for *above average* and 12.7% for *much*. The *below average* to *little* interval was chosen by 13% of the respondents.

Listening skills were reported to be developed in the range from *average* to *much* by 84.9% of the respondents with 38.1 % for *above average* and 16.4% for *much*. The *below average* to *little* interval was chosen by 15.1% of the respondents.

Speaking skills were said to be developed in the range from *average* to *much* by 71.9% of respondents with 22.1 % for *above average* and 7.7% for *much*. The *below average* to *little* interval was chosen by 28.1% of the respondents.

The summary of language skills development of UND undergraduate students majoring or minoring in an L2 is presented in Table 3:

Table 3.

Frequencies and Descriptive Statistics of Language Skills Development

Skill / Statistic	N	M	SD	Range	Skewness	Kurtosis	"Support" %	Rank
Reading	299	3.71	.97	1-5	- .536	.189	92	1

Listening	299	3.53	.99	1-5	- .377	- .320	84.9	2
Writing	299	3.36	.96	1-5	- .122	- .238	83.9	3
Speaking	299	3.03	1.0	1-5	.02	- .302	71.9	4

Grammar was reported to be developed and supported in the range from *average* to *much* by 86.6% of the respondents with 35.5 % for *above average* and 13.4% for *much*. The *below average* to *little* interval was chosen by 13.3% of the respondents.

Vocabulary support was defined in the range from *average* to *much* by 94% of the respondents with 43.5 % for *above average* and 26.8% for *much*. The *below average* to *little* interval was chosen by 6% of the respondents.

Pronunciation was said to be developed and supported by digital means in the range from *average* to *much* by 76.2% of the respondents with 27.9 % for *above average* and 11.1% for *much*. The *below average* to *little* interval was chosen by 23.8% of the respondents.

Style support was defined in the range from *average* to *much* by 68.5% of the respondents with 18.1 % for *above average* and 7.4% for *much*. The *below average* to *little* interval was chosen by 31.5% of the respondents.

The summary of language skills development of UND undergraduate students majoring or minoring in an L2 is presented in Table 4:

Table 4.

Frequencies and Descriptive Statistics of Language Aspects Development

Aspect/ Statistic	N	M	SD	Range	Skewness	Kurtosis	"Support" %	Rank
Vocabulary	299	3.9	.89	1-5	- .584	.115	94	1
Grammar	299	3.46	.94	1-5	- .241	- .175	86.6	2
Pronunciation	298	3.21	1.03	1-5	- .085	- .490	76.2	3

Style	298	2.93	1.02	1-5	.096	- .260	68.5	4

SILL Domains

The SILL survey as the instrument was described in more detail in chapters 2 and 3. As already stated, this is a validated 50-item questionnaire representing language learning strategies organized in six domains. The same type 5-point Likert scale with 1 –"Never or almost never true of me", 2 – "Usually not true of me", 3 –"Somewhat true of me", 4 – "Usually true of me", and 5 – "Always or almost always true of me" was used to collect the respondents' answers on all six domains.

Item 1 of the *Memory* domain, *I think of relationships between what I already know and new things I learn in L2*, was agreed upon by 91.3% (*usually true* – 35.5% and *always or almost always true* – 22.7%) with 8.7% responding negatively, (M = 3.71 , SD = .94) . Item 2, *I use new L2 words in a sentence so I can remember them*, was defined as true by 77.6% (*usually true* – 30.8% and *always or almost always true* – 12%) with 22.4% responding negatively (M = 3.71 , SD = .99). Item 3, *I connect the sound of a new L2 word and an image or picture of the word to help me remember the word*, was considered as a common practice by 69.6% (*usually true* – 29.1% and *always or almost always true* – 16.1%) with 30.4% responding negatively (M = 3.22 , SD = 1.2). Item 4, stressing the establishment of mental connections to the extralinguistic context, *I remember a new L2 word by making a mental picture of a situation in which the word might be used*, was defined as true by 63.5% (*usually true* – 24.4% and *always or almost always true* – 13.7%) with 36.5% responding negatively (M = 3.06 , SD = 1.2).

Item 5 of the domain, disclosing a memorization approach, *I use rhymes to remember new L2 words*, was defined as a practice by 26.7% (*usually true* – 7% and *always or almost always true* – 5.7%) with 73.3% responding negatively (M = 2.10 , SD = 1.13). A rather commonplace

flashcard memorization technique of item 6, *I use L2 flashcards to remember new L2 words*, was shared by 60.5% of the respondents (*usually true* – 21.1% and *always or almost always true* – 16.1%) with 39.5% responding negatively (M = 2.95 , SD = 1.35). Methodologically close to the latter learning technique of item 7, *I physically act out new L2 words*, was practiced just by 19.8% of the respondents (*usually true* – 5% and *always or almost always true* – 2.7%) with 80.2% responding negatively (M = 1.79 , SD = 1.02). Regular review of lesson materials suggested by item 8, *I review L2 lessons often*, was practiced by 76.6% of the respondents (*usually true* – 25.8% and *always or almost always true* – 11%) with 23.4% responding negatively (M = 3.20 , SD = 1.01). The final item of the domain pointing out associations based on physical properties, *I remember new L2 words or phrases by remembering their location on the page, on the board, or on a street sign*, was of common practice for 56.5% of the respondents (*usually true* – 20.1% and *always or almost always true* – 8.7%) with 43.5% responding negatively (M = 2.74 , SD = 1.23).

The summary of memory use strategy domain by UND undergraduate students majoring or minoring in an L2 is presented in Table 5 (original SILL statements are abridged):

Table 5.
Memory Domain Item Frequencies and Descriptive Statistics

Strategy Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"True" %	Rank
1. I connect known and new things	299	3.71	.94	1-5	- .261	- .477	91.3	1
2. I use words in a sentence	299	3.31	.99	1-5	.007	- .710	77.6	2
3. I connect sound and a word image	299	3.22	1.2	1-5	- .170	- .943	69.6	3
8. I review lessons	299	3.2	1.01	1-5	- .021	- .429	76.6	4

4. I make a mental image of the context	299	3.06	1.2	1-5	.030	- .976	63.5	5
6. I use flashcards	299	2.95	1.35	1-5	.024	- 1.177	60.5	6
9. I remember by location on the page	299	2.74	1.23	1-5	.141	- .960	56.5	7
5. I use rhymes	299	2.10	1.13	1-5	1.050	.434	26.7	8
7. I act out words	298	1.79	1.02	1-5	1.340	1.280	19.8	9

Item 1 of the *Cognitive* domain, *I say or write new L2 words several times*, was agreed upon by 70.3% (*usually true* – 26.4% and *always or almost always true* – 10.7%) with 29.7% responding negatively, (M = 3.11 , SD = 1.1). Item 2, *I try to talk like native L2 speakers*, was defined as true by 73.3% (*usually true* – 26.8% and *always or almost always true* – 18.7%) with 26.7% responding negatively (M = 3.28 , SD = 1.22). Item 3, *I practice the sounds of the L2*, was considered as a common practice by 83.3% (*usually true* – 37.1% and *always or almost always true* – 15.4%) with 16.7% responding negatively (M = 3.48 , SD = 1.0). Item 4, *I use the L2 words I know in different ways*, stressing the usage of a lexical unit, was defined as true by 73.6% (*usually true* – 28.8% and *always or almost always true* – 8.4%) with 26.4% responding negatively (M = 3.13 , SD = 1.02). Item 5 of the domain, *I start conversations in the L2*, was defined as a habit by approximately half of the respondents, 55.2% (*usually true* – 18.4% and *always or almost always true* – 7.7%) with 44.8% responding negatively (M = 2.75 , SD = 1.14). A rather common audio-lingual method technique introduced by item 6, I *watch L2 language TV shows spoken in L2 or go to movies spoken in the L2*, was shared just by 42.5% of the respondents (*usually true* – 10.7% and *always or almost always true* – 13.4%) with 57.5% responding negatively (M = 2.5 , SD = .56). Reading as a supportive L2 learning practice focused on in item 7, *I read for pleasure in the L2*, exhibited the lowest in this domain statistics:

only 20.8% of the respondents were positive about it (*usually true* – 6.4% and *always or almost always true* – 3.4%) with 79.2% responding negatively (M = 1.86 , SD = 1.06). Writing as a supportive L2 learning practice focused on in item 8, *I write notes, messages, letters, or reports in the L2*, was practiced by 31.1% of the respondents (*usually true* – 9.4% and *always or almost always true* – 5.7%) with 62.8% responding negatively (M = 2.26 , SD = 1.16). Item 9, *I first skim an L2 passage (read over the passage quickly) then go back and read carefully*, was of common practice for 61.5% of the respondents (*usually true* – 27.4% and *always or almost always true* – 12%) with 38.5% responding negatively (M = 3.00 , SD = 1.24). A strategy described by item 10, *I look for words in my own language that are similar to new words in the L2*, was utilized by 87% of the respondents (*usually true* – 29.1% and *always or almost always true* – 32.1%) with just 13% responding negatively (M = 3.76 , SD = 1.12). Item 11, *I try to find patterns in the L2*, exhibited the highest descriptive scores in this domain: 88.3% of the respondents agreed it was true (*usually true* – 36.5% and *always or almost always true* – 33.1%) with just 11.7% responding negatively (M = 3.89 , SD = 1.05). Item 12 that stresses the utilization of the learners' morphological knowledge, *I find the meaning of an L2 word by dividing it into parts that I understand*, described a strategy common for 76.3% of the respondents (*usually true* – 29.1% and *always or almost always true* – 20.1%) with just 23.7% responding negatively (M = 3.37 , SD = 1.2). A strategy to avoid literal correlations (item 13), *I try not to translate word for word*, was practiced by 65.9% of the respondents, (*usually true* – 20.1% and *always or almost always true* – 7.7%) with 34.1% responding negatively (M = 2.93, SD = 1.04). The final item of the domain, *I make summaries on information that I hear or read in the L2*, was of common practice for 60.1% of the respondents (*usually true* – 22.7 and *always or almost always true* – 10.4%) with 39.1% responding negatively (M = 2.92 , SD = 1.19).

The summary of cognitive use strategy domain by UND undergraduate students majoring or minoring in an L2 is presented in Table 6 (original SILL statements are abridged):

Table 6.
Cognitive Domain Item Frequencies and Descriptive Statistics

Strategy Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"True" %	Rank
11. I try to find patterns	299	3.89	1.05	1-5	- .762	- .094	88.3	1
10. I look for similarities	299	3.76	1.12	1-5	- .610	- .372	87	2
3. I practice sounds	299	3.48	1.01	1-5	- .345	- .387	83.3	3
12. I split words into parts for meaning	299	3.37	1.19	1-5	- .331	- .766	76.3	4
2. I try to talk like a native	299	3.28	1.22	1-5	- .233	- .862	73.3	5
4. I use words in different ways	299	3.13	1.02	1-5	- .119	- .489	73.6	6
1. I say or write words frequently	299	3.11	1.09	1-5	- .049	- .677	70.3	7
13. I evade translating word for word	299	2.93	1.04	1-5	.117	- .458	65.9	8
9. I skim read first and go back	299	3.00	1.24	1-5	- .036	- 1.066	61.5	9
14. I make summaries	299	2.92	1.19	1-5	- .078	- .891	60.1	10
5. I start conversations	299	2.75	1.14	1-5	.250	- .706	55.2	11
6. I watch L2 TV shows or movies	299	2.50	1.37	1-5	.564	- .891	42.5	12
8. I write notes	299	2.26	1.16	1-5	.704	- .300	31.1	13
7. I read for pleasure	298	1.86	1.06	1-5	1.278	1.011	20.8	14

Item 1 of the *Compensation* domain., *To understand unfamiliar L2 words, I make guesses*, was agreed upon by 82.2% (*usually true* – 33.9% and *always or almost always true* –

9.7%) with 17.8% responding negatively, (M = 3.33 , SD = .95). Item 2, *When I can't think of a word during a conversation in the L2, I use gestures*, was defined as true by 74.4% (*usually true* – 32.3% and *always or almost always true* – 10.8%) with 25.6% responding negatively (M = 3.21 , SD = 1.09). Item 3, *I make up new words if I do not know the right ones in the L2*, was considered as a common practice just by 40.6% (*usually true* – 10.7% and *always or almost always true* – 5.7%) with 59.4% responding negatively (M = 2.36 , SD = 1.55). Item 4, *I read the L2 without looking up every new word*, was defined as true by 69.5% (*usually true* – 29.2% and *always or almost always true* – 8.4%) with 30.5% responding negatively (M = 3.1 , SD = 1.05). Item 5 of the domain, *I try to guess what the other person will say next in the L2*, was defined as a practice by 59.1% (*usually true* – 21.8% and *always or almost always true* – 5.7%) with 40.9% responding negatively (M = 2.78 , SD = 1.11). The highest descriptive scores in the domain were registered for item 6, *If I can't think of an L2 word, I use the word or phrase that means the same thing*, - 84.6% (*usually true* – 33.6% and *always or almost always true* – 20.8%) with 15.5% responding negatively (M = 3.55 , SD = 1.07).

The summary of compensation strategy domain by UND undergraduate students majoring or minoring in an L2 is presented in Table 7 (original SILL statements are abridged):

Table 7.
Compensation Domain Item Frequencies and Descriptive Statistics

Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"True" %	Rank
6. I use synonyms	298	3.55	1.07	1-5	- .437	- .359	84.6	1
1. I make guesses	298	3.33	.95	1-5	- .211	- .238	82.2	2
2. I use gestures	297	3.21	1.09	1-5	- .266	- .592	74.4	3
4. I don't look up every word	298	3.10	1.05	1-5	- .054	- .690	69.5	4
5. I predict what will be said next	298	2.78	1.11	1-5	.069	- .760	59.1	5

3. I make up words	298	2.36	1.16	1-5	.593	- .420	40.6	6

Item 1 of the *Meta-cognitive* domain, *I try to find as many ways as I can to use my L2,* was agreed upon by 68.5% (*usually true* – 19.1% and *always or almost always true* – 8.4%) with 31.5% responding negatively, (M = 2.99 , SD = 1.01). Item 2, *I notice my L2 mistakes and use that information to help me do better*, was defined as true by 90.3% of the respondents (*usually true* – 37.8% and *always or almost always true* – 16.7%) with just 9.7% responding negatively (M = 3.58 , SD = .96). Item 3, *I pay attention when someone is speaking the L2*, considered as a common practice by 95% (*usually true* – 44.8% and *always or almost always true* – 32.1%) with only 5% responding negatively (M = 4.03 , SD = .87) thus exhibiting the domain highest positive item values. Item 4, stressing the learners' attempts to improve the learning process, *I try to find out how to be a better learner of the L2*, was defined as true by 90.3% (*usually true* – 35.5% and *always or almost always true* – 23.1%) with 9.7% responding negatively (M = 3.69 , SD = .99). Item 5 of the domain, disclosing the importance of time management, *I plan my schedule so I will have enough time to study the L2* , was defined as a practice by 72.2% (*usually true* – 25.4% and *always or almost always true* – 10.4%) with 27.8% responding negatively (M = 3.10 , SD = 1.09). Item 6, *I look for people I can talk to in the L2*, was shared by 54.2% of the respondents (*usually true* – 16.1% and *always or almost always true* – 11%) with 45.8% responding negatively (M = 2.74 , SD = 1.25). Item 7, *I look for opportunities to read as much as possible in the L2,* was practiced by 40.1% of the respondents (*usually true* – 12.4% and *always or almost always true* – 4.3%) with 59.9% responding negatively (M = 2.4 , SD = 1.09). Item 8, *I have clear goals for improving my L2 skills,* was shared by 74.9% of the respondents (*usually true* – 27.1% and *always or almost always true* – 14.4%) with 25.1% responding negatively (M = 3.23 , SD = 1.13). The final item of the domain pointing out the aspect of monitoring one's own

learning, *I think about my progress in learning the L2*, was of common practice for 86.3% of the respondents (*usually true* – 35.1% and *always or almost always true* – 18.4%) with 13.7% responding negatively (M = 3.55 , SD = 1.01).

