

ARTICLE



Sociotechnical structures, materialist semiotics, and online language learning

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Abstract

Based on a study of the digital literacy practices of immigrant Filipino students in Vancouver, this paper focuses on how learners with unequal access to resources engage with different tools to locate information and find opportunities for language learning online. Data was collected through interviews and observations of participants as they used YouTube, Google Search, and Google Translate to decode unfamiliar words and find resources for learning. Framed through a materialist semiotic lens, this study examined how the students negotiated their resources on these platforms to achieve different intentions. Findings show that the way learners navigate these spaces can vary based on the devices they use (laptop vs. mobile phone), the user interface (browser vs. app), and the orientation they choose (landscape vs. portrait). The material dimensions of the screen determine the arrangement of semiotic forms, and varying configurations of devices, interfaces, and orientations shape the information made available to the learner and the digital literacy practices of scrolling, clicking, and shifting tabs. Recognizing how the online environment of a platform can shift across these layers of mediation, this paper conceptualizes the linguistic and semiotic forms that constitute design as sociotechnical structures which provide various learning affordances and constraints.

Keywords: Digital Literacy, Materiality, Semiotics, Equity

Language(s) Learned in This Study: English

APA Citation: Darvin, R. (2023). Sociotechnical structures, materialist semiotics, and online language learning. *Language Learning & Technology*, 27(2), 28–45. <https://hdl.handle.net/10125/73502>

Introduction

In the special issue of *Language Learning and Technology* celebrating the 25th anniversary of its *Emerging Technologies* column, Godwin-Jones (2021) asserts how CALL research today needs to be informed by an ecological approach (Levine, 2020; Reinhardt, 2020) that draws attention to context not as a background but as “a vital, fully participating, and dynamic actor in the learning process” (Godwin-Jones, 2021, p. 15). From this perspective, cognition and agency are distributed across the body, the physical environment, and the resources available at a specific time and space. This ecological approach in CALL is aligned with the recent materialist turn in language education research (Canagarajah, 2018; Pennycook, 2018) that examines the dynamic and contingent connections between the social and material world. From this sociomaterial perspective (Fenwick, 2015; Fenwick et al., 2011; Toohey, 2019), learners engage with objects and physical environments in ways that can involve both disorder and a certain level of predictability. Semiotic resources are gathered together in assemblages where the entanglement of human and nonhuman interactants produces actions that may or may not involve specific intentions (Guerrettaz et al., 2021). Even when the material objects or forms are no longer present in later contexts, traces of their influence remain entangled in patterns of behavior (Sert & Amri, 2021).

Aligned with Reinhardt and Oskoz’s (2021) observation that CALL as a field has increasingly paid attention to situating the uses and designs of emergent tools in language learning, recent CALL research that

integrates a sociomaterial perspective has largely focused on the physical environment of learners as they engage with digital devices. Advocating for the rewilding of language education, Thorne et al. (2021) draw on notions of emergent assemblages and entangled actions to demonstrate the connections between locative media, place-based contexts, and human action. For Reinhardt (2020), the metaphor of technology as ecology highlights how the use of tools is not only contextualized, but also socially networked and interconnected. The computer is not a neutral means to access knowledge, and learners have to negotiate their intentions with other users and the tools that mediate “what learners see, where they go, and what they do” (p. 236). Chun (2016) points out that concomitant with this ecological CALL is the emergence of research on digital literacies that draws attention to the linguistic and multimodal resources needed to navigate online spaces. This focus aligns with van Lier’s (2004) view that ecology and semiotics cannot be separated and that learning contexts are activity spaces where action, perception and affordance contribute to the way signs are imbued with meaning. This semiotic-ecological approach demonstrates the relationship between the person and the world, the material, social, and symbolic. Consistent with this perspective, Kern (2021) asserts that meaning resides “*between* the images, elements of language, spatial arrangements of features” (p. 142) and within them; it is this relation that connects digital literacies with communicative practices.

Drawing on these notions of contexts, tools, and multimodal features, this study recognizes that what learners see in one platform can vary, and that these differences impact how they locate information and find opportunities for language learning. While learners use digital tools within physical spaces of home and school where the arrangement of objects and bodies shape interaction, this paper draws attention to digital platforms as material environments where semiotic forms are arranged to serve both social and technical purposes and where space is *structured* by design. Learners perform different actions online not just because of their knowledge of certain functionalities, but because design has the capacity to shape behavior. In these online spaces, semiotic arrangements shift across devices and orientations, whether landscape or portrait, reconfiguring how information is presented and redirecting user attention in different ways. Developing a critical awareness of these *sociotechnical structures* that comprise the architecture of online spaces thus becomes a necessary component of digital literacies. By applying a theoretical lens that fuses semiotics with materiality, this paper also draws attention to issues of equity and demonstrates how the availability of semiotic resources can index the inequalities of learners. What learners can see depends on what tools they use to look. Because the arrangement of sociotechnical structures shifts across devices, screens, and platforms, unequal access to material resources such as laptops, desktops, mobile phones, or tablets can shape contrasting digital literacies and learning trajectories (Darvin, 2018). By understanding the link between tools and accessible information, learners can develop the critical digital literacies that contribute to agentive language learning online.

Research Questions

Recognizing that platforms like Google Search, Google Translate and YouTube have reconfigurable designs depending on the devices used to access them, this paper poses the following questions:

1. How do the material differences of devices shape the semiotic arrangement of information online?
2. To what extent do these shifting arrangements shape the way learners access information and find opportunities for language learning?

Theoretical Framework

To address these questions, this paper draws on a materialist theory of semiotics and recognizes that the material design of a platform is a semiotic arrangement that has the power to direct attention and shape behaviour. Blommaert (2013) defines *materialist semiotics* as

a study of signs that sees signs not as primarily mental and abstract phenomena reflected in “real” moments of enactment, but as material forces subject to and reflective of conditions of production and patterns of distribution, and as constructive of social reality, as real social agents having real effects in social life (p. 33).

