Technologies, Learning Strategies, and Development of Second Language Skills in the Digital Age

Volodymyr Lazar

Like many other areas of human knowledge, the field of language learning has undergone changes affected by the application of digital technologies. 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).

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. The research rationale drove the purpose of the study which was to determine whether and what kind of relationship exists between categories of digital learning resources widely available through the use of computing devices and the Digital Natives’ (Prensky, 2001) ways of managing their language learning strategies (LLS; Rubin, 1975; Oxford, 1990) while mastering L2 skills and aspects. In other words, the purpose of this study was to highlight the learning side of acquiring another language, the digital native L2 learners’ choices, practices, and behaviors which suit their cognitive, psycholinguistic, and social needs.

The theoretical approach taken follows the point of view that the theory of self-regulation (Zimmerman, 1990) 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.

The Modern Learner

A popular claim argues that Digital Natives or Net-Geners (Shakarami et al., 2017) 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.
Some researchers (Small & Vorgan, 2008) claim that digital immersion, gaming, and use of other digital technologies can profoundly affect the development of their 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 potentially altering some parts of the brain structure (Thompson, 2013).

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.

Technologies in the Field of Language Learning

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).

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. From L2 methodological and pedagogical perspectives, it seems reasonable to distinguish 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.
Setting

The setting for this study was made up by Midwestern University 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 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. Overall, 327 respondents attempted the survey, 26 survey responses were left in progress and a week later they were automatically recorded as not completed, and two recorded as “not wishing to participate”, thus bringing the total number of completed and analyzed responses to 299.

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. 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).

The latter, the six-factor Strategy Inventory for Language Learning (SILL) developed by Oxford in the early 1990s is the most frequently employed screening instrument around the world. 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). 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.

Technological Categories

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 helps 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.

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.

Research Questions

The research was guided by the following questions:
1. What categories of digital learning technologies are engaged in L2 learning by undergraduate university students as the digital age learners? 2. What digital learning tools contribute most to supporting the development of L2 skills and aspects? 3. What tendencies in the use of language learning strategies are noted among the digital age L2 learners?

Method

Both descriptive and inferential methods of data analysis were employed in the study to obtain answers to 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 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 was used to identify statistically significant correlational patterns between the Scales items. 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.

Findings: 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.

Social Domain Strategies

The Social domain showed high medium range descriptive values (M = 3.43, SD = .84, ranked 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* ($\chi^2 (16, N = 299) = 32.40, p = .009$), 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* ($\chi^2 (64, N = 298) = 86.16, p = .03$) and 7, *audio/video platforms* ($\chi^2 (64, N = 298) = 89.17, p = .02$). The Social domain as a construct was found to establish statistically significant correlations with two Tech categories: 5, *assistive technologies* ($\chi^2 (92, N = 299) = 115.18, p = .05$), and 7, *audio/video platforms* ($\chi^2 (92, N = 298) = 136.80, p = .002$).

Meta-Cognitive Domain Strategies

The Meta-cognitive domain showed high medium range descriptive values (M = 3.26, SD = .73, ranked 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, *I pay attention when someone is speaking the L2*, with the highest among all 50 items mean value of 4.03, *I try to find out how to be a better learner of the L2* (M = 3.69), *I notice my L2 mistakes and use that information to help me do better* (M = 3.58), and *I think about my progress in learning the L2* (M = 3.55) represent high strategy use range.

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: *online textbooks*, *online references*, *online learning resources*, *assistive technologies*, and *audio/video platforms*. 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* with the mean of the transformed variable still in the high usage range (M = 3.71).

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, one meta-cognitive item (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*).

The Meta-cognitive domain as a construct 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.
Cognitive Domain Strategies

The Cognitive domain 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, strategies \textit{I try to find patterns in the L2} (M = 3.89) and \textit{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, strategy 11 (\textit{I try to find patterns...}) was found to be in statistically significant relations to 7 out of 10 Tech items: online references, language learning websites, online learning resources, assistive technologies, news and social media in L2, audio/video platforms, and language learning games. Strategy 10 (\textit{I look for similarities...}) was found to be in statistically significant relations to 4 Tech items: online textbooks, news and social media in L2, language learning games, and intelligent tutoring systems.

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.

The two low usage interval cognitive variables, 8 (M = 2.26), \textit{I write notes, messages, letters, or reports in the L2}, and 7 (M = 1.86), \textit{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 online references ($\chi^2$ (172, N = 299) = 207.07, $p = .04$), news and social media ($\chi^2$ (172, N = 298) = 242.78, $p < .001$), audio/video platforms ($\chi^2$ (172, N = 298) = 252.67, $p < .001$), and intelligent tutoring systems ($\chi^2$ (172, N = 299) = 215.89, $p = .01$).

Compensation Domain Strategies

The Compensation domain 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 out of six strategies, \textit{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 online learning resources ($\chi^2$ (16, N = 297) = 31.08, $p = .01$) and news and social media ($\chi^2$ (16, N = 297) = 26.45, $p = .05$).