The summary of meta-cognitive strategy domain use by UND undergraduate students majoring or minoring in an L2 is presented in Table 8 (original SILL statements are abridged):

Table 8.
Meta-cognitive Domain Item Frequencies and Descriptive Statistics

Strategy Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"True" %	Rank
3. I notice L2 speech	299	4.03	.87	1-5	- .801	.597	95	1
4. I find out ways to be a better L2 learner	299	3.69	.99	1-5	- .490	- .049	90.3	2
2. I notice L2 mistakes	299	3.58	.96	1-5	- .488	.260	90.3	3
9. I think about progress	299	3.55	1.01	1-5	- .386	- .247	86.3	4
8. I have clear goals	299	3.23	1.13	1-5	- .183	- .646	74.9	5
5. I schedule my study	299	3.10	1.09	1-5	- .107	- .557	72.2	6
1. I use L2 in many ways	299	2.99	1.00	1-5	.186	- .333	68.5	7
6. I seek opportunities to talk in L2	299	2.74	1.25	1-5	.272	- .881	54.2	8
7. I look for opportunities to read much	299	2.40	1.09	1-5	.565	- .335	40.1	9

Item 1 of the *Affective* domain, *I try to relax whenever I feel afraid of using the L2,* was agreed upon by 79.6% (*usually true* – 30.8% and *always or almost always true* – 10%) with 20.4% responding negatively, (M = 3.25 , SD = 1.01). Item 2, *I encourage myself to speak the L2 even when I am afraid of making a mistake,* was defined as true by 78.3% of the respondents (*usually true* – 31.1% and *always or almost always true* – 13.4%) with just 21.7% responding negatively (M = 3.33 , SD = 1.02). Item 3, *I give myself a reward or treat when I do well in the*

L2, considered as a common practice by just 37.8% (*usually true* – 13.7% and *always or almost always true* – 5.4%) with 62.2% responding negatively (M = 2.29 , SD = 1.21). Item 4, stressing the learners' attempts to improve the learning process, *I notice if I am tense or nervous when I am studying or using the L2*, was defined as true by 62.4% (*usually true* – 22.8% and *always or almost always true* – 11.7%) with 37.6% responding negatively (M = 2.94 , SD = 1.23). Item 5 of the domain, disclosing the importance of time management, *I write down my feelings in a language learning diary*, was noted as a practice just by 8.4% (*usually true* – 1% and *always or almost always true* – 2%) with the record for the domain 91.6% (*never or almost never* – 79.2%) responding negatively (M = 1.34 , SD = .8). Item 6, *I talk to someone else about how I feel when I am learning the L2* , was shared by 30.2% of the respondents (*usually true* – 11.4% and *always or almost always true* – 5.4%) with 79.8% responding negatively (M = 2.1 , SD = 1.22).

The summary of affective strategy domain use by UND undergraduate students majoring or minoring in an L2 is presented in Table 9 (original SILL statements are abridged):

Table 9.
Affective Domain Item Frequencies and Descriptive Statistics

Strategy Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"True" %	Rank
1. I try to relax	299	3.25	1.01	1-5	- .258	- .254	79.6	1
2. I encourage myself	299	3.33	1.02	1-5	- .113	- .623	78.3	2
4. I notice if I am tense	298	2.94	1.23	1-5	.021	- .949	62.2	3
3. I reward myself	299	2.29	1.21	1-5	.621	- .642	37.8	4
6. I share my feelings	298	2.10	1.22	1-5	.898	-.272	30.2	5
5. I keep a learning dairy	298	1.34	.80	1-5	2 .829	8.452	8.4	6

Item 1 of the *Social* domain, *If I do not understand something in the L2, I ask the other person to slow down or say it again*., was agreed upon as true by 83.6% (*usually true* – 36.1% and *always or almost always true* – 21.1%) with 16.4% responding negatively, (M = 3.58 , SD =

1.08). Item 2, *I ask L2 speakers to correct me when I talk*, was defined as true by 77.6% of the respondents (*usually true* – 31.1% and *always or almost always true* – 19.7%) with just 22.4% responding negatively (M = 3.42 , SD = 1.15). Item 3, *I practice the L2 with other students*, was considered as a natural activity by 72.2% (*usually true* – 28.8% and *always or almost always true* – 17.1) with 27.8% responding negatively (M = 3.22 , SD = 1.26). Item 4, stressing the learners' readiness to seek for help, *I ask for help from L2 speakers*, was defined as true by 72.9% (*usually true* – 31.4% and *always or almost always true* – 16.4%) with 27.1% responding negatively (M = 3.29 , SD = 1.19). Item 5 of the domain, *I ask questions in the L2*, was noted as a practice by 76.9% (*usually true* – 28.8% and *always or almost always true* – 15.4%) with 23.1% responding negatively (M = 3.3 , SD = 1.19). Item 6, *I try to learn about the culture of L2 speakers*, was shared by the record for the domain 86% of the respondents (*usually true* – 29.4% and *always or almost always true* – 32.8%) with 14% responding negatively (M = 3.75 , SD = 1.17).

The summary of social strategy domain use by UND undergraduate students majoring or minoring in an L2 is presented in Table 10 (original SILL statements are abridged):

Table 10.
Social Domain Item Frequencies and Descriptive Statistics

Strategy Item / Statistic	N	M	SD	Range	Skewness	Kurtosis	"True" %	Rank
6. I learn L2 culture	299	3.75	1.17	1-5	- .715	- .265	86	1
1. I ask to say again	299	3.58	1.08	1-5	- .482	- .398	83.6	2
2. I ask to correct me	299	3.42	1.15	1-5	- .323	- .728	77.6	3
5. I ask questions	299	3.30	1.12	1-5	- .231	- .611	76.9	4
4. I ask for help	299	3.29	1.19	1-5	- .283	- .829	72.9	5
3. I practice L2	299	3.22	1.26	1-5	- .298	- .888	72.2	6

Correlations of Scale Items and Subsets

SPSS® Statistics cross tabulation tool was used to examine correlations between numerous variables constituting the four notionally different data collection Scales. The application of this tool was prompted by its capacity to provide multivariate correlations and generate values with counts and percentages for each distinct scale point of a layer variable. The indicator of strength of relationship in cross tabulation is the percent difference. Also, at this moment of our investigation, the cross-tabulation output sufficed the research needs to find out statistically significant or close to significant correlation patterns to be further tested inferentially. The description of the relationships between categorical and ordinal variables involved comparison of the degrees of freedom, observed to the expected count in each cell of the statistical output, Pearson Chi-Square testing, and *p*-value statistics.

The Learner and Technologies Correlations

The first demographic variable of Scale 1, g*ender*, in correlations to Scale 2 items displayed no statistically significant difference between males and females in the use of 7 out of 10 digital learning technologies classes. In the use of *language learning websites*, female students contributed to high statistical values of two of its scale points, "always or almost always use" and "usually use" although not statistically significant with *p*-values set up at the .05 level (χ^2 (12, N = 299) = 20.43, p = .06). Statistical significance was also displayed by female students in the use of Tech items 9, *language learning games* (χ^2 (12, N = 299) = 31.03, $p < .01$) and 10, *intelligent tutoring systems* (χ^2 (12, N = 299) = 21.68, p = .04), but on the subscale point of "never or almost never use". As both classes of technologies showed extremely low overall use frequencies, female language learners supposedly contributed more to low utilization of these tools than male learners.

The second and third demographic variables, learners' age and status, in correlations to Scale 2 items displayed no statistical significance between age groups, student status, and the use of 9 out of 10 digital learning technologies classes. The age group of "under 20" contributed to Tech item 3 statistical significance on the scale point of "always or almost always use" while the age group of "20-25" on the scale point of "never or almost never use" (χ^2 (12, N = 299) = 24.16, p = .02). The student status categories "freshman" and "senior" (variable 3) contributed to the statistical significance of the same Tech item (χ^2 (16, N = 299) = 31.18, p = .01) exhibiting opposite trends in the correlation of observed and expected counts on the scale point of "always or almost always use".

Analysis of correlations between demographic variable 4, L2 learned, and Scale 2 Tech item 1, *use of online textbooks*, resulted in its statistical significance highlighting the contribution of the L2 category subsets of German and Latin as L2 target languages to the scale point of "always or almost always use" (χ^2 (20, N = 299) = 36.86, p = .01). L2 learners' proficiency level (variable 5) in its correlation with the Tech Scale exhibited borderline statistical significance in Tech item 6, *L2 news and social media* (χ^2 (8, N = 298) = 15.32, p = .05) due to the contributions of the subsets of intermediate students to the "usually use" scale point and of advanced learners to the scale point of "always or almost always use".

The study mode (demographic variable 6) in relation to Scale 2 Tech item 2, *use of online references*, exhibited statistical significance (χ^2 (8, N = 298) = 20.27, p = .01) due to the contribution of hybrid studying students to the value of the "never or almost never use" scale point. Although not statistically significant between the category subsets, the use of this digital affordance had especially high use frequency (71.6%) on the scale point of "always or almost always use".

Individual versus *in a group* learning style preference (Scale 1, variable 7) did not establish statistically significant correlations with 9 out of 10 technological classes. The only exception was its correlation with Scale 2 Tech item 8, *use of collaboration platforms*, due to the contribution of the subset of group study preference students to the "somewhat use" scale point (χ^2 (4, N = 298) = 12.67, p = .01).

Scale 1 variable 8, *participation in social media in L 2*, that exhibited respondents' substantially low frequencies of L2 social presence, quite conceivably interacted with the negative subset of Scale 2 Tech item 6, *news and social media*, contributing to the statistical significance of their correlation (χ^2 (4, N = 298) = 51.07, p < .001) due to the less observed than expected count on the "always or almost always use" scale point and, vice versa, the more observed than expected count on the "never or almost never use" scale point. A similar type of correlation was registered on the "always or almost always use" scale point between this variable and Scale 2 Tech item 7, *use of audio and video platforms* (χ^2 (4, N = 298) = 20.09, p < .001).

Scale 1 variable 10, *frequency of digital technologies use*, formally exhibited the highest number of statistically significant correlations with Scale 2 items: Tech item 1, *use of online textbooks* (χ^2 (8, N = 299) = 17.03, p = .03), item 4, *online learning resources* (χ^2 (8, N = 298) = 21.43, p < .01), item 6, *news and social media* (χ^2 (8, N = 298) = 17.78, p = .02), item 7, *use of audio and video platforms* (χ^2 (8, N = 298) = 21.40, p < .01), and item 9, *language learning games* (χ^2 (8, N = 299) = 21.77, p < .01). In all these cases, the "several times a day" subset contributed most to the "always or almost always use" scale point due to more observed than expected counts.

Internet availability of digital training and practicing opportunities in L2 (variable 11 of Scale 1) exhibited a statistically significant correlation with Scale 2 Tech item 3, *language*

learning websites, due to the "high" subset contribution to the "always or almost always use" scale point. Variable 12 of Scale 1 exposing the overall *perception of the effect* of digital technologies on L2 learning practices displayed statistically significant correlations with Scale 2 Tech item 2, *online references* (χ^2 (8, N = 299) = 20.72, $p < .001$), item 4, *online learning resources* (χ^2 (8, N = 298) = 17.15, $p = .03$), and item 8, *use of collaboration platforms* (χ^2 (8, N = 299) = 16.60, $p = .03$).

Technologies and L2 Skills Correlations

Analysis of correlations between digital technologies categories (Tech items) and their support of the development of L2 skills and aspects was performed using the SPSS® Statistics cross-tabulation tool. Each of the ten technology Scale categories was examined from the perspective of exhibiting statistically significant correlations with Scale 3 four language skills items, *reading*, *writing*, *listening*, and *speaking*, and four language aspects items, *grammar*, *vocabulary*, *pronunciation*, and *style*.

Tech item 1, *online textbooks*, was found to be in statistically significant correlations with four out of eight Scale 3 items, three skills and one aspect. The statistical output for the four correlation pairs indicated higher values for item 1, *reading* skills (χ^2 (16, N = 299) = 43.52, $p < .001$) and item 6, *vocabulary* (χ^2 (16, N = 299) = 41.67, $p < .001$), and lower for item 2, *writing* (χ^2 (16, N = 299) = 29.76, $p = .02$) and item 3, *listening* (χ^2 (16, N = 299) = 26.68, $p = .05$) skills.

Tech item 2, *online references*, was found to be in statistically significant correlations with two language aspects items, item 6, *vocabulary*, and item 7, *pronunciation*. The statistical output for both correlation pairs delivered similar Pearson Chi-Square and the same *p* values: for item 6 = (χ^2 (16, N = 299) = 28.58, $p = .03$) and item 7 = *vocabulary* (χ^2 (16, N = 298) = 28.83, $p = .03$).

Tech item 3, *language learning websites*, was found to be in statistically significant correlations with one language skill, item 2, *writing*, and one language aspect, item 5, *grammar*. The statistical output for both correlation pairs showed higher values for item 5 (χ^2 (16, N = 299) = 36.91, p = .002) than for item 2 (χ^2 (16, N = 299) = 29.37, p = .02).

Tech item 4, *online learning resources*, was statistically significantly correlated to two language aspects, item 5, *grammar*, and item 8, *style*. The statistical output for the correlation pairs showed the following values: for item 5 = (χ^2 (16, N = 298) = 25.91, p = .05) and for item 2 = (χ^2 (16, N = 297) = 32.51, p = .01). Only one significantly correlated technology/language pair was established between Tech item 5, *assistive technologies*, and Scale 3 item 7, *pronunciation* (χ^2 (16, N = 298) = 40.02, p < .001) .