Recognizing signs as *material forces* is not to imbue them with determinism but to draw attention to how they can shape interactions in concrete ways. For Appadurai (2015), this mediation is not just association or translation of meanings but an embodied practice that functions as “a mode of materialization” (p. 233) where matter becomes agentive and has the power to engender effects in the world. Public signs, for instance, can organize and regulate space, imposing restrictions and directing norms of conduct. This demarcation constructs normative expectations of what to find in specific places, producing habitual interpretations of what is in place or out of place. How we perceive and interpret these signs is dependent on our visual repertoire, the culturally and socially constructed competences of decoding the explicit and implicit codes embedded in these signs (Blommaert, 2013).

This recognition of signs as social agents that produce material effects aligns with Kress’ (2010) conception of social semiotics that underlines the centrality of design and rhetoric. By arranging semiotic resources in a specific way, design is the means through which a rhetor’s intention is materialized. Layout orients viewers and interactants to information, and produces specific forms of interaction. The positioning of semiotic forms in a framed space such as a screen is a way to show the relationships between these forms and to distribute and classify information. It orients users to information that is central or marginal, static or dynamic, inputted by the user and produced as output through interaction. By arranging elements from left to right, centre or margin, vertical or horizontal, layout communicates the structures and processes through which some information is valued over others. As a rhetor, the user of different platforms assembles semiotic resources to achieve particular intentions, and these resources, together with material, cultural, and social resources or capital are forms of power (Bourdieu, 1986; Darvin & Norton, 2023). Learners with unequal access to resources need to negotiate their intentions with those of other users. Software engineers, the architects of different platforms, also assemble semiotic forms to achieve both technical and social intentions. In this case, the design of platforms indexes the intentions of its designers (Darvin, 2022; Scollon & Scollon, 2003), and the interaction between users and the material structures of a platform involve a negotiation of power.

As users engage with different platforms—locating, constructing, and distributing information—these platforms do not just mediate interaction but also shape it (Gillespie, 2018). The architecture and design of online spaces have the power to construct conditions of possibility for sociality in these spaces (Bucher, 2018), that is, as *programmed sociality*. Sociality implies the ways in which human and nonhuman entities are associated with each other to enable interaction (Latour, 2005). This sociality is not ‘programmed’ in a technologically determined sense. Rather, it recognizes that the architecture and material substrate of a medium can assemble and organize information in dynamic ways. In this case, platform design is a sociotechnical arrangement of signs that both achieve a technical function while enabling specific social actions. This design does not determine behaviour, but it does set parameters of what users can access and how they can interact with information. On Twitter, for instance, a user can only comment, retweet, like, or share a tweet. When filling out forms online, a user may only be able to provide information through drop down menus where preset choices are given, or through fields where the number of characters is limited. Semiotic arrangements shift depending on the device, the dimensions of the screen, and whether the platform is accessed as an app or on a browser, as well as when users manipulate these tools to choose an orientation (landscape or portrait) and zoom in and out. As structures shift, the reading paths of learners are negotiated between the interests and intentions of learners and the ‘walls and doors’ of online spaces. In this case, the material architecture of a platform has the power to direct attention and foreground information, but users also have the agency to reconfigure such arrangements to achieve their own purposes.

Methodology

This research drew on a *critical, comparative, connective* case study approach to examine the digital literacy practices of immigrant secondary school students in Canada. It is comparative because it compares and contrasts how learners with differential access to resources acquired and negotiated these practices. As a multiple case study, it identified each student as a case, and in reporting the findings, those cases that highlight specific issues relevant to the discussion are presented. In the sense proposed by Leander (2008), this study is connective because it collapses the binaries of online / offline and virtual / physical, and recognizes that learners occupy these spaces simultaneously, moving fluidly to and from these different sites. Given these dimensions, the study examined how the secondary school students engaged with various platforms within physical spaces, produced digital texts using a variety of devices, and communicated with others in virtual spaces. At the same time, as an examination of literacy practices, the study also paid attention to the connections between the digital literacies of the participants, and how they shifted codes, registers, and styles as they moved across online spaces. While the analysis of the data begins with an interpretivist perspective, the analysis of these cases is critical in that it examines how relations of power and inequalities of access to resources can shape learner practices as they negotiate the meaning and value of different digital literacies. It recognizes as well that both human and nonhuman interactants—users, designs, algorithms—operate with different purposes and have the power to shape digital practices.

On an interpretivist level, this study seeks to grasp the subjective meanings of people's literacy practices, recognizing that their behaviour is based on their interpretation of reality using their own common-sense constructs (Bryman et al., 2009). In trying to derive the point of view of these social actors, it attempts “to catch the process of interpretation through which [actors] perform their actions” (Blumer, 1962, p. 188). In this sense, the researcher is providing an interpretation of others' interpretations, as participants articulate their own beliefs, practices, and insights about their digital practices.

Relationship Between the Study and Previous Work

This study draws on previous work in CALL research that examines the materiality of devices and the multimodal design of platforms. In a review of how mobile phones have been researched within CALL, Godwin-Jones (2017) points out that most studies involve loaned devices for institutional use and formal language learning, while studies of platform design are usually focused on functionality and ease of navigation. Focused on mobile augmented reality (AR) pedagogical interventions, Thorne et al. (2021) examined how learners used an AR game called *ChronoOps* to gain insight on how meaning making is achieved through visible embodied displays and in interaction with physical environments and public semiotic resources. In this case, communicative action is understood as multimodal, embodied, and entangled with material and semiotic forms. Price et al. (2016) employ a multimodal analytic approach to examine how mobile technologies shape understandings of space and place, while also exploring how semiotic forms of digital information mediate interaction.

