

**Embodying Technology in ESL Contexts as a Knowledge Acquisition Means
for Academic, Professional, and Everyday Needs: A Practical Solution**

by

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The student author, whose presentation of the scholarship herein was approved by the program of study committee, is solely responsible for the content of this creative component. The Graduate College will ensure this creative component is globally accessible and will not permit alterations after a degree is conferred.

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NOMENCLATURE

AR	Augmented Reality
ARKit	Augmented Reality Kit
CALL	Computer-assisted Language Learning
DoF	Degree of Freedom
ESL	English as a Second Language
HMD	Head-mounted Display
HTML	HyperText Markup Language
KF	Knowledge Framework
KS	Knowledge Structure
KV	Key Visual
LC	Linguistic Construction
L1	First or Natively Acquired Language
L2	Second/Additional Language
L2L	Learner of English as a Second Language
MR	Mixed Reality
SFL	Systemic Functional Linguistics
SLA	Second Language Acquisition
S.M.A.R.t	Synthetic/Mixed/Augmented Reality Template
3D	Three-dimensional
TLF	Target Linguistic Feature
VR	Virtual Reality

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ABSTRACT

Despite significant achievements in second language (L2) acquisition research, the field of second language acquisition (SLA) is yet to provide a general, uncontested metatheory consolidating the efforts of competing models and approaches to L2 learning. As the understanding of the complexity of the learning process continues to mature, so do society, learner environments, and the educational resources potential for knowledge and meaning conceptualization, communication, distribution, and interpretation. While a rapid proliferation and repurposing of digital tools dynamically changes education ecologies, computer–human interaction developments seem to hinder SLA digital adaptation, thus precluding an informed teachers’ use of technology. The gap at the theory level, limitations stemming from computerization, and the need for pedagogical technology applications that span diverse aspects of learning have yet to be addressed holistically, thus calling for new and dedicated, theory–practice interfaces.

This creative component responds to that need by incorporating the Knowledge Framework (KF), a pedagogical heuristic, and adapting various SLA perspectives to repurpose emerging multimodal virtual reality (VR) means to devise a tool of diversified affordances operationalized as an L2 teaching and learning aid, projecting it for testing, reevaluation, and application.

Keywords: second language acquisition (SLA), social SLA, cognitive SLA, sociocultural SLA, knowledge framework (KF), computer-assisted language learning (CALL), social practice, learning in media environments, virtual reality (VR), S.M.A.R.t

CHAPTER 1. INTRODUCTION

Language learning is one of the social practices (experiences) that every human embarks on from infancy, and despite starting from a growing but limited knowledge base, most humans have completed the basic language acquisition process by the age of five (Yule, 2016). As we grow, accumulate knowledge, and develop various skills, learning an additional language becomes quite a different challenge — to the point where, notwithstanding the efforts and diverse strategies, achieving the target second language (L2) repertoire matching that of an adult native speaker is unlikely (Yule, 2016). For some, the L2 is the language needed for basic communication; others need it for a fuller integration into society or for accomplishing a certain goal (Hall, 2019). There are likely those for whom learning an L2 is a tedious task realized through schoolwork. Regardless of the circumstances, each person can face difficulties, which, depending on how they are addressed, determine learning outcomes.

Tasked to understand how people learn an additional language, the second language acquisition (SLA) discipline has accumulated a large body of research. Reflecting theoretical diversity within SLA, findings frequently offer contrasting results regarding the factors influencing L2 learning experiences and hence linguistic progress. While the internal conflict seems beneficial for the field itself, the fragmentation can lead to distinct teaching practices. Furthermore, the application of the theories depends on the capacity for their interpretation and reconceptualization, thereby presenting additional challenges to the average L2 instructor.

With the proliferation of technology, the profession embarked on providing a theory–practice, technology-mediated interface, but thus far has not fully succeeded in integrating a principled use of technology tools into L2 curricula. Meanwhile, the expanding computerization

of society and advances in technology bring new ways for consumption, interpretation, production, and communication of knowledge and meaning. This presents new challenges to the field. Ultimately, L2 learners' strategies, learning choices, and linguistic gains seem gauged by the scope of a particular epistemology as well as SLA paradigms and their recognition and application of technology as a valid learning aid. This is particularly the issue in environments with heterogeneous L2 populations.