On average, the next three Tech items of Scale 2, *news and social media*, *audio/video platforms*, and *collaboration platforms* (items 6, 7, and 8) set up statistically significant correlations with two items representing language skills or aspects. Item 6, correlated to *grammar* (χ^2 (16, N = 298) = 32.76, p = .01) and *style* (χ^2 (16, N = 297) = 37.90, p = .002), item 7 – to *listening* (χ^2 (16, N = 298) = 43.82, p < .001), *pronunciation* (χ^2 (16, N = 297) = 32.76, p = .008), and *style* (χ^2 (16, N = 297) = 33.20, p = .007), and item 8 – to *speaking* (χ^2 (16, N = 299) = 27.01, p = .04) and *style* (χ^2 (16, N = 298) = 27.10, p = .04).

The two remaining Tech items, 9, *language learning games*, and 10, *intelligent tutoring systems*, also displayed establishment of statistically significant correlated pairs, but of reverse value. Formally, Tech item 9 set up a Scale 3 record in being a member of five statistically correlated pairs with *reading*, *writing*, *listening*, *pronunciation*, and *style*. However, significance in these correlated pairs was achieved due to higher than observed counts in the negative intersections of the correlated scale points that evaluated the usage and role of the item in the

development of language skills or aspects as “below average” and “usually do not - never or almost never”. Tech item 10 displayed two correlations with *writing* and *style* but with the directionality of values similar to that of item 9.

Technologies and LLS Correlations

Analysis of correlations between digital technology categories and language learning strategies (SILL domain items) was done on an item-to-item basis with focus on the correlations between strategy usage levels (low, medium, and high) differentiated by the SILL scale points in the intervals from 1 to 2.4, 2.5 to 3.4, and 3.5 to 5.0 (Oxford, 1990) and technology categories usage levels measured respectively. Additionally, the means of transformed variables representing items’ scale points subsets (or intervals), when applicable, and of the domains as single constructs were also analyzed for correlations.

The SILL instrument Memory domain that comes first in the inventory showed one of the lowest descriptive values (M = 2.9, SD = 0.61) with item means ranging from 1.79 to 3.71. High memory usage was registered among 15.1% of respondents, with 58.1% medium, and 26.8% low.

On item-to-item scale, memory item 1, *I think of relationships between what I already know and new things I learn in L2*, exhibited the highest usage mean (M = 3.71) among all other nine memory domain strategies. On the SILL range, it represents high strategy use interval. In correspondence to technologies used in L2 learning, this memory strategy was found to be in statistically significant relations to Tech item 1, *online textbooks* (χ^2 (16, N = 299) = 28.47, p = .03), Tech item 2, *online references* (χ^2 (16, N = 299) = 36.16, $p < .01$), Tech item 4, *online learning resources* (χ^2 (16, N = 298) = 26.33, p = .05), and Tech item 7, *audio/video platforms* (χ^2 (16, N = 298) = 30.49, p = .02).

Memory item 2, *I use new L2 words in a sentence so I can remember them*, follows item 1 in rank (M = 3.31), but represents the medium interval of strategy use. With respect to technologies used in L2 learning, this variable was found to be in statistically significant relations to Tech item 1, *online textbooks* (χ^2 (16, N = 299) = 29.22, p = .02), Tech item 2, *online references* (χ^2 (16, N = 299) = 30.89, p = .01), Tech item 6, *news and social media* (χ^2 (16, N = 298) = 58.20, p < .001), Tech item 7, *audio/video platforms* (χ^2 (16, N = 298) = 56.79, p < .001), Tech item 9, *language learning games* (χ^2 (16, N = 299) = 39.07, p = .001), and Tech item 10, *intelligent tutoring systems* (χ^2 (16, N = 299) = 34.00, p = .005). Other medium usage interval memory variables (Memory items 3 (M = 3.22), 8 (M = 3.2), 4 (M = 3.06), 6 (M = 2.95), and 9 (M = 2.74)) generated similar correlation patterns with the Tech Scale variables contributing to this correlation due to more observed than expected counts on the positive scale spectrum.

The two low usage interval memory variables, 5 (M = 2.10), *I use rhymes to remember new L2 words*, and 7 (M = 1.79), *I physically act out new L2 words*, do not establish as many statistically significant correlations with the Tech items as medium and high usage memory variables. Occasional cases of statistical significance took place with *language learning games* and *intelligent tutoring systems*, the items which experienced extremely low usage among the respondents.

In all such cases, SPSS® Statistics correlation output tables display positive correlations between the "use" scale points of the Tech items and "true of me" of the memory domain: the higher the "use" scale point is, the more the number of observed counts over expected is on the "true of me" scales. The negative scale points, "do not use" and "not true of me" also correspond to each other in the same fashion: the more the number of observed "do not use" counts over expected is, the more "not true of me" observed counts are on the "not true of me" scales.

The whole Memory domain as one composite variable (the mean of the sum of the items' means) shows significant correlations with Tech items 4, *online learning resources* (χ^2 (120, N = 298) = 150.50, p = .03), 7, *audio/video platforms* (χ^2 (120, N = 298) = 157.14, p = .01), 9, *language learning games* (χ^2 (120, N = 299) = 201.78, p < .001), and 10, *intelligent tutoring systems*, (χ^2 (120, N = 299) = 202.41, p < .001). The first two technology categories which exhibit from high to medium usage means on the positive scale spectrum (3.52 and 2.77 respectively) and ranking (3rd and 6th) may be supposed to contribute most to memory utilization in L2 learning. However, lower item means (2.27 and 1.82 respectively) and ranking (8th and 10th) of the second two Tech variables do not allow them to be regarded as contributors to the Memory domain support due to representing the negative scale spectrum.

The Cognitive domain that goes second in the inventory showed medium range descriptive values (M = 3.02, SD = 0.66, rank 4) with item means ranging from 1.86 to 3.89. High usage of cognition was registered among 22.1% of respondents, with 61.8% medium, and 16.1% low.

On item-to-item scale, cognitive items 11, *I try to find patterns in the L2* (M = 3.89), and 10, *I look for words in my own language that are similar to new words in the L2* (M = 3.76), exhibited the highest usage, in fact, the only two representing the high interval out of 14. In correspondence to technologies used in L2 learning, variable 11 was found to be in statistically significant relations to 7 out of 10 Tech items: 2, *online references*, 3, *language learning websites*, 4, *online learning resources*, 5, *assistive technologies*, 6, *news and social media in L2*, 7, *audio/video platforms*, and 9, *language learning games*. Variable 10 was found to be in statistically significant relations to 4 Tech items: 1, *online textbooks*, 6, *news and social media in L2*, 9, *language learning games*, and 10, *intelligent tutoring systems*. Statistical values for these

correlations were much alike: degree of freedom – 16, number of respondents – 299 or 298, Pearson Chi-Square values ranging from 27.25 to 32.69, and *p*-values – from .01 to .04.

Medium domain usage was recorded for 10 items, and that makes it the most item represented scale usage range. To find out statistically significant correlations between medium usage range cognitive items and technology classes and to avoid detailed description of each of the items, a new variable was created as a mean of these 10 items' means. The analysis showed that medium range values that represent the use of the cognitive domain contribute to establishing significant correlations with Tech items 6, *news and social media in L2*, 7, *audio/video platforms*, 9, *language learning games*, and 10, *intelligent tutoring systems*. Statistical values for these correlations were as follows: degree of freedom – 132, number of respondents – 298 or 299, Pearson Chi-Square values ranging from 160.94 to 232.38, and *p*-values – from < .001 to .04.

The two low usage interval cognitive variables, 8 (M = 2.26), *I write notes, messages, letters, or reports in the L2*, and 7 (M = 1.86), *I read for pleasure in the L2*, also establish many statistically significant correlations with the Tech items as medium usage cognitive variables. Cases with statistical significance were observed in correlations between them and *language learning websites, online learning resources, news and social media, audio/video platforms, collaboration platforms, language learning games*, and *intelligent tutoring systems* Tech items.

The Cognitive domain as a composite construct shows significant correlations with Tech items 2, *online references* (χ^2 (172, N = 299) = 207.07, p = .04), 6, *news and social media* (χ^2 (172, N = 298) = 242.78, p < .001), 7, *audio/video platforms* (χ^2 (172, N = 298) = 252.67, p < .001), and 10, *intelligent tutoring systems* (χ^2 (172, N = 299) = 215.89, p = .01). The first technology class which exhibits high usage mean on the positive scale spectrum (3.74) and

ranking (1st) may be supposed to contribute most to the utilization of cognition in L2 learning alongside with the medium range Tech item 7 (M = 2.77, 6th rank). However, lower item means (2.09 and 1.82 respectively) and ranking (9th and 10th) of other Tech variables do not allow them to be regarded as contributors to the support of the cognition domain due to manifesting the negative scale spectrum values.

The Compensation domain that goes third in the inventory showed medium range descriptive values (M = 3.05, SD = 0.65, rank 3) with item means ranging from 2.36 to 3.55. High usage of compensation techniques was registered among 26.2% of respondents, with 56% medium, and 17.8% low.

Only one item out of six, item 6, *If I can't think of an L2 word, I use the word or phrase that means the same thing*, with the mean value of 3.55 represents the high use range. In correspondence to technologies used in L2 learning, this variable was found to be in statistically significant relations to Tech item 4, *online learning resources* (χ^2 (16, N = 297) = 31.08, p = .01), and Tech item 6, *news and social media* (χ^2 (16, N = 297) = 26.45, p = .05).

Four items with medium range means, 1 (M = 3.33), *To understand unfamiliar L2 words, I make guesses*, 2 (M = 3.21), *When I can't think of a word during a conversation in the L2, I use gestures*, 4 (M = 3.1), *I read the L2 without looking up every new word*, and 5 (M = 2.78), *I try to guess what the other person will say next in the L2*, were transformed into one composite variable representing the medium use range items of the compensation strategy (M = 3.1, SD = .67). The latter was found to establish statistically significant correlation with one Tech item that comprised a variety of tools known as *assistive technologies* (χ^2 (60, N = 298) = 85.11, p = .02). It would be worth mentioning that other compensation items with higher usage means exhibited a broader spectrum of statistically significant correlations that narrowed down with the decrease

of the item mean values: for example, item 1 significantly correlated to four Tech items, *online textbooks, online references, online learning resources,* and *news and social media,* while item 2 correlated to two Tech items, *online references* and *assistive technologies,* and item 4 to only one, *collaboration platforms*.

Item 3 (M = 2.36), *I make up new words if I do not know the right ones in the L2,* that represents the low usage range was in significant correlation to three Tech items, *online references, assistive technologies,* and *news and social media*. These correlation patterns repeat some of the patterns of high and medium compensation strategy use ranges which seems consistent with overall use frequencies of the Compensation domain.

The Compensation domain as a construct (sum of the items means) shows significant correlations to one Tech item, *assistive technologies* (χ^2 (92, N = 298) = 129.97, p = .01), that exhibited significant correlations on medium and low use scale ranges as well. This factor allows them to be regarded as strategy contributors to the support of the compensation domain.

The Meta-cognitive domain that goes fourth in the inventory showed high medium range descriptive values (M = 3.26, SD = .73, rank 2) with item means ranging from 2.4 to 4.03. High usage of meta-cognitive activities was registered among 34.8% of respondents, with 54.2% medium, and 11% low.

As many as four items out of nine, item 3, *I pay attention when someone is speaking the L2,* with the mean value of 4.03, item 4 (M = 3.69), *I try to find out how to be a better learner of the L2,* item 2 (M = 3.58), *I notice my L2 mistakes and use that information to help me do better,* and item 9 (M = 3.55), *I think about my progress in learning the L2,* represent high strategy use range. It is worth noting here that item 3 of this domain exhibited the highest item value among all 50 inventory items across all six domains. This factor makes it interesting to compare the

spectrum of its statistically significant correlations to the technology classes with the transformed high use range variable.

In correspondence to technologies used in L2 learning, item 3 was found to be in statistically significant relations to five out of nine Tech items: 1, *online textbooks*, 2, *online references*, 4, *online learning resources*, 5, *assistive technologies*, and 7, *audio/video platforms*. Statistical values for these correlations were as follows: degree of freedom – 16, number of respondents – 299 or 298, Pearson Chi-Square values ranging from 28.09 to 43.99, and *p*-values – from < .001 to .043.

The transformed variable (the mean of the high usage range item means) was found to be in statistically significant relations to three Tech items, *online references*, *online learning resources*, and *language learning games* though the mean of the transformed variable was still in the high usage range (M = 3.71). This fact may bring us to the necessity of considering the factor of load levels of domain items in contributing to their overall usage.

Four items with medium range means, 8 (M = 3.23), *I have clear goals for improving my L2 skills*, 5 (M = 3.1), *I plan my schedule so I will have enough time to study the L2*, *I use gestures*, 1 (M = 2.99), *I try to find as many ways as I can to use my L2*, and 6 (M = 2.74), *I look for people I can talk to in the L2*, were also transformed into one variable representing the medium use range items of the Meta-cognitive strategy (M = 3.01, SD = .86). The latter was found to establish statistically significant correlation with four Tech items that represent a variety of technology categories such as, *language learning websites* (χ^2 (64, N = 299) = 89.01, p = .02), *online learning resources* (χ^2 (64, N = 298) = 100.14, p = .003), *audio/video platforms* (χ^2 (64, N = 298) = 112.98, p < .001), and *language learning games* (χ^2 (64, N = 299) = 104.88, p < .001). The last Tech category which has one of the lowest usage means on the Tech Scale has typically

achieved its correlation significance due to the negative scale correlations between “usually or never use” and “usually or never true of me” points. However, in its correlation to the Meta-cognitive domain items, statistically significant correlation was achieved on the positive scale between “always or almost always use” and “always or almost always true of me” points.

It was noted that the transformed variable constituted by meta-cognitive items with higher usage means also exhibited a broader spectrum of statistically significant correlations than the derivation variable. For example, meta-cognitive item 8 significantly correlated to five Tech categories (*language learning websites, online learning resources, news and social media, audio/video platforms,* and *language learning games*), item 5 correlated to three Tech items (*language learning websites, audio/video platforms,* and *language learning games*), item 1 to six items (*online textbooks, online references, online learning resources, news and social media, audio/video platforms,* and *language learning games*), and item 6 to six as well (*online textbooks, online learning resources, assistive technologies, news and social media, audio/video platforms, and intelligent tutoring systems*).

Item 7 of the Meta-cognitive domain (M = 2.4), *I look for opportunities to read as much as possible in the L2,* the only low usage domain item, was in significant correlation to the majority of Tech categories (7 out of 10). This result could take place due to more observed than expected counts on both negative and positive extremes of the scale. The factors that contributed to such a distribution of counts under the Meta-cognitive strategy domain may belong to different external circumstances and, thus, require additional research.

The Meta-cognitive domain as a construct (sum of the items’ means) shows significant correlations to five Tech categories that repeat previously described correlation counterparts of the meta-cognitive items. Significant correlations were registered on high, medium, and low use

scale ranges of the Meta-cognitive domain, and so this factor allows them to be regarded as contributors to the domain support.