Machine translation (MT) research has often focused on functionalities and systems of MT tools: rule-based systems that require grammatical and syntactic tools (Jimenez-Crespo, 2017; Qun & Xiaojun, 2015), statistical machine translation that draw on relations between parallel texts (Le & Schuster, 2016; Qun & Xiaojun, 2015; Wu et al., 2016), and deep learning (Poibeau, 2017). Godwin-Jones (2015) provides a comparison of various MT tools (Google Translate, PROMT-Online, Babylon, and Microsoft) to demonstrate their reliability and accuracy, and for learners to understand the differences between rule-based and parallel text systems, and between L1 and a target L2. In contrast to earlier research that focused on an analysis of tools, their innovation, and ease of use, this study focuses on how specific learners with unequal access to resources use these tools, and how these inequalities are reflected in the way information and translations are made available and presented through design. In a Special Issue of *L2 Journal*, Vinall and Hellmich (2022) point out that translation is “not a transparent process” and that MT research must take into consideration “contexts, identities, and structures” (p. 14). This study addresses this need by examining not only the contexts and identities of learners using MT and other tools, but also the way the structures of

these platforms shape behaviour, with power distributed unequally across human and nonhuman interactants.

Research on technology and multimodal design has often focused on how learners assemble their semiotic resources to achieve communicative purposes. In a study of how university students created a scientific digital video documentary, for instance, Hafner and Ho (2020) constructed a model of assessment that draws attention to modal interaction and the variety of semiotic resources used by learners for digital multimodal composition. In an article that proposes a framework for evaluating language learning apps in terms of pedagogy, user experience, and technology, Rosell-Aguilar (2017) refers to the significance of design or visual content. Standards regarding multimodal elements are limited, however, to questions of whether images used are stereotypical representations or stock photos, if they are used in a meaningful way, and if the interface is clear or uncluttered and easy to navigate. The extent to which the multimodal design of platforms shape user behaviour is not an area of concern. In contrast, Kern's (2018) paper that advocates for a *relational pedagogy* draws attention to how "the material infrastructures of our communication technologies have always been tied to particular communicative cultures" (p. 2), which in turn shape the way learners read, write, and exchange knowledge. Understanding the relation between these social, individual, and material dimensions contributes to a "critical symbolic awareness" (Kern, 2018, p. 2), where learners are encouraged to interpret, for instance, the effects of typefaces and page layout design on the communication process. To contribute to the development of such an awareness, this study examines platform design through a materialist semiotics lens where design features have the power to direct attention and shape digital practices and cultures-of-use (Thorne, 2016).

How modes are layered and foregrounded, and the extent to which a mode is intricately intertwined with other modes in different platforms, is examined by Jewitt (2017) in a study of digital texts, particularly food blogs. Mode refers to a "semiotic system with an internal grammaticality, such as speech, color, taste, or the design of images" (Levine & Scollon, 2004, p. 2). These modes, together with proxemics, posture, gesture, gaze, music, and layout, carry interactional meaning and possess different materiality, whether audible or visible, fleeting or enduring, embodied or disembodied (Norris, 2004). By examining how bloggers made choices regarding design, Jewitt (2017) highlights how certain modes can be privileged not just in terms of frequency of use, but also the functions they serve. Through a systematic description of modes and the organization of signs in a platform, she demonstrates the meaning potentials of hyperlinks, images, and other multimodal ensembles. The amount of space a mode occupies on the screen or the way semiotic forms are ordered signals modal density and indexes hidden discourses. This attention to multimodal design and its power to make some information more visible than others is adopted by this study as well.

Participants and Research Site

The case studies presented here are taken from a larger research project that was conducted for a period of 18 months in two public high schools and one private high school in Vancouver, Canada. Participants included 18 recently immigrated Filipino students Grades 8 to 11 enrolled in English as a second language (ESL) classes. The study focused on Filipino immigrants in order to examine how learners from the same country but with different migration pathways and access to resources negotiated their languages and literacies during their first two years in Canada. While the students had different L1s (Ilocano, Ilonggo, Aklanon, or Filipino), they all spoke the national language, Filipino, and had English as a medium of instruction in their schools in the Philippines. With the exception of Grade 12, the graduating year, the participants represent all year levels of secondary school to gain a more comprehensive understanding of this phase of learning. Most interviews were conducted on campus after class hours, while some were held at the students' homes.

Data Collection and Analysis

Data Collection

After participants signed consent forms, data was collected through the following methods:

1. Participant observation, which included observing how participants would use digital devices at home, in the classroom, and in online spaces. Low inference descriptions of these observations were recorded in field notes, where the researcher also reflected, raised questions, and theorized on what was being observed.
2. Questionnaires, where learners provided demographic information including details about the devices, apps, and programs they use.
3. Interviews of students, which were semi-structured (e.g., asking students about the devices or apps they use) or narrative (e.g., asking students to recount their language learning trajectories). Some interviews were conducted as students demonstrated and explained their digital practices. In this case, their own social media profiles, pictures, and so forth served as elicitation devices during these interviews. Each interview took 45 to 60 minutes, and was recorded using the Voice Memo app on an iPhone, and then transcribed using the [Express Scribe](#) app.
4. Group discussions, where focal participants from a particular school gathered together to discuss and exchange ideas regarding their digital practices. In this situation, the students were gathered in a circle, with the researcher beginning by asking a specific question and students responding freely.
5. Journals, where learners jotted down their own experiences and reflections on their own digital practices. Journals and guiding questions were provided at the beginning of the research period. Participants were asked to write brief entries every two weeks, but those who were not invested in this activity were instead given journal sheets where they answered specific questions regarding their technology use.
6. Digital artefacts, which include digital texts produced by the focal participants (e.g., photos or social media posts), or screen captures of websites or apps that the focal participants were using while being observed. In many cases, the researcher took pictures of the artefacts themselves, and would ask for the permission of the student each time. Taking a picture of the digital artefact as it appeared on a particular device served both practical and methodological purposes: the researcher would not have to rely on the participant to connect online and send the artefacts, and these pictures allowed a visualization of these artefacts in both their digital and physical contexts. The researcher collected more than 150 photos of these artefacts, including those including those produced by teachers for class and accessed by students.