The goal for this project is thus to create a pedagogical *Accessory* (realized as S.M.A.R.t, — a template based on the concept of Synthetic, Augmented, and Mixed Realities¹) that links theory, practice, and technology while synergistically fulfilling each. The basis for the *Template* is the “Knowledge Framework” (KF), a pedagogical heuristic created by Bernard Mohan (1986; 2001). The KF is built around two equally important dimensions of knowledge — theory and practice — needed for academic and professional success as well as for performing daily social practices. As such, it is especially relevant to L2 audiences as it addresses their linguistic goals while expanding their knowledge base about any specific topic and general concepts. To help integrate KF-informed lessons with a digital environment, this project looks for insights from various SLA-driven theories to ultimately demonstrate a content–language–knowledge conceptualization of learning administered via a novel medium, further described below. As society continues to incorporate technology into all aspects of life, so does technology continue to affect the ways we live, work, and learn. The current project is therefore a creative, exploratory approach to the L2 acquisition experience.

¹*Synthetic Reality* supplants the concept of *Virtual Reality* and subsumes *Augmented* and *Mixed Realities*. The concept aims to conceptualize and accomplish such computer–human interactions that authentically engage physical sensations within digitally enhanced environments. These can be constructed through various inputs and, as a product, can be instantiated as overlays of technology onto the ‘real’ world. For simplicity, this paper utilizes the “*Virtual Reality*” denotation to be a generic term.

Outline of the Creative Component Project

This report explains the rationale for the project and presents how the proposed solution accomplishes the goal. It will begin by detailing (a) the existing division within SLA, (b) the resultant theory–practice disconnect, (c) the role and integration of computerization in the field, and the current status of how adequately a-, b-, and c-related gaps have been addressed. With consideration of these as motivational for the project, the report will (a) introduce a *solution* and explain (b) the project’s underlying pragmatic approach as well as (c) how the resources are being consulted in order to (d) inform and direct the conceptualization (and the designing) of the digitally afforded Accessory (S.M.A.R.t) that will ultimately (e) effectuate the *solution*. As the description of the Solution involves a discussion of the decisions made to enable its *conceptualization*, this section also incorporates the discussion of instrumental literature that provides necessary justification, with Chapter 2 presenting an overview of the theories that inform the Solution’s *implementation*. In Chapter 3, the S.M.A.R.t will be exemplified through a selection of affordances to orient the reader on how to use it while *emphasizing* the need to consider such a generic demonstration as a compilation of randomly selected S.M.A.R.t features with *the aim being to showcase their operationalization*; and as such, the features appearing in the roster are subject to selection by L2 instructors to suit (and be modified before incorporation into) their teaching materials.