Four strategies with medium range means, \textit{To understand unfamiliar L2 words, I make guesses} (M = 3.33), \textit{When I can’t think of a word during a conversation in the L2, I use gestures} (M = 3.21), \textit{I read the L2 without looking up every new word} (M = 3.1), and \textit{I try to guess what the other person will say next in the L2} (M = 2.78) 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 ($\chi^2 (60, N = 298) = 85.11, p = .02$).

The Compensation domain as a construct shows significant correlations to one Tech item, assistive technologies ($\chi^2 (92, N = 298) = 129.97, p = .01$), 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.

Memory Domain Strategies

The Memory domain 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, strategy 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 *online textbooks* ($\chi^2 (16, N = 299) = 28.47, p = .03$), *online references* ($\chi^2 (16, N = 299) = 36.16, p < .01$), *online learning resources* ($\chi^2 (16, N = 298) = 26.33, p = .05$), and *audio/video platforms* ($\chi^2 (16, N = 298) = 30.49, p = .02$).

Memory strategy 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 *online textbooks* ($\chi^2 (16, N = 299) = 29.22, p = .02$), *online references* ($\chi^2 (16, N = 299) = 30.89, p = .01$), *news and social media* ($\chi^2 (16, N = 298) = 58.20, p < .001$), *audio/video platforms* ($\chi^2 (16, N = 298) = 56.79, p < .001$), *language learning games* ($\chi^2 (16, N = 299) = 39.07, p = .001$), and *intelligent tutoring systems* ($\chi^2 (16, N = 299) = 34.00, p = .005$).

The two low usage interval memory strategies, *I use rhymes to remember new L2 words*, and *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.

The Memory domain as one composite variable shows significant correlations with *online learning resources* ($\chi^2 (120, N = 298) = 150.50, p = .03$), *audio/video platforms* ($\chi^2 (120, N = 298) = 157.14, p = .01$), *language learning games* ($\chi^2 (120, N = 299) = 201.78, p < .001$), and *intelligent tutoring systems*, ($\chi^2 (120, N = 299) = 202.41, p < .001$). 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.

Affective Domain Strategies

The Affective domain 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 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 strategies were registered.
Affective strategy 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 ($\chi^2 (16, N = 298) = 28.20, p = .03$), 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.

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/always or usually use” and “always/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.

The Affective domain as a construct was found to establish statistically significant correlations with four Tech categories: assistive technologies, news and social media, audio/video platforms, and 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.

Findings: 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. The findings are as follows:

- **Online textbooks** were found to be in statistically significant correlations the development of reading skills ($\chi^2 (16, N = 299) = 43.52, p < .001$), vocabulary ($\chi^2 (16, N = 299) = 41.67, p < .001$), writing ($\chi^2 (16, N = 299) = 29.76, p = .02$), and listening ($\chi^2 (16, N = 299) = 26.68, p = .05$) skills.

- **Online references** also significantly contributed to the development of vocabulary ($\chi^2 (16, N = 299) = 28.58, p = .03$) as well as pronunciation ($\chi^2 (16, N = 299) = 28.83, p = .03$).

- **Language learning websites** significantly correlated with one language skill, writing, and one language aspect, grammar. The statistical output for both correlation pairs showed higher values for grammar ($\chi^2 (16, N = 299) = 36.91, p = .002$) than for writing ($\chi^2 (16, N = 299) = 29.37, p = .02$).

- **Online learning resources** were statistically significantly correlated to two language aspects, grammar ($\chi^2 (16, N = 298) = 25.91, p = .05$, and style ($\chi^2 (16, N = 297) = 32.51, p = .01$).

- **News and social media**, audio/video platforms, and collaboration platforms established statistically significant correlations with grammar ($\chi^2 (16, N = 298) = 32.76, p = .01$), style ($\chi^2 (16, N = 297) = 37.90, p = .002$), listening ($\chi^2 (16, N = 298) = 43.82, p < .001$), pronunciation ($\chi^2 (16, N = 297) = 32.76, p = .008$), and speaking ($\chi^2 (16, N = 299) = 27.01, p = .04$).
- Only one significantly correlated technology/language pair was established between assistive technologies and pronunciation ($\chi^2 (16, N = 298) = 40.02, p < .001$).
- The two least frequently utilized tools, language learning games and intelligent tutoring systems, also displayed the establishment of statistically significant correlated pairs with reading, writing, listening, pronunciation, and style, but of reverse value: 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”.

Conclusions

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), this research supports the view that they did not lead immediately to the innovative use of digital technologies for language learning. The differences in the digital use among the Digital Natives suggest that although the use of digital technologies for basic communication is common for them, very few create text, audio or video content (Thompson, 2013).

As none of the study variables has been manipulated by the researcher, it 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.
References