Data Analysis

This study followed an iterative research process, where the questions, data collection tasks, and data interpretation were continually refined as the research progressed to engage with *thematic analysis* (Duff, 2012). Working within a series of interlocking circles, the researcher acknowledged original hunches and looked in multiple directions—from emic and etic perspectives, from their own data to existing theories—in order to arrive at justifiable claims (Heath & Street, 2008). After recordings were transcribed with time stamps, the digital artefacts collected during the interviews were added to another column in the transcript to match the relevant utterances, while the field notes were added in another column. Codes were developed from the data by examining repetitions, metaphors, and other patterns. These codes were mapped out through [NVivo](#), a Computer-Assisted Qualitative Data Analysis (CASQDA) software, and then combined into categories and sub-categories, based on certain exemplars. This process included classifying “resources” into material, cultural, linguistic, semiotic, and social, and “digital practices” as informational, relational, recreational, expressive, or transactional. As these codes were categorized, the researcher documented the coding processes and choices in coding memos, while posing questions and making connections in theoretical memos. It is through this recursive analytic reflection informed by etic knowledge that themes useful for theoretical explanations emerged.

A *multimodal discourse analysis* (Jewitt, 2017) of the digital artefacts was conducted by identifying whether it was a screen capture or a picture of the device with the content of the screen visible. The multimodal transcription identified the device that was in the picture or that was used for the screen capture, the linguistic and semiotic forms that constituted the platform design, and the linguistic and semiotic forms

inputted by the participant, and the corresponding notes about screen orientations, layout, and other observations.

Findings

In the larger study, learners consistently referred to YouTube, Google Search, and Google Translate as their preferred platforms for language learning. Learning activities mediated through these platforms included finding translations or definitions of words, understanding concepts, and acquiring a target language (usually English) by watching videos and reading various online texts. One learner, Frank, shares how he trained himself to be more fluent in English even before moving to Canada by watching YouTube videos and reading English stories online. He talks about advising another participant, Kris, “*punta siya sa mga ibang websites at saka videos na magwatch, at saka para mag-improve ng slight yung English*” (to go to websites and watch videos so that he could improve his English a bit). In the first case study, Eric is one of those learners who value YouTube as a source of information and believes that learning English comes with constant input, whether from reading or watching YouTube videos. When it comes to discovering the meanings of words, there was a noticeable pattern in the differences of learners’ preferred platforms. Those who had uninterrupted access to a laptop and demonstrated greater linguistic confidence would search for definitions either through Google Search or dictionary apps like [Merriam-Webster](#). Those who were not as confident in English and who relied mostly on their phones would use Google Search or Google Translate, as the case is for [Nancy](#) and [Jimmy](#).

Recognizing how learners have different digital literacy practices when using various platforms for language learning, this study sought to understand how the designs of these platforms shaped their practices and provided different learning affordances and constraints. Drawing on individual interviews and digital artefacts of three participants, the findings from these case studies demonstrate how locating information, learning an L2, and negotiating meanings online are deeply entangled with semiotic and material affordances and constraints. In this context, the structures of online spaces have the power to shape the actions of learners, who in turn have the power to manipulate these tools in a way that serves their interests. How these learners evaluate search results and decode unfamiliar words is largely dependent on semiotic clues: the perception and interpretation of images, icons, and layouts that often precede attention to linguistic forms. The semiotic arrangement of space in these platforms—the use of colour, font size, and white space—direct the attention of learners to specific information. At the same time, the material dimensions of the screen (i.e., laptop vs. mobile phone) determine not only the reading strategies of scrolling, clicking, and shifting tabs but also the orientation (landscape vs. portrait) and layout of pages. Because the types of devices impact how information is presented and how online spaces can be navigated, learners who have uninterrupted access to a laptop can be presented more opportunities for language learning compared to those whose access is limited to a mobile phone, presenting issues of equity.

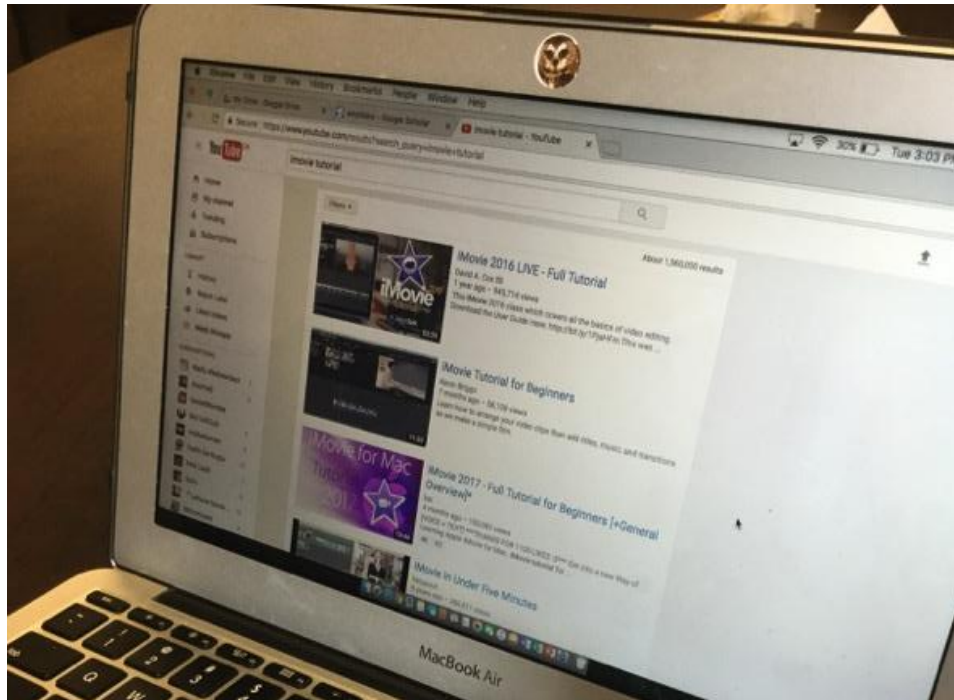
Eric: YouTube Search Results Viewed from a Browser on a Laptop