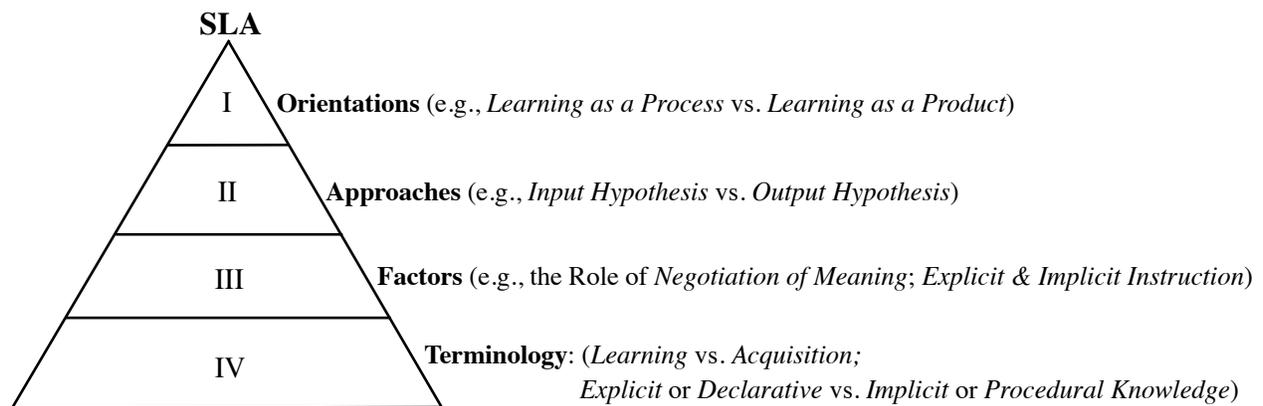
Statement of the Problem

The developmental route the discipline has undertaken has created a scientific ecology of multiple, diverse, and often conflicting views on how an L2 is learned (see Figure 1). Drawing from different epistemologies, these range from theory to practice to linguistic terminologies;

this symbiosis is yet to provide a general theory of learning (R. Ellis, 2015). Even the same SLA theory can be replete with conflicts within it. See, for example, the issue in cognitive SLA regarding the role of ‘consciousness’, where researchers such as Williams (2005) and Leung and Williams (2011) report evidence of linguistic progress without any awareness while Schmidt (2001) and DeKeyser (2003) refute any such claims. Still others (e.g., N. Ellis, 2005; R. Ellis, 2015) complement either position by arguing that it is the task type that determines whether to engage either implicit subconscious or explicit conscious knowledge for the most efficient learning.

Figure 1

The Divide in SLA: Reflecting a Diversity of Views on L2 Learning Process



Note. At level I are major ideological directions whose epistemologies have been historically shaped by different disciplines. Corresponding to the main viewpoints are various theories and approaches (level II) that continue the diversification by investigating unique factors and variables deemed as conducive to learning (level III) as well as adapting theory-appropriate nomenclature (level IV).

Several movements called “Emergentism” (R. Ellis, 2015) within the field have recently embarked on a task to incorporate multiple theoretical viewpoints while foregrounding L2 learners’ roles, choices, and needs. Most notable among these is perhaps Complexity Theory — first introduced and applied to SLA by Larsen-Freeman (2011). This can be generally summarized as an all-embracing theory that incorporates cognitive and social orientations. However, such theories still have their own selection standard as to what is legitimate SLA. As of now, the ideas behind them are “not fully developed” (Chapelle, 2009, p. 748). Their solutions to address L2 learning needs in modern society are, according to Hall (2019), impractical, irrelevant, or ineffective. R. Ellis (2015) critiques researchers for being “stuck with looking at ... discrete parts of ... social, psychological, and linguistic components” (Location No. 4620). According to Swan (2004), “it seems very unlikely . . . that these models are applicable to any useful extent” (p. 69).

Alongside the ongoing ideological conflict within SLA was another concern. That is, given a large number of SLA studies, theoreticians and practitioners have emphasized the need to reconceptualize research findings, that is, to give L2 instructors clear-to-understand as well as more definitive, succinct interpretations for application — as authentic, reliable, and *appliable* pedagogical solutions. A credible, promising approach to developing L2 materials is to look at those theories that have been empirically tested. Traditionally, however, as R. Ellis (2015) notes, “researchers have been wary of prescribing or proscribing how to teach, preferring instead to exercise caution” (Location No. 7122). Highly technical or nuanced SLA literature, R. Ellis (2015) admits, is neither accessible to most L2 instructors nor relevant to their pedagogical contexts.

In light of computerization that continues to defy traditional literacies and pedagogies, L2 instructors' vulnerability is especially topical because the SLA–CALL (computer-assisted language learning) relationship has not manifested effective and ready-made solutions. In building a bridge between SLA theory and CALL practice, very few efforts have managed to extrapolate various SLA findings into ideas for CALL design (see, e.g., Doughty and Long's (2003) conceptualization of task-based activities). The implications of such suggestions for teaching, expectedly, adhere to the underlying SLA theoretical viewpoints, thus suggesting only a limited scope for CALL use.