The Affective domain that goes fifth in the inventory showed low medium range descriptive values (M = 2.54, SD = .67, rank 6) with item means ranging from 1.34 to 3.33. High usage of affective activities was registered among 8% of respondents, with 43.5% medium, and 48.5% low. It is a 6-item domain, and by rank, it's the lowest strategy domain utilized by the survey respondents in L2 learning. Three Affective strategy items represent the domain's medium scale range and the other three the low one. No high scale usage items were registered. Cross tabulation for significant correlations was focused on comparison of two extreme values item means, two transformed variables representing medium and low usage domain items, and of the whole domain as a construct with the Tech categories.

Affective domain item 2, *I encourage myself to speak the L2 even when I am afraid of making a mistake*, exposed the highest of the two extreme mean values (M = 3.33) and established statistically significant correlation with one Tech category, *news and social media* (χ^2 (16, N = 298) = 28.20, p = .03), while the lowest mean value item 5 (M = 1.34), *I write down my feelings in a language learning diary*, exhibited statistically significant correlations with seven Tech categories, items 3, *language learning websites*, 4, *online learning resources*, 6, *news and social media*, 7, *audio/video platforms*, 8, *collaboration platforms*, 9, *language learning games*, and *intelligent tutoring systems*. Statistical output for these correlations was as follows: degree of freedom – 16, number of respondents – 299 or 298, Pearson Chi-Square values ranging from 27.02 to 50.09, and p-values – from < .001 to .04.

However, such results should not be confusing as there is substantial difference in the nature of the above-mentioned data: the item with the higher mean value contributed to the

significance due to more observed than expected counts on positive scale points displaying relations between “always/almost always or usually use” and “always/almost always or usually true of me” while the one with the lower mean value indicated the negative scale points range. The latter correlations are established between “never or almost never use” and “never or almost never true of me” scale points, so, in fact, not being converted into any L2 learning activities, they do not imply actual strategies.

A similar correlation trend was observed between each of the two transformed medium and low usage Affective domain variables and Tech items. The medium usage strategies represented by one of the transformed variables established no statistically significant correlations with any of the Tech categories while the other one that represented low usage strategies exhibited statistically significant correlations with three Tech categories, 8, *collaboration platforms,* 9, *language learning games*, and *intelligent tutoring systems*.

The Affective domain as a construct was found to establish statistically significant correlations with four Tech categories: 5, *assistive technologies*, 6, *news and social media*, 7, *audio/video platforms*, and 9, *language learning games*. However, the lowest usage mean of the Domain does not let us suppose that these correlations signify substantial involvement of digital technologies into managing stresses and emotions in the L2 learning process.

The Social domain that goes last (sixth) in the SILL inventory showed high medium range descriptive values (M = 3.43, SD = .84, rank 1) with item means ranging from 3.22 to 3.75. High usage of socially oriented learning practices was registered among 54.2% of respondents, with 35.1% medium, and 10.7% low. By rank, it’s the highest strategy domain utilized by the survey respondents in L2 learning. Two Social strategy items represent the domain’s high scale range and the other four the medium one. No low scale usage items were

registered. Cross tabulation for significant correlations was focused on comparison of two transformed variables representing high and medium scale ranges and of the whole domain as a construct with the Tech categories.

Social domain item 6, *I try to learn about the culture of L2 speakers*, represented the domain's highest mean value (M = 3.75) and established statistically significant correlation with one Tech category, *online references* (χ^2 (16, N = 299) = 32.40, p = .009), while the composite high strategy usage variable established none. The transformed medium strategy usage variable established statistically significant correlations with two Tech categories, items 6, *news and social media* (χ^2 (64, N = 298) = 86.16, p = .03) and 7, *audio/video platforms* (χ^2 (64, N = 298) = 89.17, p = .02).

The Social domain as a construct was found to establish statistically significant correlations with two Tech categories: 5, *assistive technologies* (χ^2 (92, N = 299) = 115.18, p = .05), and 7, *audio/video platforms* (χ^2 (92, N = 298) = 136.80, p = .002). Possible explanations of the difference in representing the domain items content through the construct mean value will be elucidated in Chapter Five.

L2 Learner – Technologies – LLS Correlation Patterns and Regularities

A comprehensive descriptive portrayal of the research sample subjects followed by particular observations of the scale structures, along with itemized and composite values of the research variables allows us to point out aspects within each variable that present interest for further investigation. Applying advanced research methods to investigating related variables disclosed other correlation aspects that will give us grounds for making conclusions about the Digital Age Learner – Technology – LLS correlation patterns and making predictions about the SILL instrument relevancy to the research goals. Directionality of correlations, their statistical

significance, generalizability of findings, observed usage trends, and exploration of factor loadings of the SILL domain items were among the aspects discovered. Testing based on the comparison of group means and exploration of their statistical significance is what would fit our needs because once a relationship between two categorical variables is statistically significant it means that the relationship observed in the sample is unlikely to have occurred unless there really is a relationship in the population (Gravetter & Wallnau, 2009).

A number of categorical variables that displayed suggestive for the research purposes descriptive values have been selected to determine whether extending the sample data observations to wider population, or in other words for data generalization, is possible. Nine out of 12 Scale 1 variables were admitted for inferential considerations of their grouping means differences compared to variables of Technology Scale 2, L2 Skills Scale 3, and LLS Scale 4. Independent-samples two-tailed *t*- test as a fundamental parametric inferential statistics test (McGregor, 2018) reported with levels of sample size and significance was applied to measuring the correlations of the Scales variables and to provide their statistical power.

Correlation Factors and Scope of L2 Learning Patterns

Gender difference was found to be a statistically significant factor in utilizing technologies for language learning (Scale 2 Tech items). Female students showed higher group means in using Tech items 3, *language learning websites*, (t (294) = 3.88, $p < .001$, two-tailed, d = 1.18), 5, *assistive technologies*, (t (294) = 2.73, p = .007, two-tailed, d = 1.2), and 9, *games*, (t (294) = 2.71, p = .007, two-tailed, d = 1.19) while reporting significant difference between male and female group means. In relation to skills and aspects Scale 3, gender difference was not found to be a statistically significant factor in supporting the Scale items as no significant difference between male and female group means was reported. In relation to LLS Scale 4,

statistically significant distribution of higher mean values for female students was reported for the *Memory* domain (t (294) = 2.48, p = .01, two-tailed, d = .60).

Age in relation to technologies for language learning (Scale 2 items) was a statistically significant feature between *Under 20* and *20-25* years old groups. Students under 20 exhibited higher group means than their counterparts between 20 and 25 in using Tech item 3, *language learning websites*, (t (274) = 3.90, p < .001, two-tailed, d = 1.19), and their counterparts between 25 and 30 in using Tech item 9, *games*, (t (161) = - 3.19, p = .002, two-tailed, d = 1.19). In relation to Scale 3 items, age difference between L2 learners was found to be a statistically significant factor in supporting the development of L2 *grammar* (t (274) = 2.25, p = .03, two-tailed, d = .93) and *listening* skills (t (161) = 2.51, p = .01, two-tailed, d = .98). In both tested cases, it was also the group of younger learners under 20 that exhibited higher group means related to this factor. In relation to Scale 4 language strategy constructs, no statistically significant difference in the use of strategy domains was found between the age groups.

Student *status*, as a categorical variable, interacts to some degree with the *age* variable, but reflects a different perspective on the L2 learner, more academic level-oriented than age-related. From the academic status perspective, statistically significant mean differences were reported between freshmen, sophomores, and seniors in utilizing technologies for language learning. *Freshmen* exhibited higher scores over *sophomores* in using Scale 2 Tech item 7, *audio/video*, (t (186) = 1.99, p = .05, two-tailed, d = 1.21), and 3, *language learning websites*, (t (152) = 3.04, p = .003, two-tailed, d = 1.22). The latter item was also utilized more by *sophomores* than *seniors* (t (117) = 2.81, p = .006, two-tailed, d = 1.14). In contrast, *seniors* exhibited higher group mean than *freshmen* in using Tech items 2, *online references*, (t (152) = 1.98, p = .05, two-tailed, d = 1.13).

In relation to items from Scale 3, *status* was found to be a statistically significant factor in supporting the development of L2 *vocabulary* (t (130) = 2.07, p = .04, two-tailed, d = .85) in favor of *junior* L2 learners compared to *sophomores* and *senior* compared to *sophomores* (t (117) = 2.13, p = .04, two-tailed, d = .88). Interesting was the comparison of a low-represented *self-paced* category of learners (N = 13) to *sophomores*: along with displaying higher means for each language skill and aspect, statistical significance for *reading* (t (88) = 2.53, p = .01, two-tailed, d = .88) and *writing* (t (88) = 2.05, p = .04, two-tailed, d = .91) was reached. In relation to LLS Scale 4 constructs, statistically significant difference in the use of strategy domains between *freshmen* and *seniors* was observed on the Memory domain. *Freshmen* were found to rely on memory in L2 learning more than *seniors* (t (152) = 2.16, p = .03, two-tailed, d = .60).

With the L2 studied, Technology Scale 2 items demonstrated versatile patterns of statistically significant correlations between the usage level of technology categories and the related factor. All 10 Tech items were reported to be in correlation with at least one target language. *Spanish* learners demonstrated higher group means than *French* learners in utilizing Tech item 1, *online textbooks*, (t (200) = 2.14, p = .03, two-tailed, d = 1.34), than *German* learners in utilizing Tech items 3, *language learning websites*, (t (230) = 2.96, p = .003, two-tailed, d = 1.18), 8, *collaboration platforms*, (t (230) = 2.02, p = .04, two-tailed, d = 1.34), and than *Latin* learners in utilizing Tech item 7, *audio/video platforms*, (t (187) = 1.98, p = .05, two-tailed, d = 1.18).

German learners exposed higher group means than *Spanish* learners in utilizing Tech item 6, *L2 news and social media*, (t (229) = 2.30, p = .02, two-tailed, d = 1.12) and than *Latin* learners in utilizing Tech items 6, *news and social media*, (t (53) = 2.11, p = .04, two-tailed, d = 1.18) and 7, *audio/video platforms*, (t (53) = 2.17, p = .03, two-tailed, d = 1.24). *French* learners

demonstrated higher group means than *German* learners in utilizing Tech items 4, *online learning resources*, (t (66) = 2.37, p = .02, two-tailed, d = 1.10) and 10, *intelligent tutoring systems*, (t (66) = 2.17, p = .03, two-tailed, d = 1.00), than *Norwegian* learners in item 5, *assistive technologies*, (t (47) = 2.09, p = .03, two-tailed, d = .87), and than *Latin* learners in utilizing Tech item 7, *audio/video platforms*, (t (47) = 2.38, p = .03, two-tailed, d = 1.39). *Norwegian* learners demonstrated higher group means than *Spanish* learners in utilizing Tech item 7, *audio/video platforms*, (t (187) = 1.98, p = .05, two-tailed, d = 1.18), than *German* learners in utilizing Tech items 3, *language learning websites*, (t (77) = 2.36, p = .02, two-tailed, d = 1.19) and 8, *collaboration platforms*, (t (77) = 2.17, p = .03, two-tailed, d = 1.19), than *French* learners in utilizing item 2, *online references*, (t (47) = 2.25, p = .03, two-tailed, d = .87), and than *Latin* learners in utilizing Tech item 7, *audio/video platforms* (t (47) = 3.10, p = .004, two-tailed, d = 1.15).

The student population studying *Latin* was the smallest among the five language groups; however, in relation to utilizing technologies in L2 learning they managed to demonstrate higher group means in several Tech categories when compared to the other four groups of language learners. In utilizing Tech item 1, *online textbooks*, they surpassed with statistical significance *Spanish*, *German*, *French*, and *Norwegian* learners (t (187) = 2.93, p = .004, two-tailed, d = 1.33; t (53) = 2.68, p = .01, two-tailed, d = 1.4; t (23) = 4.47, p < .001, two-tailed, d = 1.10; t (34) = 3.14, p = .004, two-tailed, d = 1.24 respectively); in utilizing Tech item 3, *language learning websites*, (t (53) = 2.50, p = .02, two-tailed, d = 1.16), – *German* learners; and in item 9, *language learning games*, – *Spanish*, *German*, and *French* learners (t (187) = 2.93, p = .004, two-tailed, d = 1.14; t (53) = 2.22, p = .03, two-tailed, d = 1.20; t (23) = 2.13, p < .04, two-tailed, d = 1.24 correspondingly).

In relation to language skills and aspects, *L2 studied,* as a factor, displayed versatile correlations. Thus, *Spanish* learners exhibited one case of statistically significant difference related to assessing the role of digital technologies in developing L2 *grammar,* displaying a higher mean than *French* learners (t (200) = 2.05, p = .04, two-tailed, d = .94) while the *Norwegian* learners' group mean was higher than the *Spanish learners' group*. Also, *Norwegian* and *Spanish* learners were statistically different in estimating the role of technologies in L2 development of *reading* (t (211) = 2.43, p = .02, two-tailed, d = 1.00) and *writing* (t (211) = 2.70, p = .007, two-tailed, d = .97).

Interesting was the comparison of *Latin* learners to students representing other L2 groups. They differed significantly from *Spanish* learners in assessing the input of technologies to supporting L2 *reading* (t (187) = 2.52, p = .01, two-tailed, d = 1.00), *writing* (t (187) = 2.28, p = .02, two-tailed, d = .97), *grammar* (t (187) = 2.69, p = .008, two-tailed, d = .93), and *vocabulary* (t (187) = 2.53, p = .01, two-tailed, d = .88). The comparison of mean differences of *Latin* learners to *German* and *French* learners brought about similar results while a comparison of means to *Norwegian* learners yielded statistical significance only for *grammar* and *vocabulary*.

In relation to LLS Scale 4 constructs, statistically significant differences in the use of strategies by L2 learners of the five languages were observed on the *Memory, Cognitive, Meta-cognitive,* and *Social* domains. L2 learners representing two language groups, *Norwegian* and *Latin*, showed several group means that were higher than those of the other language groups, *Spanish*, *German*, and *French*. *Norwegian* learners utilized more *Cognitive, Meta-cognitive,* and *Social* strategies (t (211) = 2.86, p = .005, two-tailed, d = .67; t (211) = 3.27, p = .001, two-tailed, d = .74; and t (211) = 2.21, p = .03, two-tailed, d = .84 respectively) compared to *Spanish* leaners and more *Meta-cognitive* strategies than *German* (t (77) = 2.52, p = .01, two-tailed, d = .66) and

French (*t* (47) = 2.29, *p* = .03, two-tailed, *d* = .68) learners. *Latin* learners utilized more *Memory* strategies compared to *Spanish* (*t* (187) = 2.71, *p* = .007, two-tailed, *d* = .60) and *German* learners (*t* (77) = 2.52, *p* = .01, two-tailed, *d* = .66).