Eric is a Grade 9 student from a private school in Vancouver who has his own tablet and laptop for his sole use, and a desktop at home that he shares only with his mother, a nurse. At the start of the study, he did not have his own phone because his mother wanted him to focus on using technology only for schoolwork. For him, a phone is specifically for making friends, saying “Pag may cellphone ka po kasi, kahit nasaan ka, kahit anong oras, nakakausap mo po sila” (When you have a cellphone, wherever you are, whatever time, you can talk to [your friends]). In contrast, he recognizes the laptop as a tool for learning. At school, he uses his laptop to take down notes and search for information on Google. For an inquiry project in one class, he researched on brain development and emotions, and downloaded articles using Google Scholar. He talks about searching for novels online and reading them from his laptop. His access to a computer is uninterrupted as he travels from home to school and back, and he finds it easy to move across devices. For Eric, YouTube is a useful platform to watch the news and to learn about gaming and other skills. He talks about watching YouTube videos for French class and how even videos about making crêpes help him expand his vocabulary. He demonstrates a great awareness of the affordances of YouTube for learning,

saying “*halos lahat naman po kasi mero na doon eh*” (almost everything is already there). He says he learned how to use iMovie, for instance, by watching tutorials on YouTube, and he demonstrates how he searches for useful videos by entering “iMovie tutorials” into the YouTube search bar (Figure 1).

Figure 1

YouTube Search Results on Eric’s Laptop When He Enters “iMovie Tutorials”



The design of YouTube search results varies depending on the device one accesses it from. From a mobile phone, the search results can only be viewed in portrait mode and the video thumbnail occupies the entire width of the screen. The only linguistic forms that appear under each thumbnail are the title, the uploader’s username, the number of views, and the time that has elapsed from when the video was uploaded. From a browser in full screen mode on a laptop (Figure 1), the first few lines of the description appear below these details, and the sidebar also provides other options for the user. A number of videos appear on the search results, and in Excerpt 1, Eric explains which one from the list he would choose to watch (Note: “po” is an honorific form in Filipino to convey respect for elders).

Excerpt 1

- Eric: The first one *po*.
- Researcher: Why the first one?
- Eric: *Yung may* most views and longest length *po*. (The one with the most views and longest length.)
- Researcher: Why the longest?
- Eric: In depth *po*.
- Researcher: Why would you choose the one with most views?
- Eric: *Yun yung parang bago po na madaming nakanood*. (It would be the one that’s like new that many have watched.)

YouTube’s search ranking system identifies relevance, engagement, and quality as the three main factors that determine search results, and this ranking involves the title, tags, description, video content, watch time of a video, and the expertise of the source (YouTube, n.d.). While Eric’s interpretation of how YouTube’s search algorithm works is not necessarily consistent with YouTube’s explanation, what is most salient is that he expresses confidence about this interpretation. He states that he would choose to watch the video that appears first in the results, and the reason he gives why this video appears first is a combination of three aspects: popularity (“most views”), length (“longest length”), and freshness (“the one that’s like new”). In this case, the layout of the search results as a single column clearly identifies a top result (*iMovie 2016 LIVE – Full Tutorial*). Each result foregrounds a video thumbnail on the left whose dimensions are much bigger than the accompanying text on the right; each result usually has five lines of text: (1) the title in a larger blue font, (2) the author of the video (David A. Cox [check mark icon assigned to Verified creators, indexing source quality]), (3) the time elapsed since the video was posted (1 year ago), followed by the number of views (945,714 views), and (4 to 5) the first two lines of video description (“This iMovie 2016 class which...”).

It can be observed that Eric’s interpretation of what appears at the top is not entirely accurate: the top three results are not arranged by number of views (the top video with 945,714 views is followed by videos with 58,108 and 150,080 views), length (the top video with a length of 53:39 is followed by videos with a length of 11:33 and 13:44), nor freshness (the top video posted 1 year ago is followed by videos posted 7 months ago and 4 months ago). As Eric points out details about the top video to explain its ranking, it becomes apparent that he is not comparing it with other videos listed on the search results. Instead, he is inferring an algorithmic logic based on the video details foregrounded by this semiotic arrangement. In this top search result, the time elapsed and number of views are allotted a separate line that is highlighted because it is surrounded by white space; the video length appears prominently at the bottom right of the thumbnail as an overlay with high contrast (white font over black). In this case, the multimodal features of these details direct the attention of Eric and in turn shape perceptions of what constitutes a valuable or credible search result.

Regardless of whether it aligns with YouTube’s algorithms (which remain proprietary and therefore cannot be completely ascertained), Eric’s interpretation indexes the authority that is bestowed upon algorithms and design. Jones (2019) points out how many users regard algorithms as objective, scientific, and reliable, and how these users can employ certain “credibility heuristics” (Metzger & Flanagin, 2013) when accessing digital texts. In YouTube, the foregrounding of certain video details through multimodal design contribute to the construction of these heuristics. In this case, YouTube’s algorithms and semiotic arrangement of space have the power to shape perception, direct attention, and foreground information. These interpretations of algorithms and design have implications in terms of how participants determine the value or credibility of videos whether they be for language learning or exploring different areas of interest.

Nancy: Google Search Results from a Browser on a Mobile Phone

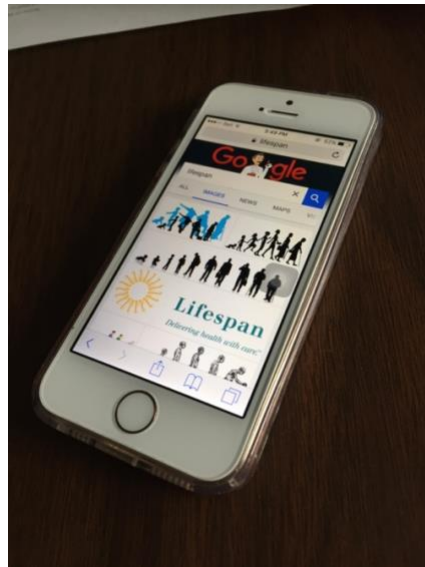
Nancy, a Grade 8 student in a public secondary school in East Vancouver, has her own phone but the single laptop in the household is shared with five other members of the family, including her mother who works as a nanny. Because the laptop is shared, the parents have instructed them that it must only be used on a table in the living room right next to the TV and where the family members congregate, providing multiple distractions. For this reason, Nancy does her schoolwork in the room she shares with her sisters and relies mostly on her phone to search for information. In the study, most of the learners who expressed linguistic confidence in English would search for the definitions of unfamiliar words either by using a dictionary app or by searching for it on Google (i.e., inputting the word and adding “define” or “definition” in the search tab). Other learners like Nancy who were not as confident in English would use Google Translate to find out what the unfamiliar word is in Filipino.