Since learners' out-of-school practices have an impact on their L2 learning, some researchers have used a bottom-up² approach by focusing on how L2 learners actually use technology for learning. The studies have investigated mainstream and entertainment gadgets and digital environments, such as phones, gaming, and social networking, to determine the factors conducive to L2 growth. Despite resulting in considerable empirical evidence, with some findings providing valid and valuable resources for technology-based curricula (see, e.g., Park & Slater, 2014), scholars have noted that teachers seemed digitally unprepared to make use of digital affordances, let alone productively integrate them (see, e.g., Lee & Lee, 2013).

Some findings are contradictory. For example, while confirming the linguistic potential of specific CALL features, researchers reported debilitating effects stemming from other variables (see, e.g., inconsistent effects from *interactivity* in deHaan et al.'s 2010 and Mohsen's 2016 studies or the double-edged benefit of *multimodality* in Legault et al.'s 2019 work). Also,

²'Bottom-up' studies of L2 learners' actual uses of technology provide ideas as to which affordances may facilitate L2 learning and thus it is worth considering them for further integration into SLA-based instruction (e.g., to increase motivation and engagement, to afford communication and socialization, and to enhance or modify input).

studies whose design involved manipulation of multiple variables (as in Rott, 2007) provide such elaborate implication strategies that replicating them in authentic classrooms seems unrealistic. To illustrate, Rott (2007) has suggested that (a) defining target features (TFs) four times and (b) defining them once followed by translation with bolding two times is more productive than (c) defining TFs once followed by placing them in bold three times.

As of this writing, there have been no CALL studies found for this project that are devoid of some ideological preconditioning of their scope of investigation by a particular theoretical perspective. Also, while top-bottom³ approaches aim at finding and testing theory-fit digital affordances, very few have proceeded with actually creating an SLA-dedicated, CALL-mediated learning instrument, let alone distributing it in a meaningful way.

Inquiry into the studies investigating the teaching capacity of VR, AR (augmented reality), and MR (mixed realities) immersive experiences leads to the assumption that none of these have generated enough interest in SLA, although pedagogical linguistic potential of many VR-tied key attributes has been future-proofed by many SLA scholars who have long been probing unconventional means and environments for L2 instruction. For example, Kress (2003) and Kress et al. (2014) have argued that the shift from text-based representations of meaning to that of the screen is the result of the tremendous flexibility of digital media for borrowing, repurposing, and creatively appropriating preexisting materials for new forms and processes of multimodal expression. In responding to a 2011 interview about simulations, virtually rendered worlds, and scenario-based approaches difficult to model in a classroom, Thorne (in Antoniadou,

³‘Top-bottom’ studies focus on investigating particular technology features found promising after investigations of neighboring fields (e.g., linguistics, psychology) to inform CALL design from the SLA-oriented perspective (enhancements, pushed output, meaning-oriented activities, etc.).

2011) asserted a near-future growth of such “industry in the area of computer-assisted language learning” because it was “importan[t] in education” and “useful for language learning” (p. 107).

Despite the seeming recognition of VR efficacy potential manifested in much theoretical literature, there are few empirical investigations that are both SLA-oriented and VR-executed. In a few studies found for this project, researchers designed dedicated VR- and AR-mediated learning spaces with features such as textual overlays, manipulation with objects, and spatial arrangement, variedly administered to ascertain the most impactful VR scenarios, with the overall findings being reported toward VR favor (see, for example, the *ARbis Pictus* project in the 2018 study done by Ibrahim et al. or *iVR* in Legault et al.’s 2019 work). Notable, however, is that the scope of investigation in these and other multimodality-oriented projects has been limited to vocabulary development (e.g., kitchen utensils, made-up nonsense words), comprehension (e.g., a medical procedure, arrangement of dance moves), and students’ perceptions (fun, captivating, complicated, etc.). Turning to the pragmatic side, it is important to comment that the apparently high sophistication of the aforementioned VR implementations raises questions about their feasibility and accessibility for end-users, both teachers and learners. As of today, beyond academia, there appear to be only two SLA-focused VR programs available to the general consumer: *Mondly* (ATi Studios, 2017) and *House of Languages VR* (Fox3D, 2018), both purporting learning success. The following Table 1 summarizes the aspects of growing concern among SLA scholars as those precluding practitioners’ intended fulfillment of the accumulated knowledge and therefore those limiting L2 learners’ access to opportunities.