L2 proficiency level proved to be a distinguishing factor in relation to Scale 2 Tech items. Throughout proficiency subscales, the overall tendency was that respondents with higher L2 proficiency reported higher group means in the use of technologies than their peers with lower proficiency. Statistically significant differences were found between *intermediate* and *elementary* learners in using Tech item 6, *L2 news and social media*, (*t* (274) = 3.09, *p* = .002, two-tailed, *d* = 1.10), between *advanced* and *intermediate learners* in using Tech item 2, *online references*, (*t* (162) = 2.21, *p* = .03, two-tailed, *d* = 1.01), and between *advanced* and *elementary learners* in using Tech items 2, *online references*, (*t* (155) = 3.11, *p* = .002, two-tailed, *d* = 1.01), item 6, *L2 news and media,* (*t* (155) = 2.64, *p* = .009, two-tailed, *d* = 1.07), and item 7, *audio/video platforms*, (*t* (154) = 2.00, *p* = .005 two-tailed, *d* = 1.24).

The level of *L2 learners' proficiency* was a significant factor in differentiating the group means of *intermediate* and *elementary learners* in developing *reading* skills (*t* (275) = 2.33, *p* = .02, two-tailed, *d* = .93), *listening* (*t* (187) = 2.38, *p* = .02, two-tailed, *d* = .94), *grammar*, (*t* (275) = 3.31, *p* = .01, two-tailed, *d* = .001), and *style* (*t* (275) = 1.97, *p* = .05, two-tailed, *d* = .99) which could be expected. Intermediate learners also exhibited higher mean scores than *advanced* learners in *grammar* (*t* (162) = 2.57, *p* = .01, two-tailed, *d* = .90) which was less likely expected.

In relation to LLS Scale 4 constructs, statistically significant differences in the use of strategy domains by L2 learners with different levels of L2 proficiency were observed on all but the *Memory* domains but with level to level variation. Again, respondents with higher L2 proficiency reported higher group means than their peers with lower proficiency. The most

striking strategy use difference was reported for *Intermediate* learners when compared to *Elementary* learners: statistical significance was reported with even bigger *t*-test values and smaller *p*-values on *Cognitive, Compensation, Meta-cognitive, Affective,* and *Social* domains. When compared to *Elementary* learners, *Advanced* learners reported a higher usage of *Cognitive* (t (155) = 4.92, $p < .001$, two-tailed, $d = .62$), *Compensation* (t (154) = 2.38, $p = .02$, two-tailed, $d = .62$), *Meta-cognitive* (t (155) = 4.61, $p < .001$, two-tailed, $d = .69$), and *Affective* (t (155) = 2.28, $p = .02$, two-tailed, $d = .70$) strategies and when compared to *Intermediate* learners, a higher usage of *Cognitive* (t (162) = 2.56, $p = .01$, two-tailed, $d = .67$) and *Meta-cognitive* (t (162) = 2.57, $p = .01$, two-tailed, $d = .74$) strategies.

The *Study mode* was not found to be a significant factor for L2 learners studying in a face-to-face, online, or hybrid environment. There were no differences found in using either technologies for language learning (Scale 2 items), assessing the role of technologies in supporting the development of language skills and aspects (Scale 3 items), or utilizing language learning strategies (Scale 4 domains).

In relation to Technology Scale 2 items, learners' predisposition to study L2 either *individually* or *in a group* was found to be statistically different while utilizing Tech item 8, *collaboration platforms*, (t (296) = 2.16, $p = .03$, two-tailed, $d = 1.23$). In relation to Scale 3 items, learners' study preferences exhibited statistically significant differences favoring technologically supported *individual* study choices compared to *group* ones in developing *listening* (t (296) = 2.58, $p = .01$, two-tailed, $d = .97$) and *pronunciation* (t (295) = 2.42, $p = .02$, two-tailed, $d = 1.02$). In relation to Scale 4 LLS domains, no statistically significant difference in using learning strategies was found between the two study options.

In relation to Technology Scale 2 items, learners' affiliation with social media in L2 was found to be statistically significant while utilizing Tech item 2, *online references*, (t (297) = 3.73, p < .001, two-tailed, d = 1.02), item 4, *online learning resources*, (t (296) = 2.01, p = .05, two-tailed, d = 1.20), item 6, *L2 news and social media*, (t (296) = 6.964, p < .001, two-tailed, d = 1.06.), and item 7, *audio/video platforms*, (t (296) = 3.63, p < .001, two-tailed, d = 1.22). In relation to Scale 3 items, affiliation with L2 social media was not a significant factor for differentiating L2 learners' attitudes as to whether technologies support the development of language skills and aspects.

In relation to Scale 4, the test results for significance between students affiliated and not affiliated with social media in L2 were just the opposite. The "yes" group exhibited statistically significant differences on all six LLS domains with the following statistical output for these correlations: degrees of freedom – 297, t-values ranging from 2.37 to 7.19, p-values – from < .001 to .02, and d-values from .61 to .81.

In relation to Technology Scale 2 items, *frequency* of usage showed a tendency to be a distinguishing factor in relation to the majority of Scale 2 Tech items. The general tendency was that respondents with higher usage *frequency* exhibited higher group means than their peers with lower frequency. Statistically significant differences were noted between learners reporting *several times a day* and *several times a week* usage practice for all Tech items but Tech items 2, *online references*, and 5, *assistive technologies*.

Frequency of usage of digital technologies for L2 learning was t-tested for Scale 3 L2 skills and aspects support and development variables to find out if learners who use technologies more often would exhibit statistically significant differences. The group statistics showed that L2 learners who utilized technologies on a more frequent basis (*several times a day*) also displayed

higher means for the *frequency of usage* variable than the learners who practiced it *several times a week*. The test to prove the supportive role of the digital technology use frequency factor in the development of language skills and aspects confirmed earlier obtained descriptive statistics observations. The mean differences were significant for *reading* (t (223) = 2.64, p = .009, two-tailed, d = .93), *writing* (t (223) = 3.67, p < .001, two-tailed, d = .95), and *grammar* (t (223) = 2.10, p = .04 two-tailed, d = .93).

In relation to Scale 4, the test results for the significance of the frequency factor and the use of language strategies brought out statistic results similar to those obtained earlier for the *proficiency* factor. The "several times a day" group exhibited statistically significant differences in all six LLS domains but *Compensation* with the following output for these correlations: degrees of freedom – 158, t-values ranging from 2.28 to 3.17, p-values – from .002 to .02, and d-values from .60 to .80.

In relation to Technology Scale 2 items, availability of digital resources, as a research variable, was found to yield statistically significant differences in the means of its constituting groupings, *scarce*, *sufficient*, and *rich*. Three Tech items, item 3, *language learning websites*, (t (120) = 2.77, p = .006, two-tailed, d = 1.25), item 4, *online learning resources*, (t (266) = 1.20, p = .05, two-tailed, d = 1.19), and item 7, *audio/video platforms*, (t (265) = 2.21, p = .03, two-tailed, d = 1.23) exhibited greater usage as technologies offering "rich" L2 learning availabilities.

In relation to Scale 3, statistically significant mean differences between respondent groups that were asked to correlate digital *resources availability* and development L2 skills and aspects were recorded for all eight Scale 3 items when extreme grouping variables, *scarce* and *rich*, were related; for five items when *scarce* was compared to *sufficient* and for four items when *sufficient* was compared to *rich*.

In relation to Scale 4, statistical significance between the means of the variable groupings *rich* and *scarce* was observed on three LLS domains, *Cognitive* (*t* (120) = 3.02, *p* = .003, two-tailed, *d* = .70), *Compensation* (*t* (119) = 2.96, *p* = .004, two-tailed, *d* = .64), and *Meta-cognitive* (*t* (120) = 2.22, *p* = .03, two-tailed, *d* = .80). No statistical significance was found between the means of "*scarce*" and "*sufficient*" groups.

In relation to Technology Scale 2 items, perception of the overall effect of digital technologies on L2 learning was found to yield statistical difference in the means of respondents' groupings *yes*, *not sure*, and *no*. Positive evaluation of the effect as existing was expressed in relation to seven out of ten Tech items, from item 1 to 7, with the following output: degrees of freedom – 288 or 289, *t*-values ranging from 2.08 to 3.19, *p*-values – from .003 to .04, and *d*-values from 1.03 to 1.35.

Statistically significant mean differences between *"yes*" and "*not sure*" respondent groups that related the overall effect of the digital technologies and Scale 3 L2 skills and aspects development were reported for *grammar* (*t* (289) = 2.83, *p* = .005, two-tailed, *d* = .93), and *pronunciation* (*t* (288) = 2.44, *p* = .01, two-tailed, *d* = 1.02). In relation to Scale 4, statistical significance between the means of the variable groupings *yes*, *not sure*, and *no* was observed on five out of six LLS domains, *Memory* (*t* (289) = 2.90, *p* = .004, two-tailed, *d* = .59), *Cognitive* (*t* (289) = 3.11, *p* = .002, two-tailed, *d* = .64), *Compensation* (*t* (288) = 2.30, *p* = .02, two-tailed, *d* = .65), Affective (*t* (289) = 2.48, *p* = .01, two-tailed, *d* = .66), and *Social* (*t* (289) = 2.30, *p* = .02, two-tailed, *d* = .82) with higher means for the *yes* grouping.

CHAPTER V

DISCUSSION

Technology-enhanced Practices in L2 Learning

In quantitative survey studies, the ability to generalize results from participants to a larger population is of utmost importance (Hutchinson, 2004). To support this claim, the study undertaken is not about an individual learner, a particular learning style, a learner's favorite digital device or tool, or any other single item viewed discretely. When all these characteristics are brought together, a wholistic vision of common learning approaches and preferences can be derived from an extensive list of students' self-reported language learning practices that makes them an offprint of a group-related behavioral idiosyncrasy rather than a trait supposedly influenced by a discrete subjective or objective factor.

The overarching purpose of this study was to examine potential impacts of present-day digital technologies on language skills development and the use of language learning strategies in L2 language learning. Accompanying research interests were to measure the load factor of each of the six language learning strategic domains in the process of second language acquisition by the digital-age students and to identify other positive or negative correlations between the study variables. It is worth mentioning that our research goals are not focused on the reasons why L2 learners use a specific technology, but just on what technologies are mostly used, how they correlate with the L2 acquisition agents and elements, and what tech-infiltrated usage patterns are characteristic of undergraduate learners.

The main source of research outcomes in this paper is in the magnitude of possible differences between subsets and groupings of all research variables that register common practices used by the Net-generation language learners and correlations between categories of digital tools, acquisition of language skills and language aspects, and the use of learning

strategies. It is a way to maintain the research need to understand how Net-generation learners manipulate, express, and employ learning behaviors in any type of learning environment available in a digital age. To support this research target, the analytic instrumentation used in the study allows us to build essential generalizations pertaining to today's college language learners even if any kind of an uncontrolled factor implies a seemingly diverge perspective. The summarized review of observations and findings about the four research Scales, 80 Scale variables, and 41 variable subsets is presented in the chapter as answers to the Research Questions altogether with relevant discussion considerations and implications.

Research Question 1: The Digital Age L2 Learners

The scope of research interest was in the identification of consistent statistically significant correlations between the L2 digital age learners' attributes and utilization of digital technologies in L2 learning. The compiled picture of the L2 learner is made up the majority of young adults under 25 years old (92.3%) out of which those under 20 constituted more than half of all respondents (52.8%) which gives us grounds to consider them as Digital Native. The young age of the majority of students explains the prevalence of freshmen over other student categories and, possibly, of elementary and intermediate language proficiency levels (45.2% and 47.5% correspondingly) over advanced (7.4%). The biggest gender groups were females (57.9%) and males (41.1%), other genders were statistically irrelevant. Spanish learners made up the biggest L2 affiliated group (63.3%), followed by German (17%), Norwegian (10.4%), French (6.6%), and Latin (2.1%) learners.

L2 learners taking face-to-face classes made up the majority (65.2%) of the respondents, while the online and hybrid study formats were shared almost equally. The majority of undergraduates (64.1%) exhibited their preference to study individually rather than in a group.

Rather unexpectedly, no involvement in social media in L2 was reported by the overwhelming majority of respondents (84.3%) with only 15.7% affiliated. At the same time, almost half of the respondents (46.5%) reported infrequent use of the Internet for L2 learning (several times a week), with almost a quarter using it once a day, and almost a third of respondents reported using it several times a day. An overwhelming majority of survey respondents stated that there was an effect of digital technologies on their L2 learning and estimated digital learning resources availability as rich and sufficient. The participants' device use practices showed that computers were ranked first by 89.5%, cell phones were ranked second by 75.4%, and tablets ranked third by 68.5%.

By themselves, the discovered frequencies of the L2 learner portrayal do not tell in a specific way how the attributes are related to Tech items; however, they serve well to make a background for predicting what significant correlations are likely to happen between Scale 1 and 2 items. As all ten Scale 2 variables are ordinal by nature, we can expect that statistically and practically significant correlations may be established not just between a variable as a whole but rather between a subset of a nominal variable and a subscale point of an ordinal variable.

Such research architecture should be of benefit if more than one statistic instrument is used to detect existing correlation ties. The two tools employed to obtain comprehensive correlation data between variables were cross tabulation and *t*-testing, They are known to be based on different principles of comparison, comparison of percentages and comparison of mean difference between grouping variables, or variable subsets, and that gives a researcher a more sensitive and powerful instrumentation to identify such cases.

With this instrumentation, the following correlation patterns were observed: 1. Female students demonstrated significantly higher usage of language learning websites and assistive

technologies and significantly lower usage of games and intelligent tutoring systems than male students; 2. Students under 20 demonstrated higher usage of language learning websites than students between 20 – 25 years old and of games than students between 25-30 years old; 3. Freshmen demonstrated higher usage of audio/video platforms and language learning websites than sophomores, but lower usage of online references than seniors. Sophomores used language learning websites significantly more than seniors; 4. L2 studied exhibited multidirectional statistical significance in relation to the technologies used. The tendency observed was that more common languages such as Spanish, German, French, and Norwegian were more strongly related to using language learning websites, L2 news and social media, audio/video platforms, and collaboration platforms. Conceivably, Spanish, German, and French exhibited multiple correlations to Tech items, however, Norwegian was stronger related to some particular Tech categories than any of the other three (to audio/video platforms than Spanish, language learning websites and collaboration platforms than German, and online references than French). Latin learners displayed a unique correlation to using online references: stronger than any other language group, which underlines the informational importance of this resource to Latin learners; 5. Higher levels of L2 proficiency had a stronger correlation with the use of online references, audio/video platforms, and L2 news and social media than lower; 6. Group study preference was significantly related to the use of collaboration platforms; 7. Affiliation with L2 social media predicted strong correlations with online references, online learning resources, audio/video platforms, and L2 news and social media; 8. Higher frequency of digital affordances usage was in significant correlations with all technology classes but online references and assistive technologies; 9. Perceived digital resourcefulness correlated with language learning websites, online language resources, and audio/video platforms; 10. Perceived digital effects on L2

learning correlated with Tech items 1 to 7, expectedly leaving out such low-usage technology classes as games and intelligent tutoring systems.