When these learners said they still could not get the meaning from Google Translate, they would go and ask friends. The only exception would be Nancy, whose other strategy would involve searching it on Google. On one occasion while reading her Math textbook, she encountered the word “lifespan” that she

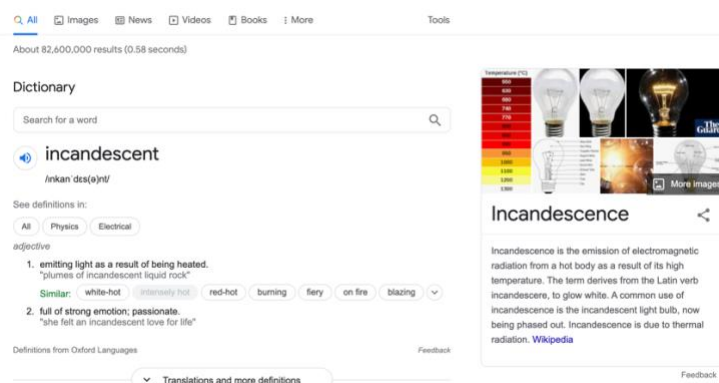
was unfamiliar with, and to interpret its meaning, she used her phone to input the word into Google, although she did not add the word “define.” Because of this omission, the first two items that appeared in the search results was the website of a private enterprise, “Lifespan: Rhode Island Hospitals and Health Services,” the description of which fully occupied her phone screen. She does not scroll down further where definitions from online dictionaries would have appeared, and instead her thumb moves horizontally on top and clicks on “IMAGES,” which is the tab right next to “ALL”. With the exception of the logo of the Lifespan health services that appeared in the earlier tab, the top image results (Figure 2) that occupied her screen were consistently graphics that depicted the lifespan, and there are no titles or captions that accompany these graphics.

Figure 2

Google Images That Appear When Nancy Searches for “Lifespan”



Asked about how she navigates the results of this Google search, Nancy says “Minsan po yung image, tapos minsan video” (sometimes, [I look at] the image, then sometimes the video), and that when she looks at these visual texts, “Naiintindihan ko na po, parang ganun” (Then I understand it, just like that). However, when the researcher asked her to explain what meaning she inferred and how the image helped this interpretation, she avoids answering. What is key here is that while Nancy draws on semiotic clues to interpret the meaning of the word, the Google Image results from a mobile phone does not provide any linguistic forms to aid this interpretation. To find words, she would need to either click on the images or move back to the “ALL” tab and scroll down, neither of which she does. Later, when she tries to interpret the meaning of the word “incandescent,” she repeats the process as earlier and does not look at the definition of the word that the search results generate but instead turns immediately to Google Images which provides her pictures of light bulbs. She relies on the images that appear on the screen and does not scroll down or switch between tabs. If Nancy had searched for the word from a laptop (Figure 3), the landscape orientation would have provided her with both a definition of the word and the knowledge panel on the right which includes pictures of light bulbs above the excerpt of the Wikipedia entry for “incandescence.”

Figure 3*Google Search Results for “Incandescent” From a Laptop*

The knowledge panel is the information box that appears in Google search results. It provides a snapshot of information from a variety of resources (usually Wikipedia) and includes Google Images results. This panel would have also appeared on her phone if she scrolled down, although it would not have been foregrounded in the same way as it appears here. For a learner like Nancy who tends towards more visual forms to interpret words, the benefit of a browser view from a computer is that both linguistic and semiotic forms appear side by side to serve as resources for interpretation. However, in Nancy’s home, the fixed location of the shared laptop and the distractions surrounding it constrain opportunities for use. In this case, Nancy’s limited access to material resources shapes her opportunities for language learning. The design of Google Search results page determines access to specific information and shapes the way the learner navigates online spaces to discover opportunities for language learning.

Jimmy: Google Translate Results on a Mobile Phone App

Jimmy is a Grade 8 student from the same school as Nancy, and just like her, he has his own phone but shares the single laptop at home with all the other family members. He says that he almost never uses the laptop and only does so when his phone has run out of battery. When trying to interpret the meaning of unfamiliar words, Jimmy usually turns to the Google Translate app on his phone. While going through his science textbook, he encountered the unfamiliar word “immune.” He took his phone and described his process of entering the word into the app that already had English to Filipino as the default.

Excerpt 2

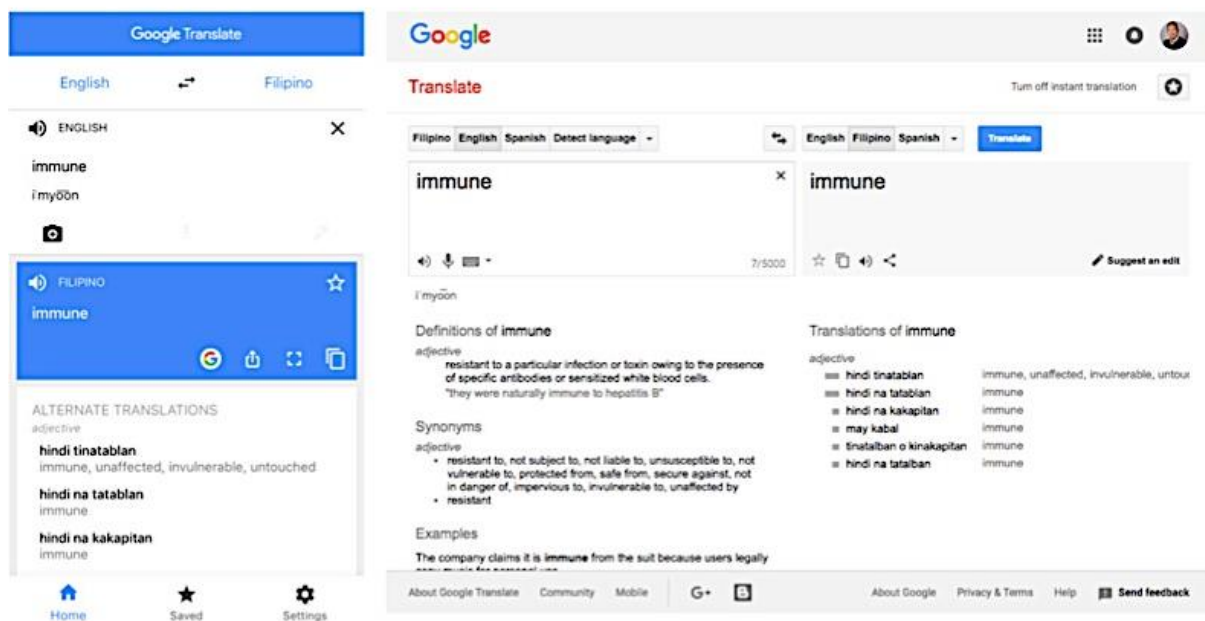
- J: Ito, pipindutin ko po yung “Translate.” (Here, I would click “Translate”).
- R: Okay, and then?
- J: [points to the blue box which contains the result] Tapos nakakarating na ako doon (Then, I am able to arrive there).

In **Excerpt 2**, Jimmy’s choice of words to explain how he locates the answer is interesting because instead of the answer showing up, he talks about himself “arriving” in the blue box, which he recognizes as where the answer should be. What appeared in the blue box however was still the word “immune” (**Figure 4**) and Jimmy says, “Parang parehas lang po yung English, di po puwedeng gamitin...” (It seems it’s the same word in English. I can’t use this). The absence of an equivalent word in Filipino is most likely because there may be insufficient Filipino translation corpora for Google’s neural-machine translation system to process. In this case, Filipino can be considered a “low-resource language” (Johnson et al., 2017) because there is little available data to base source-target pairs on. In contrast, translations from or into European languages are more comprehensive and accurate because the European Parliament translates their proceedings into 21 languages, providing robust corpora to support Google Translate.

When Jimmy sees that there is no translation into Filipino, he does not attempt to find other ways to search for the meaning of the word. Fixated on the blue box that provides the translation, he overlooks that below the box, in grayed out font is the heading “ALTERNATIVE TRANSLATIONS” which does provide valid Filipino terms in bold letters (“hindi tinatablan, hindi na tatablan, hindi na kakapitan”). In this case, the blue box is a multimodal form that directs Jimmy’s attention and that is internalized by Jimmy, perhaps through repeated use, as the only place “to arrive” at in order to find the answer. It has become a culture-of-use (Thorne, 2016), “historically sedimented associations, purposes, and values” (p. 185) that accrue to a platform and that generate expectations of platform-specific activity. Such interactional and relational associations together with expectations of platforms are learned through processes of platform socialization.

Figure 4

(Left) Screenshot From Jimmy’s Phone of the Google Translate App and (Right) Laptop Browser Layout of the Google Translate Page



In contrast to the mobile app, the box in the browser layout of Google Translate from a laptop or desktop is a light gray. While this box is foregrounded because of its dimensions and the font size of the translation, it does not necessarily fix a user’s gaze. In the space below the boxes, the English definitions, synonyms, and sample sentences are provided. The alternative translations from the mobile app are not listed as “alternative” and the word “immune” from the heading “Translations of **immune**” is written in bold. Not only is there more information in this browser view, but the semiotic arrangement of information enables the user to navigate the space multi-directionally and draw on different combinations of resources to interpret meaning. In the case of Jimmy, however, when he views these results on the app on his phone, the blue box has the power to direct his attention and to shape expectations of finding a singular, definitive answer. His minimal access to a laptop, shared with other family members at home, constrains him from examining Google Translate results from a landscape browser view and limits his opportunities for language learning.

Discussion

While earlier studies in CALL have demonstrated how digital platforms provide diverse affordances and constraints for language learning (Dooly, 2018; Godwin-Jones, 2021; Rosell-Aguilar, 2017), this study adopted a critical materialist semiotic perspective to focus on how platform designs, as particular semiotic arrangements, can determine the way information is distributed and presented. It also examined how the material differences of devices can shape these designs and in turn, the types of information and navigation pathways made available to learners.

The findings demonstrate how online platforms have reconfigurable designs that depend on the devices used to access them (laptop vs. mobile phone), the interfaces made available (browser vs. app), and the orientations learners choose (landscape vs. portrait). In the study, well-resourced learners who have sole access to a laptop like Eric were able to find more opportunities for language learning on a browser (e.g., definitions of words, sample sentences, descriptions of videos, etc.). In contrast, when less-resourced learners like Nancy or Jimmy used Google Search or Translate on their phone to determine the meaning of a word, the portrait orientation on the small screen limited the variety of linguistic and semiotic resources made available to them. Material features of devices such as screen size and portability had “structural effects on information processing” (Dunaway & Soroka, 2021, p. 72), and thus played a role in the way learners were able to locate resources for learning. In this case, human and nonhuman interactants are entangled in ways that shape action, and this interaction involves a negotiation of power. Platform design has the power to program sociality online while learners have to draw on their own resources, their own forms of power, to agentively navigate these spaces structured by design.