Learner characteristics make up an important constituent of instructional design (Smith & Ragan, 2005). From this perspective, the aforementioned correlation patterns between learner attributes and utilization of technological tools provide an instructional designer with rich data for establishing sets of relevant learners' predispositions to be considered while developing instruction for a specific L2 target audience. The identified patterns as well as particular statistically significant attributes reflect all four major categories of learner characteristics distinguished in instructional design (cognitive, physiological, affective, and social, Smith & Ragan, 2005) thus helping the designer justify their choice of applied instructional strategies such as medium and media of instruction, students grouping, response mode, L2 skill level, vocabulary used, approaches for gaining and focusing attention, learning guidance, and the mode of reinforcement.

Research Question 2: Technology Use in L2 Learning

The scope of research interest of Question 2 was to rank the Tech categories utilized in L2 learning by undergraduate university students as the digital age learners and identify their applicability. Eight out of ten Tech categories were found to be significantly related to other Scales variables to a different extent, that is why we will introduce the correlations between technology classes and their L2 learning users in the ranking order, starting with the Tech item that exhibited the highest reported usage. Statistically significant correlations between the components have already been stated above in the answer to Research Question 1.

Online reference sources, ranked first in usage, were reportedly used by 88% of the respondents. Examples of this type of online L2 learning tools are bilingual or monolingual

translation or explanatory dictionaries with examples of use in a sentence, explanation of the word origin, and audio support of their entries. This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: academic status, proficiency, language studied, affiliation with L2 social media, usage frequency, and perceived technology effect. Although not statistically significant between the Study Mode category subsets, the use of this digital affordance had especially high use frequency (71.6%) on the scale point of "always or almost always use."

Language learning websites, ranked second, were reported to be utilized by almost 82% of the respondents. An example of this type of online L2 learning service is Duolingo or Babbel that offer training and support in all languages mentioned in the survey. This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: age, language studied, usage frequency, resource availability, and perceived technology effect.

Ranked third, *online learning resources* obtained close usage numbers: almost 80% of respondents used them in some form. Examples of this type of online L2 learning tools are services that offer practice in all language skills, vocabulary building, grammar development, books on language learning, educational games, flashcards, and some other activities. This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: language studied, usage frequency, affiliation with social media in L2, resources availability, and perceived technology effect.

Online books and *course textbooks*, ranked fourth, were used by 73% of respondents. Subsets of language studied, usage frequency, affiliation with social media in L2, resources availability, and perceived technology effect variables were found to be in statistically significant correlations with the item.

Assistive learning technologies, ranked five, are usually referred to such supportive instrumentation as closed captioning, text-to-speech conversion, grammar or spelling checkers, or transcription. They exhibited usage by almost 68% of the respondents. Subsets of gender, language studied, and perceived technology effect variables were found to be in statistically significant correlations with the item.

Audio and video platforms, ranked sixth, were reported to be utilized by a bit more than half of the respondents. Podcasting, video streaming, or audio/video sharing that offer access to authentic L2 materials with excellent quality could have become item number 1 in this ranking, but it did not. This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: language studied, academic status, usage frequency, affiliation with social media in L2, and perceived technology effect.

Collaboration platforms in L2, ranked seventh, were reported to be utilized by a bit more than 40% of the respondents. Several internet services such as Goggle Docs are widely utilized by students regardless of the field of knowledge, but in the L2 area their utilization could have been at a higher level. At the same time, learners' predisposition to study L2 in a group was the factor that was expectedly found to be statistically different from individually-oriented learners . This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: language studied, usage frequency, and perceived technology effect.

L2 Learning games, ranked eighth, were reported to be utilized by under 40% of the respondents. Although free services such as Digitaldialects.com offer a variety of languages and activities to choose from, their methodological efficiency is not obvious. This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: gender, age, language studied, and usage frequency.

News and social media in L2, ranked ninth, were reported to be utilized by less than third of the respondents. Participation in L2 social media exhibited respondents' substantially low frequencies of L2 social presence and quite conceivably interacted with the negative subset of this item. This Tech item was found to be in statistically significant correlations with several subsets of L2 learner variables: language studied, L2 proficiency, usage frequency, resources availability, and perceived technology effect.

Intelligent tutoring systems, ranked last, were reported to be utilized by under a quarter of the respondents. Subsets of language studied and frequency of usage variables were found to be in statistically significant correlations with the item.

Research Question 3: Technology Support in Developing L2 Skills and Aspects

The scope of research interest of question 3 was to identify what digital learning tools contribute most to supporting the development of L2 skills and aspects. A positive view of the role of digital technologies used in supporting and developing L2 skills was shared by the overwhelming majority of respondents with higher ranking given to receptive skills (reading and listening) and lower to expressive skills (writing and speaking). As with the conclusions made about the use of the technological items, we focus the results discussion on the cases that have statistical significance.

Reading as an L2 skill was found to be in statistically significant correlation with one Tech item, online textbooks, which seems quite predictable. The investigation of correlations between reading and categorical variables of Scale 1 displayed several cases of statistically significant mean differences between their subsets, or groupings. The development of L2 reading skill through digital technologies was determined by Norwegian learners with statistical significance compared to Spanish learners due to a higher group mean exhibited. Likewise, in

assessing the supportive role of technologies for reading, Latin learners differed statistically significantly from Spanish learners and learners representing two other L2 groups, German and French.

Other observations on the respondents' assessment of reading – technology correlation testified to the importance of using digital technologies for support. In addition to displaying higher means for each language skill, a small group of self-paced learners (N = 13) exhibited statistical significance for reading compared to sophomores. Proficiency level of L2 learners was noted as a positive significant factor to differentiate the group means of intermediate compared to elementary learners in L2 reading development. The frequency of technologies usage also yielded significant mean difference for reading between L2 learners who use them several times a day versus several times a week.

Listening as an L2 skill was found to be in statistically significant correlations with two Tech items, online textbooks and audio/video platforms. These findings could be naturally expected for affordances with focus on audio and less expected for online textbooks, but an online textbook today is more than a collection of printed pages in a regular book. With L2 focused auditory service, online textbooks have become an indispensable element of listening support.

Other Scale 1 categorical variables that exhibited statistically significant subsets in supporting the development of L2 listening skill were age difference between L2 learners, L2 learners' proficiency (intermediate vs elementary), and L2 learners' study preferences that favored individual study practices compared to group ones in developing this skill. The latter observation may give the L2 instructor a hint to consider teaching this skill out of class time in favor of other L2 development activities.

Writing as an L2 skill was found to be in statistically significant correlations with two Tech items, online textbooks and language learning websites. Although an additional Tech item was found to be particularly supportive for this skill, its correlations resemble those of reading. As in the case with L2 reading support, Norwegian learners evaluated the development of L2 writing skill through digital technologies with statistical significance compared to Spanish learners. Likewise, in assessing the supportive role of technologies for writing, Latin learners differed statistically significantly from Spanish learners and learners representing two other L2 groups, German and French.

Self-paced learners, who do not establish a permanent L2 cohort and, as such, represent different proficiency levels, estimated with statistical significance the supportive role of technologies for writing development compared to sophomores. Proficiency level of L2 learners was noted as a positive significant factor to differentiate the group means of intermediate compared to elementary learners in L2 writing development. The frequency of technologies usage also yielded significant mean difference for writing between L2 learners who use them several times a day versus several times a week.

Speaking as an L2 skill was found to be statistically significant correlations with only one Tech item, collaboration platforms. No other variables or their subsets were noted for establishing statistically significant correlation with the technology mediation in developing the speaking skill.

A positive view of the role of digital technologies used in supporting and developing L2 aspects was also shared by the overwhelming majority of respondents. Language aspects developed are presented below from vocabulary and grammar to pronunciation and style in the higher to lower support ranking order.

Vocabulary as a L2 aspect developed was found to be in statistically significant correlations with two Tech items, online textbooks and online references. Also, some subsets of two demographic factors, the academic status and the L2 studied were found to be in statistically significant correlations with the aspect. Juniors differed significantly in their assessment of the role of digital technologies in supporting the development of L2 vocabulary compared to sophomores as well as seniors compared to sophomores. Vocabulary development in a L2 was an important learning task for Latin learners, who differed statistically significantly from Spanish, German, French, and Norwegian learners in assessing the importance of input from technologies to supporting this L2 skill.

Grammar as an L2 aspect developed was also found to be in statistically significant correlations with two Tech items, online learning resources and L2 news and social media. Several subsets of five demographic factors such as age, L2 studied, level of L2 proficiency, frequency of usage, and the perceived effect were found to be in statistically significant correlations with the aspect. Age difference between L2 learners was found to be a statistically significant factor in supporting the development of L2 grammar for younger, under 20, learners. Spanish learners exhibited just one case of statistically significant difference assessing the role of digital technologies in developing L2 grammar, displaying a higher mean than French learners. Latin learners differed statistically significantly from Spanish, German, French, and Norwegian learners in assessing the importance of technologies to supporting L2 grammar. The level of L2 learners' proficiency was a significant factor to differentiate the group means of intermediate compared to elementary and advanced learners in developing the aspect. Higher frequency of usage of digital technologies and positive perception of their effect significantly correlated with the assessment of digital technologies' impact on L2 grammar support.

Pronunciation as a L2 aspect developed was found to be in statistically significant correlations with three Tech items: online references, assistive technologies, and audio/video platforms. Subsets of two demographic factors, the study preferences and perception of the effect, were found to be in statistically significant correlations with the aspect. Learners with individual study preferences exhibited statistically significant difference compared to L2 learners with group study preferences in assessing the role of technologies in developing pronunciation. A "yes" respondent group related the overall effect of the digital technologies on L2 learning to reporting the development of this aspect with statistical significance compared to those respondents who were not sure.

Style as an L2 aspect developed was found to be in statistically significant correlations with four Tech items, online learning resources, L2 news and social media, audio/video platforms, and collaboration platforms. No subsets of the research variables were found to be in statistically significant correlation with the aspect.

In relation to skills and aspects of Scale 3, gender difference was not found to be a statistically significant factor in supporting the Scale items as no significant difference between male and female group means was reported. Statistically significant mean differences between respondent groups that were asked to correlate digital resources availability and development L2 skills and aspects were recorded for all eight Scale 3 items when extreme grouping variables, *scarce* and *rich*, were related; for five items when *scarce* was compared to *sufficient* and for four items when *sufficient* was compared to *rich*.

Research Question 4: Use and Correlations of LLS

The scope of research interest of question 4 was to identify what tendencies in the use of language learning strategy domains and particular items are noted among the digital age L2

learners and how strategy use is related to variables from other related Scales. To help define the scope of use, the original evaluation form was applied.

According to Oxford's (1990) explanation, the strategy use is considered low if its mean value is between 1.0 and 2.4, medium for mean values between 2.5 and 3.4, and high for values between 3.5 and 5.0 (Shakarami et al., 2017). Some tendencies in the use of LLS by pre-internet language learners were noted and reported in the literature (Chamot, 2001; Shakarami et al., 2017; Oxford & Green, 1995, and others). It was found that the strategy difference scope varies widely in all of the six strategy categories reported by Oxford (1990) for pre-internet language learners.

As L2 learning has its purpose to develop verbal abilities or, in other words, abilities to present information in a verbal form, it means that from the instructional design perspective it is aimed at developing declarative knowledge performance. The latter includes the acquisition of label and names, facts and lists, and organized discourse through instructional strategies of linking, organizing, and elaboration that are common to all declarative knowledge learning (Smith & Ragan, 2005). The strategies noted are defined as propositional or image based (Smith & Ragan, 2005, p. 152) and thus are heavily based on memory and cognition. In relation to the SILL strategy inventory, it may mean that the inventory's memory, cognitive, and meta-cognitive strategy domains should possess established advantages over the application of other strategy domains in the field of L2 learning. However, the actual strategy utilization by the research respondents differed from that assumption.

Following Oxford's LLS usage evaluation rubric (Oxford, 1990), we may conclude that all strategy domains were utilized by our respondents at the medium level with one domain

reaching upper medium level. They are presented below from the Social to Affective strategy domains in the higher to lower usage ranking order.

Based on the literature review findings, the Social domain as an indirect strategy could be expected to exhibit advantage in usage compared to direct strategies. However, this expectation might not extend to its usage preference compared to the other two indirect strategies, Meta-cognitive and Affective; however, that is what occurred.

Four out of six Social domain items measuring the involvement of L2 learners in their practice to communicate in the language learned obtained steady upper medium scores with two items reaching high strategy use level. These two items may denote two trends that make the Social domain contributing quite significantly to L2 learning: interest in the L2 culture and positive attitude to asking for assistance.

In relation to the Technology Scale items, the Social domain showed significant correlations with two Tech items, assistive technologies and audio/video platforms. It is beyond the scope of this study to explain particular correlation mechanisms, but, presumably, the two affordances utilized helped to set up models of authentic communication behaviors and ways to achieve one's communicative purpose most naturally.

Subsets of three demographic variables: L2 studied, frequency of usage, and perceived effect were noted for being significantly different in their relation to the domain. Social strategies were utilized significantly more by Norwegian learners compared to Spanish learners, by the group of most frequent technology users (several times a day), and by those who admit the effect of technologies on L2 acquisition compared to those who hesitate or deny it.

The second position of the Meta-cognitive domain in the usage ranking was not what could be exactly predicted by the literature review, but four out of nine domain items measuring

the involvement of L2 learners in developing skills to organize their own learning obtained rare high scores with one item reaching the absolute high value (M = 4.03) among all 50 SILL items. As it was earlier mentioned, L2 acquisition often faces methodological problems related to teaching meta-cognitive strategies to students, so our expectations were that the domain would not get high mean scores. However, the predominantly high and medium usage level of strategies aimed at paying attention to making learners' conscious efforts to help themselves develop L2 skills speaks for itself. Although maintaining these skills seems no less important than the literature review suggested, the fact is that it is meaningfully incorporated into L2 learning of digital native college-level students.

In relation to the Technology Scale items, the Meta-cognitive domain showed numerous significant correlations with five Tech items, language learning websites, online learning resources, L2 news and social media, audio/video platforms, and language learning games. In relation to Scale 1, subsets of four demographic variables, L2 studied, proficiency level, frequency of usage, and perceived effect were noted for being significantly different in their relation to the domain. Meta-cognitive strategies were utilized significantly more by Norwegian learners compared to Spanish, German, and French learners, by more proficient compared to less proficient (advanced compared to elementary and intermediate) L2 learners, by frequent technology users (several times a day), and by those who evaluated the availability of digital resources as rich compared to users who determined them as scarce.

The third, or even higher, position of the Cognitive domain in the usage ranking could be expected to some degree following the SILL discussion in the literature review. Traditionally, theories of learning dedicate much attention to its importance in the acquisition of knowledge, so its ranking could be higher. However, that did not occur although its 14 items make it the most

sensitive measuring instrument compared to other domains. The majority of items obtained medium usage scores with two items reaching absolute second (M = 3.89) and third (M = 3.76) high strategy use level.