Recognizing how platforms are sites of competing and colluding intentions, the way information on these platforms is presented through design is also circumscribed by power. The provision and ordering of search results in platforms like Google Search or Google Translate can index powerful interests as well as material inequalities. When Jimmy searches for the Filipino word for “immune,” he does not get an adequate result because Filipino is a relatively low-resource language in the economy of big data. When Nancy enters the single word “lifespan” in Google Search, what appears at the top of the results is the website of a private enterprise in the US rather than a definition. While the algorithm that has enabled such a result cannot be ascertained, this result reflects how enterprises promoting services in a local setting with the resources for search engine optimization can be prioritized over definitions or other educational sources of information. When Eric finds results on YouTube, the way information is arranged can reflect the interests of YouTube as a private enterprise as well. The highlighting of the number of views indexes ideologies of quantification that are embedded in such systems as these are implicated in monetization processes (Postigo, 2016). These numbers determine revenue, stimulate engagement, and encourage interactions that enable the collection of more data, which in turn produces profit. In this case, the intentions of app developers and software engineers are embedded in the semiotic structures and algorithmic processes of platforms (Darvin, 2021; 2022; Jones, 2019).

While users draw on the semiotic affordances of platform design and make choices regarding which buttons to press and which links to click on, how user input is processed to generate a specific output is a product of algorithms. Social actions are coded into algorithms, which operate invisibly not only because algorithmic processes are hidden, but also because they are proprietary and therefore not shared publicly. Nonetheless, patterns created by these algorithms can be inferred. Eric recognizes that the search results on his YouTube search are arranged based in part on the number of views each video has received, and because of YouTube’s algorithm, he ends up watching videos that have been, in a sense, promoted and verified by other users who have decided they are legitimate. As a legitimated knowledge logic, algorithms integrate and protect specific interests. They construct a hegemonic rationality that privileges certain sources of information over others (Gillespie, 2018; Granka, 2010; Kirkpatrick, 2008), while determining who will have access to specific types of information. The semiotic forms that are foregrounded on the screen through design index this logic and play a role in the way learners like Eric interpret and evaluate the information

presented to them. In this case, semiotic forms serve as structures that have the power to shape knowledge and behaviour.

For platforms to serve both the intentions of developers and the needs of users, they are designed in ways that negotiate the social with the technical (Whitworth & Ahmad, 2014). The semiotic forms in various interfaces (e.g., a blue box in the Google Translate app, the tabs and corresponding icons for “Images,” “News,” and “Videos” in Google Search results, the thumbnails in YouTube search results) are chosen and arranged to correspond to a sociotechnical logic, and these semiotic arrangements in turn shape cultures-of-use. While human-computer interaction studies examine the psychological and cognitive components of technology use (Dunaway & Soroka, 2021), a sociotechnical lens enables inquiry into how the architecture of platforms can program sociality online (Bucher, 2018). Attention to sociotechnical design contributes to an ecological approach to CALL by expanding the notion of context to include not just physical spaces but also online spaces that learners occupy.

To signal this expanded notion of context from a materialist semiotic perspective, I propose the term *sociotechnical structures* to refer to the linguistic and semiotic forms that constitute platform design and that have been arranged to serve both social and technical purposes in ways that afford and constrain various online actions. The use of *structures* in this term is not to index a structure-agency duality, but to assert the materiality of a platform’s architecture. Just like walls, aisles, and doors in physical spaces, these sociotechnical structures like output fields (e.g., the blue box in Google Translate), comment boxes, reaction buttons, and the like can direct attention, enable modes of interaction, and provide access to different types of information. These sociotechnical structures also index the intentions of app developers and software engineers to collect and categorize data, and encourage specific actions. As the configuration of these structures shifts across devices, interfaces, and screen orientations, how learners with different intentions navigate these structured spaces and access opportunities for language learning will vary. Hence, sociotechnical structures that serve as an affordance for one learner can be a constraint for another. For learners who use tools such as Google Search, YouTube, or Google Translate, the extent to which they recognize the power of sociotechnical structures to direct attention and distribute information impacts their opportunities for language learning.

Limitations of the Study

Conducting observations of the learners’ digital practices in a more natural environment was difficult to achieve because of limited access to the spaces of home and school. While there were observations of the learners in class (where they may or may not engage with digital practices), most of the observed digital practices were those during interviews outside the authentic use environments. Because of this limitation, the observed practices are mostly those that were enacted because of a prompt that was provided by the researcher (i.e., how they would use a particular app, search for information, or authenticate a website) rather than naturally occurring. While there were only 18 participants in this study, the goal was not to draw on a large sample size to produce generalizations about digital practices, but to demonstrate particular ways in which different material constraints shape access to information.

Implications of the Study

By drawing attention to the materiality of language learning tools and demonstrating how differences in the semiotic arrangement of space can shape online actions (Blyth, 2018; Godwin-Jones, 2021; Vinall & Hellmich, 2022), this study asserts the need for research that takes into account the multiple, fluid, and unequal ways information is distributed and foregrounded even within the same platform. Beyond teaching functional digital literacies that enable learners to use tools for their own purposes, the language classroom needs to integrate a critical digital literacy that draws attention to how power operates within these digitally mediated spaces where human and nonhuman interactants are entangled (Darvin, 2018). By examining platform design as an assemblage of sociotechnical structures, learners can recognize to what extent tools can shape our behavior, creating conditions “under which a multifariousness of literacy practices coexist” (Reinhardt & Thorne, 2019, p. 209). In this case, the use of these tools in the language classroom needs to

involve a discussion of the literacies necessary to interpret the information these tools provide, whether they be translations of words or search engine results. The study also draws attention to how learners with unequal access to devices can access information differently, especially when they are limited to the use of mobile phones. This issue has implications for the pedagogical strategies of teachers who rely on learners bringing their own devices to the language classroom. Recognizing these inequalities, teachers will need a critical awareness of how learners navigate online spaces in contrasting ways. To address these implications further, this paper calls for more digital literacies research that uses a critical lens to examine the intersection of materiality, semiotics, and power. Insights from such research can contribute to more reflexive digital practices and equitable online language learning.

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