In relation to the Technology Scale items, the Cognitive domain showed significant correlations with online references, news and social media, and audio/video platforms. In relation to Scale 1, subsets of five demographic variables, L2 studied, L2 proficiency, frequency of technology usage, resource availability, and perceived effect were noted for being significantly different in their relation to the domain. Cognitive strategies were utilized significantly more by Norwegian learners compared to Spanish learners, by more proficient compared to less proficient L2 learners (advanced compared to elementary and intermediate) L2 learners, by frequent technology users (several times a day), by those who evaluated the availability of digital resources as rich compared to users who determined them as scarce, and by those who admit the effect of technologies on L2 acquisition compared to those who hesitate or deny it.

The Compensation domain was ranked fourth in the usage, lower than it could be as predicted by the literature review discussion. With only one item at the high level of the strategy use, the involvement of L2 learners in supporting their learning by paralinguistic means was mostly evaluated at the medium level.

In relation to the Technology Scale items, the Compensation domain showed significant correlations with only one Tech item, assistive technologies, that, in addition to the services mentioned earlier, may offer a great variety of means to express feelings and concepts through symbols. In relation to Scale 1, subsets of three demographic variables, L2 proficiency, resource availability, and perceived effect were noted for being significantly different in their relation to

the domain. Compensation strategies were utilized significantly more by more proficient L2 compared to less proficient (advanced compared to elementary) L2 learners, by those who evaluated the availability of digital resources as rich compared to users who determined them as scarce, and by those who admit the effect of technologies on L2 acquisition compared to those who hesitate or deny it. Unlike other strategy domains, the Compensation domain was not in statistically significant correlations with any subsets of L2 Studied and Frequency of Technology Usage variables.

The last but one place of the Memory domain in the usage ranking was what could be predicted by the literature review. Indeed, just one out of nine domain items measuring the involvement of L2 learners in applying their memory abilities to learning obtained a high score while the majority were at the medium level, and one at the low level (M = 1.79). The reliance of present-day learners on immediate availability of digital resources could be regarded as a compensation for an old habit of retrieving data from memory.

In relation to the Technology Scale items, the Memory domain showed significant correlations with four Tech items, online learning resources, audio/video platforms, language learning games, and intelligent tutoring systems. In relation to LLS Scale 4, subsets of five demographic variables, gender, status, L2 studied, frequency of usage, and perceived effect were noted for being significantly different in their relation to the domain. Memory strategies were utilized significantly more by female students than males, more by freshmen than seniors, more by Latin learners than Spanish and German learners, by more frequent technology users (several times a day), and by those who admit the effect of technologies on L2 acquisition compared to those who hesitate or deny it.

The last place of the Affective domain in the usage ranking was not what could be predicted by the literature review, rather just the opposite, - to be one of higher ranking domains. In relation to the Technology Scale items, the Affective domain showed significant correlations with four Tech items, assistive technologies, news and social media, audio/video platforms, and language learning games. In relation to LLS Scale 4, subsets of three demographic variables, L2 proficiency, frequency of usage, and perceived effect were noted for being significantly different in their relation to the domain. Affective strategies were utilized significantly more by more proficient compared to less (advanced compared to elementary) L2 learners, by more frequent technology users (several times a day), and by those who admit the effect of technologies on L2 acquisition compared to those who hesitate or deny it.

Finalizing our observations on the identification of correlation patterns between digital technologies categories, learners' practices, and strategy domains, it should be noted that two out of 10 Tech items, online textbooks and collaboration platforms, did not show statistically significant correlations with any of the LLS domains. The opposite correlational trend was displayed by L2 learners affiliated with the social media in L2 who utilized all LLS domains with statistically significant difference compared to non-affiliated learners. Also, in relation to LLS Scale 4 domains, statistically significant differences in their use by L2 learners with different L2 proficiency was observed on all but the Memory domains, but with level to level variation. The most striking strategy use difference was reported for intermediate level compared to elementary L2 learners: statistical significance was reported with even bigger *t*-test values and smaller *p*-values on Cognitive, Compensation, Meta-cognitive, Affective, and Social domains.

Research Implications

Preliminary assumptions about the study of correlations between the research variables based on the findings from the literature review were that they might bring out a variety of

interesting observations and developments. One of the assumptions was that a correlational research study occurs in real-life situations and that is why the data gathered is more applicable to everyday contexts (Devlin, 2018). Another one was that each variable creates a unique data set that can correlate in several different ways with expected and unexpected factors, different directionality, and different strengths of each relationship. Data from this study provides us a view of how the Digital Natives themselves see their technology use and approaches to L2 learning. The research findings suggest connections with several areas of knowledge acquisition sciences: instructional design, learning theories, and teaching methodology.

The first point that was clearly noted was that Digital Natives do learn with technologies regardless of the amount of digital technologies utilized in the classroom. This conclusion sends signals to educators, L2 instructors, and instructional designers: when designing, developing, and implementing an instructional event, digital technologies should be considered, planned, and utilized by all possible means. Unfortunately, technology usage preferences exhibited by our respondents confirm the existence of the ongoing problem of the digital use divide: present-day L2 learners are not yet active users, and this is the fact to be considered while designing and implementing technologically-enhanced activities in the classroom or as individual projects.

The next point to pay attention to is to find out what instructional approaches would best suit the L2 learners. By exhibiting adherence to utilizing indirect strategies (in our case, social and meta-cognitive) over direct (memory, compensation), present-day L2 learners send another signal to their instructors: their learning habits rely mostly on collaborative knowledge construction and much less on drilling and rote memorization.

Another research finding makes it evident that L2 learning today is more than a classroom experience, it also takes place informally outside the classroom. From the perspective

of L2 instructional methods, communicative language teaching approach offers multiple opportunities for informal learning and peer communication through reciprocal, cooperative, inquiry- and problem-based learning alongside with opportunities to repeat, organize, and summarize the content to match the learners' expectations.

The fourth point is that instructors' awareness of the technological support aimed at the strategies most utilized by the modern learners may have numerous instructional implications as each strategy is related to particular sets of teaching and learning activities employed in the classroom or planned as out of class tasks. In practical terms, such a relationship may help the instructor justify the choice of activities most efficient for their students. For example, statistically significant differences favoring technologically supported individual study choices compared to group ones in developing listening and pronunciation may imply that utilizing the class time for developing these L2 skill and aspect would not be the best teaching option. Another example of successful matching of teaching activities to learning strategies favored by students would be active and diverse exploration of strong L2 learners' interest in the culture related to the language learned that was vividly expressed by the highest domain mean of a corresponding Social strategy item.

Yet, another important point is that the instructors' awareness of L2 learners' attributes relevant to the learning process will make the efficiency of discovered correlations stronger. Academic status, L2 studied, L2 proficiency, study mode preferences, frequency of usage are only some categorical variables of which subsets may be significantly related to the key research variables (technology categories, language skills/aspects developed, and choice of strategies used). The conclusions based on obtained first-hand evidence may allow us to make broader recommendations for changes in the L2 teaching methodology. They may also prevent

instructors from making unsupported assumptions about their students' mastery of educational technology, and, consequently, neglecting to teach students the skills they need for academic success.

Although not focused on a specific research component, the L2 learner, technology, L2 skill, or learning strategy, a correlational research of such breadth has an advantage that makes it possible to narrow the findings in future studies as needed to determine causation experimentally if needed. It can be an experiential process that involves direct observation or occur through quantitative data input with additional qualitative testing.

Limitations and Delimitations

The study contains several limitations. First, the data collection is geographically limited to the student population of University of North Dakota. Second, the survey covers the digital technologies affordances for the commonly taught languages (Spanish, German, and French), leaving out less commonly taught languages, such as Arabic, Chinese, or Russian which are not offered as a program of study. Having data from students majoring or minoring in Norwegian or Latin did not likely compensate for this limitation. Also, amid five survey languages, the subject pool was noticeably skewed to Spanish. With frequencies and descriptive values being nominally sensitive to the imbalance, it stopped being an issue while applying inferential statistics based on means difference.

The next two limitations of the study are related to the convenience sampling and data analysis techniques used. The sampling method limitation will remain an issue as using random sampling efficiently for the research of such format is unlikely on the basis of relatively extensive survey. Another limitation is the data processing method. Although the correlational method is convenient and usually high in external validity, its disadvantage is the possibility of

uncontrolled intervening variables to influence the results (Ross, Morrison, & Lowther, 2010). However, in the present research, the sampling size was seemingly sufficient to overcome this potential limitation by going beyond correlational methodology and applying additional inferential methods such as *t*-testing and factor analysis.

We need to attempt making some delimitations between variables terms used in the study. A typical correlational design does not presuppose differentiation between dependent and independent variables substituting them with criterion and predictor terms (Creswell, 2012) but inferential SPSS tools that were utilized in the study apply such terminology in their user interface. As one of the main differences between independent/dependent and criterion/predictor variables is the concept of causation, we need to state that no causation was implied in the research findings.

Some of our findings represent statistically significant correlations between variables subsets and cross-tabulation cells that may seem to be small to be considered important. In the research context, we consider them equally meaningful and, what is not less important, having practical significance in addition to statistical. The crud factor theory idea that in behavioral research everything correlates with everything else also states that all variables are connected through causal structures, which result in real nonzero correlations between all variables in any given data set (Orben & Lakens, 2020). The multitude of our findings may to some extent support the statement about correlation inclusiveness, but we stress that no causal structures have been established.

Other Considerations: The SILL Instrument Re-visited

Although being constituting elements of a valid and reliable instrument across all its domains, SILL items displayed contrastive descriptive values within domains and varying

statistical significance of correlation patterns with grouping variables obtained via *t*-testing. In order to take a closer look at these inconsistencies, an exploratory factor analysis of the SILL instrument was done to determine latent factors and components on each of the SILL domains. It was the only scale that generated the need of a closer look also because the other two scales, Technology and Language Skills Scales, cannot be regarded as instruments per se as they present a classifying listing of digital technology tools and commonly known human language skills to which both categoric variables of Scale 1 and the SILL instrument items were related.

To make the SILL considerations grounded on data rather than speculations, a Principal Components Analysis (PCA) was performed for the SILL domains using SPSS® Statistics Dimension Reduction tool. Analytic options of the statistical output included a correlation matrix, coefficients, Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy, Bartlett's Test of Sphericity, and Direct Oblimin rotation with extraction set up at Eigenvalue greater than 1 and suppression of values below .30.

For this exploratory purpose, we will use the terms PCA and factor analysis interchangeably, as the SPSS® software suggests, although they possess differences (Jolliffe, 2002). Essentially, both test to see if there is a certain redundancy between the variables that can be summarized with a few factors. These factors tell us which items hold together, what construct they are tied to, and which items appear to be measuring the same construct.
The null hypothesis of the test is that the variables are not correlated, so in cases of statistical significance with *p*-values less than .05 it will be rejected. Factor analysis is a search for underlying constructs, but it does not tell what they are – it is usually done in a more qualitative way, through a semantic analysis of items that make up suggested groupings.

For the Memory domain items, two output values (KMO = .71 and Bartlett's Test χ^2 (36) = 439.82, $p < .001$) testify that the factor analysis is appropriate for the data. Three Memory domain latent components with Eigenvalue greater than 1 were extracted with component 1 loaded on each domain item. The three components explain 56.33 % of total variance with component 1 explaining 30.76%. The Pattern matrix related items 4, 3, 5, 7, 9, and 2 to this component as having value of more than .30. The number of items related to components 2 and 3 was not sufficient for considering them in the factor identification process. On those grounds, the Eigenvalue option was changed to the 2 fixed number of factors option and the PCA was re-run. In the output, Items 7 and 9 displayed the lowest communalities numbers that explain item variance for two-factor solution. Removing them did not improve the Memory domain factor statistics, but removing Item 6, as the item with lowest item-total correlation, did. The domain as a strategy construct seems to need some dimension reduction.

For the Cognitive domain items, two output values (KMO = .84 and Bartlett's Test χ^2 (91) = 1482.79, $p < .001$) testify that the factor analysis is appropriate for the data. Three Cognitive domain latent components with Eigenvalue greater than 1 were extracted (with component 1 loaded on each domain item). The three components explain 56.77 % of total variance with component 1 explaining 34.74%. The Pattern matrix related Items 3, 2, 4, 5, and 1 to component 1, items 9, 11, 12, 9, 14, and 13 to component 2 and 7, 6 , and 8 to component 3. All domain items displayed from moderate to good correlation values but item 13 displayed almost a borderline Eigenvalue of .33. The lowest communalities values were displayed by Items 1, 13, 9, and 14. The domain as a strategy construct may be improved through the dimension reduction as well, and that will be offered for discussion as well.

For the Compensation domain items, two output values (KMO = .708 and Bartlett's Test χ^2 (15) = 243.07, $p < .001$) testify that the factor analysis is appropriate for the data. Two Compensation domain latent components with Eigenvalue greater than 1 were extracted (with component 1 loaded on each domain item). They explain 55.01 % of total variance with component 1 explaining 38.39%. The Pattern matrix related Items 3, 2, and 1 to component 1, Items 5, 6, and 4 to component 2. All domain items displayed from moderate to good correlation values with the components extracted. Domain items seem to load equally well on the two components, so the domain as a strategy construct may not need any dimension reduction.

For the Meta-cognitive domain items, two output values (KMO = .86 and Bartlett's Test χ^2 (36) = 1154.68, $p < .001$) testify that the factor analysis is appropriate for the data. Two Meta-cognitive domain latent components were extracted (with component 1 loaded on each domain item). They explain 62.57 % of total variance with component 1 explaining 49.73%. The Pattern matrix related Items 7,6,1,8, and 5 to component 1, and Items 3,4, 2 and 9 to component 2. All domain items displayed from moderate to good correlation values with the components extracted. Domain items seem to load equally well on the two components, so the domain as a strategy construct may not need any dimension reduction.

For the Affective domain items, two output values (KMO = .69 and Bartlett's Test χ^2 (15) = 259.13, $p < .001$) testify that the factor analysis is appropriate for the data. Two Affective domain latent components were extracted (with component 1 loaded on each domain item). They explain 57.42 % of total variance with component 1 explaining 37.71%. The Pattern matrix related Items 6, 4, 5, and 3 to component 1, and Items 2 and 1 to component 2. All domain items displayed good correlation values with the components extracted. Domain items seem to load

equally well on the two components, so the domain as a strategy construct may not need any dimension reduction.

For the Social domain items, two output values (KMO = .85 and Bartlett's Test χ^2 (15) = 558.17, $p < .001$ testify that the factor analysis is appropriate for the data. One Social domain latent components was initially extracted (with component 1 loaded on each domain item). It explains 53.18 % of total variance. Item 3 exhibited the lowest correlation coefficient to the component. The domain was re-tested for two-dimension output. Now, the two components explained 66.96% of total variance. The rotated component pattern matrix displayed positive correlation of only domain Item 3 to component 2 with no correlation with other items and overlapping with component 1. The Pattern matrix related Items 1, 6, 2, 5, and 4, to component 1,and Items 3, 5, and 4 to component 2, with Items 5 and 4 overlapping with component 1. Domain items displayed from low to good correlation values with the components extracted. Domain items 5 and 4 are stronger correlated to component 2, so the domain as a strategy construct may need some dimension reduction.

The scope of the analysis done lets us identify to what extent particular SILL items possess domain relevant factor loadings thus contributing to the recorded use of particular domain by the digital age L2 learners. The analysis of relevancy of the SIIL instrument to adequately account for the involvement of modern technologies and the digital learner factor in the application of LLS showed that at least two domains, Memory and Cognitive, might be considered for item improvement.

On the Memory domain, strategies *I use flashcards to remember new L2 words, I physically act out new L2 words*, and *I remember new L2 words … by … location on the page … or a street sign* in addition to low communalities also exhibited low mean values. A possibility is

that as actions aimed at supporting L2 learning they are seldom used today and are in the process of becoming obsolete. On the Cognitive domain, strategies *I say or write new L2 words several times, I write notes, messages, letters, or reports in L2, I read for pleasure in L2,* and *I make summaries of information that I hear or read in L2* also do not fit well into the principal components. Supposedly, the activation of the Cognitive domain today may need other triggers to compensate for these strategies. On the Social domain, an overlap of two strategies *I ask for help from L2 speakers* and *I ask questions in L2* was noted through the factor analysis. In this case, additional descriptive specification of at least one of the strategies might differentiate them and improve the domain factor statistics.

Factor analysis conclusions made do not challenge the reliability of the SILL instrument. The reliability usually indicates how free the scale is from error (Pallant, 2010), and from this perspective, the inter-item correlation values for the three domains are in the optimal range for small scales Cronbach's coefficient value range from .2 to .4 (Briggs & Cheek, 1986). However, a change in L2 learning practices that do not match the verbal description of the original strategies needs to be reflected in the SILL either through substituting them with the description of actual learners' actions or re-formulating the strategy surface structure.

CONCLUSION

The research interest to the intersection of technology and language learning was provoked by numerous claims about the generational difference of present-day learners thus making this crossroad point even more appealing for an investigation. Would digital tools, cloud services, mobile opportunities for learning, the broadest imaginable access to data, and an essentially limitless number of sources in the field of interest make learning a second language easier and more efficient? Rich study findings came up to the researcher's expectations although establishing a generational difference, no matter how professionally enticing it might sound, was not on the agenda.

L2 learners today are different just because they live in a different time period. New technological availabilities have expanded and changed their learning practices, flexibility of schedules, and approaches to their own way of learning. Choosing indirect L2 learning strategies as their preferred way to master the L2 means that social-cultural and individually-relevant learning practices are the way that they take in L2 information.

These findings also tell instructors that learners are more inclined to follow the constructivist pathway in learning at the expense of behaviorism and even cognitivism. By choosing online references, language learning websites, and online learning resources as their most popular digital options, the L2 learner suits their need for language input thus supporting receptive language skills. In developing L2 skills and aspects, online course textbooks were reported also as a quite commonly used tool to develop reading, listening, writing, and vocabulary. The tendency has to be taken into consideration by L2 instructors and analyzed in greater detail to find out whether it is the academic factors or the L2 learners personal preferences contribute to it. The latter as correlational factors displayed an intricate statistically

significant system of combinations with preferred usage patterns of digital technologies and language learning strategies.

The study findings let us assume that L2 teaching with technologies is necessary today and that venues for applying them go far beyond the L2 classroom. With technological support and individually adjusted L2 learning activities, a smoother pathway from learning a language to actually acquiring it is what is expected by the digital age L2 learner.

Future research in the area has promising perspectives in exploring several research directions. One is a more detailed technology use study in which present technological categories are further subcategorized to find out what specific functionalities of digital tools attract L2 learners and support the development of particular language skills. The other direction could be re-consideration of the strategy domains inventory with the purpose of finding out low-use strategies and substituting them with either more time- and age-appropriate descriptions or eliminating as outdated.

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Appendix A: IRB Research Approval

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Division of Research & Economic Development
Office of Research Compliance & Ethics

Principal Investigator: Woei Hung
Protocol Title: An investigation of the relationship between the use of modern digital technologies, language learning strategies, and development of language skills in second language learning
Protocol Number: IRB0003962
Protocol Review Level: Exempt 2
Approval Date: 10/02/2021
Expiration Date: 10/01/2024

The application form and all included documentation for the above-referenced project have been reviewed and approved via the procedures of the University of North Dakota Institutional Review Board.

Attached is your original informed consent statement that has been stamped with the UND IRB approval and expiration dates. Please maintain this original on file. You must use this original, stamped consent form to make copies for participants completing the paper version of the survey. No other consent form should be used, and no signatures should be obtained from participants. Each participant must be given a copy of the informed consent statement to keep for their records.

If you need to make changes to your research, you must submit an amendment to the IRB for review and approval. No changes to approved research may take place without prior IRB approval.
This project has been approved for 3 years, as permitted by UND IRB policies for exempt research. You have approval for this project through the above-listed expiration date. When this research is completed, please submit a termination request to the IRB.

Sincerely,

Michelle L. Bowles, M.P.A., CIP
she/her/hers
Director of Research Assurance & Ethics
Office of Research Compliance & Ethics
Division of Research & Economic Development
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Appendix B: IRB Approved Study Information Sheet

UNIVERSITY OF NORTH DAKOTA
Institutional Review Board
Study Information Sheet

Title of Project:

AN INVESTIGATION OF THE RELATIONSHIP BETWEEN THE USE OF MODERN DIGITAL TECHNOLOGIES, LANGUAGE LEARNING STRATEGIES, AND DEVELOPMENT OF LANGUAGE SKILLS IN SECOND LANGUAGE LEARNING

Principal Investigator: Dr. Woei Hung, phone: (701) 777-3486, email: woei.hung@und.edu

Co-Principal Investigator: Volodymyr Lazar, email: volodymyr.lazar@und.edu

Purpose of the Study: The purpose of this research study is to examine whether the use of present-day digital technologies modifies the use of language learning strategies and facilitates the development of language skills in second and foreign language learning

Procedures to be followed: Right before the survey, you will be asked to read this information sheet about the study that will disclose the purpose of the research, procedures, risks, confidentiality, potential benefits, compensation, the voluntary nature of their participation, and contact information for the PI, co-PI, and IRB.

To help you make an informed decision on whether to go forward with the survey, you will be informed that you will be asked to answer questions about (1) your demographic characteristics, such as age, gender, year of study, language learned, proficiency, mode of study, and (2) your preferences in the use of available digital technologies in L2 learning, (3) your perception of the benefits of using technologies for the development of language skills and aspects, and to answer a six-domain language learning strategy questionnaire.

Risks:

There are no risks in participating in this research beyond those experienced in everyday life.

Benefits: The investigation of correlations between existing hi-tech digital language learning conveniences and Net-generation language learners' behavior choices might help you in finding out most efficient approaches to the utilization of technologies in second or foreign language learning.

The information about foreign language learners' choices of learning activities might also expand your future professional horizons for teaching and learning with technologies, potentially impacting lesson planning, classroom activities, nature, and typology of course assignments, and level of students' independence in the learning process.

Duration:

It will take you about 20-25 minutes to complete the survey.

Approval Date: 10/2/2021
Expiration Date: 10/1/2024
University of North Dakota IRB

Statement of Confidentiality:

The survey does not ask you for any information that would identify who the responses belong to as they are recorded anonymously. All participants willing to take part in the gift card drawing will be assigned a number as identifying information. Your email addresses will be replaced with unidentified codes before the drawing. No observation or recording what people do not expect to be public will be made. All potentially identifiable information will be deleted after the study.

All survey responses that we receive will be treated confidentially and stored on a secure UND Qualtrics server. However, given that the surveys can be completed from any computer (e.g., personal, work, school), we are unable to guarantee the security of the computer on which you choose to enter your responses. As a participant in our study, we want you to be aware that certain "key logging" software programs exist that can be used to track or capture data that you enter and/or websites that you visit.

Right to Ask Questions:

The researchers conducting this study are V. Lazar and W. Hung. If now or later you have questions, concerns, or complaints about the research please contact V. Lazar at *volodymyr.lazar@und.edu* or W. Hung at (701) 777-3486, *wei.hung@und.edu*. If you have questions regarding your rights as a research subject, you may contact the University of North Dakota Institutional Review Board at (701) 777-4279 or UND.irb@UND.edu. Please contact the UND IRB if you cannot reach research staff, or you wish to talk with someone who is an independent informed individual. General information about being a research subject can be found on the Institutional Review Board website "Information for Research Participants" http://und.edu/research/resources/human-subjects/research-participants.html

Compensation/Reward:

You will not be paid for participating in the survey. However, at the end of the survey, you will be offered an opportunity to provide your email address to be entered into 15 draws for $20 Amazon gift cards to take place at the conclusion of the study. Assigning extra credits to participating students will be solely at the discretion of the teaching professor. In this case, the same name-code replacement procedure will be applied after credits have been assigned.

Voluntary Participation:

You do not have to participate in this research. You can stop your participation at any time. You may refuse to participate or choose to discontinue participation at any time without losing any benefits to which you are otherwise entitled. You do not have to answer any questions you do not want to answer. You must be 18 years of age older to participate in this research study. Completion and return of the survey implies that you have read the information in this form and consent to participate in the research.

Please keep this form for your records or future reference.

Approval Date: 10/2/2021

Expiration Date: 10/1/2024

University of North Dakota IRB

Appendix C: The SILL Instrument

Language Learning Strategies Questionnaire (on SILL, 7.0 (ESL/EFL), Oxford, 1989)

Students read each statement and choose the response that tells HOW TRUE THE STATEMENT IS, from 1 to 5: 1 = Never or almost never true of me, 2 = Usually not true of me, 3 = Somewhat true of me, 4 = Usually true of me, 5 = Always or almost always true of me.
Abbreviation note: L2 = Second or Foreign language

A. Memory.

1. I think of relationships between what I already know and new things I learn in L2.
2. I use new L2 words in a sentence so I can remember them.
3. I connect the sound of a new L2 word and an image or picture of the word to help me remember the word.
4. I remember a new L2 word by making a mental picture of a situation in which the word might be used.
5. I use rhymes to remember new L2 words.
6. I use L2 flashcards to remember new L2 words.
7. I physically act out new L2 words.
8. I review L2 lessons often.
9. I remember new L2 words or phrases by remembering their location on the page, on the board, or on a street sign.

B. Cognition.

10. I say or write new L2 words several times.
11. I try to talk like native L2 speakers.
12. I practice the sounds of the L2.
13. I use the L2 words I know in different ways.
14. I start conversations in the L2.
15. I watch L2 language TV shows spoken in L2 or go to movies spoken in the L2.
16. I read for pleasure in the L2.
17. I write notes, messages, letters, or reports in the L2.
18. I first skim an L2 passage (read over the passage quickly) then go back and read carefully.
19. I look for words in my own language that are similar to new words in the L2.
20. I try to find patterns in the L2.
21. I find the meaning of an L2 word by dividing it into parts that I understand.
22. I try not to translate word for word.
23. I make summaries on information that I hear or read in the L2.

C. Compensation

24. To understand unfamiliar L2 words, I make guesses.
25. When I can’t think of a word during a conversation in the L2, I use gestures.
26. I make up new words if I do not know the right ones in the L2.

27. I read the L2 without looking up every new word.
28. I try to guess what the other person will say next in the L2.
29. If I can't think of an L2 word, I use the word or phrase that means the same thing.

D. Meta-cognition

30. I try to find as many ways as I can to use my L2.
31. I notice my L2 mistakes and use that information to help me do better.
32. I pay attention when someone is speaking the L2.
33. I try to find out how to be a better learner of the L2.
34. I plan my schedule so I will have enough time to study the L2.
35. I look for people I can talk to in the L2.
36. I look for opportunities to read as much as possible in the L2.
37. I have clear goals for improving my L2 skills.
38. I think about my progress in learning the L2.

E. Affective

39. I try to relax whenever I feel afraid of using the L2.
40. I encourage myself to speak the L2 even when I am afraid of making a mistake.
4l. I give myself a reward or treat when I do well in the L2.
42. I notice if I am tense or nervous when I am studying or using the L2.
43. I write down my feelings in a language learning diary.
44. I talk to someone else about how I feel when I am learning the L2.

F. Social

45. If I do not understand something in the L2, I ask the other person to slow down or say it again.
46. I ask L2 speakers to correct me when I talk.
47. I practice the L2 with other students.
48. I ask for help from L2 speakers.
49. I ask questions in the L2.
50. I try to learn about the culture of L2 speakers.

Appendix D: Demographic and Usage Preference Questionnaire

1. Gender

Male Female Other Not willing to disclose

2. Age

Under 20, 20 – 24, 25-30, 31-35

3. Current status:

Freshman, Sophomore, Junior, Senior, Self-paced

4. What foreign language are you learning?

Spanish, German, French, Norwegian, Classic, Other

5. How would you assess your foreign language proficiency level?

Elementary, Intermediate, Advanced

6. In what mode are you primarily studying the foreign language?

Face-to-face, Online, Hybrid

7. Indicate how you prefer to study:

Individually, In a group

8. Do you belong to any social networks in the foreign language you learn?

Yes, No

9. What digital device do you use most to support the language you are learning? (check all that apply in the ranking order)

Computer (desk/laptop), Tablet, Cell phone

10. How often do you use digital resources to support L2 learning?

Several times a day, Once a day, Several times a week

11. How would you assess the number of Internet digital training and practicing opportunities in the foreign language you are learning?

Scarce, sufficient, rich

12. Do you think that practically anywhere/anytime availability of digital resources has an effect on your language learning practices?

Yes, Not sure, No

Appendix E: Questionnaire and List of Technology Categories

Which digital technologies and Internet resources do you use to support **the language you are learning**? Students choose the response that tells WHETHER THE LEARNING TECHNOLOGY IS USED FOR L2 LEARNING, from 1 to 5: 1 = Never or almost never used, 2 = Usually not used, 3 = Somewhat used, 4 = Usually used, 5 = Always or almost always used.

1. Online textbooks or E-books
2. Online references (dictionaries, Wikipedia etc.).
3. Language learning websites (online training exercises, quizzes, tests, tutorials, simulations, interactive tools)
4. Online learning resources (spelling and grammar checkers, speech recognition, computer-assisted translation) and apps (Android, iOS, or like)
5. Assistive technologies (text-to-speech conversion, closed captioning/subtitles, transcriptions)
6. News and Social media (messaging, blogging etc. in the L2 language)
7. Audio/video platforms (video sharing, interactive video streaming, podcasts, movies, web conferencing)
8. Collaboration and engagement platforms (learning communities, Google docs, Flipgrid, etc.)
9. Language learning games
10. Adaptive intelligent tutoring systems