Table 1*Summary of the Current Status of SLA Developmental Route*

SLA Achievements	The Gap
SLA advancements have furthered our understanding of the L2 learning process	Thus far, there is no integrated SLA metatheory
SLA offers ample theories and empirical evidence	A pool of theoretical knowledge provides little to nothing to the average L2 instructor
Some researchers supply interpretations that can be used more readily	Reconceptualization of suggestions for authentic application is obsolete in digitally dependent contexts
Recognizing the Theory–Practice–CALL disconnect, researchers have proposed ready-made templates for material design	Extrapolation of suggestions is tied to the underlying theoretical orientations, thus limiting the scope of factors to consider
Efforts by blending several theories have been proposed to provide a more integrated approach to L2 learning	As Hall (2019) has put it, “their intellectual energies have remained on disciplinary concerns” (Location 139)
Technology has rushed into our daily, professional, and social activities, changing the ways we do things and learn	With the exception of digital dictionaries, books, and HTML-based ⁴ functionality, holistic technology adaptation in L2 education has not been informed by CALL research
To keep up with societal demands of L2 learners beyond school requires more sophisticated but efficient pedagogical practices	L2 learners use of technology outpaces the rate of digital implementation in education; teachers’ digital literacy is lagging behind
An abundance of available digital tools provides great potential for learning opportunities in SLA contexts	There is no integrated CALL metatheory to offer a discrete set of factors to be considered for CALL incorporation into L2 curricula
Some L2 teachers explore and attempt mobile, portable, and other entertaining digital affordances for language instruction	The use of mainstream digital tools has not been systematically integrated into L2 curricula in an informed way

In this landscape, the field seems to encourage designing a digitally afforded, SLA-informed, and pedagogically tested accessible L2 learning means of multimodal affordances, adjustable depending on linguistic, academic, and social needs as well as adaptable to different audiences.

⁴HTML (Hypertext Markup Language) is the code used for structuring and organizing web pages, for displaying content and documents in a web browser.

Description of the Solution

Premise

The all-in-one solution (the term S.M.A.R.t or *Template* will be used throughout this paper) that incorporates different SLA principles and links theory, practice, and technology use is an *accomplished conceptualization* of an L2 learning approach derived from a field-based need. In that sense, the S.M.A.R.t is a combination of a thought-out idea and a tangible (although through the digital means) realization instantiated in the demonstration (Chapter 3).

The idea aspect refers to the fact that, in the absence of an established procedure in the field, the designing of the S.M.A.R.t involves creativity, which presents various challenges. To sustain its validity, the originative process needs to adhere to the relevant theoretical principles throughout. Therefore, the designing commences by consulting available suggestions from the field and then proceeds to determine and justify further directions regarding the S.M.A.R.t's general concept.

The second aspect deals with the execution of the resultant proposition. Thus, after the *Solution conceptualization* has been defined in the latter part of this section, the undertaking proceeds to consult relevant theories that will ultimately inform the integration of the S.M.A.R.t's affordances. Hence, Chapter 2 presents an overview of the theories that inform the *Solution implementation*.

Having culminated in the *Demonstration: How to Use the Template* (Chapter 3), the S.M.A.R.t will be illustrated through the enactment of a generic scenario. That is, some of the S.M.A.R.t's *features/affordances/attributes* are engaged with the aim being to demonstrate the connection between theory and practice afforded by the digital means (i.e., the S.M.A.R.t).

Depending on the learners' goals and needs, the adaptability of the S.M.A.R.t allows it to engage particular attributes for balanced learning (e.g., for building content vocabulary or improving grammar; to focus on form or meaning; through the provision of textual, visual, or audio prompts). The generic scenario *is* therefore offered as a hypothetical example suitable for a specific (yet made-up for the purpose of this paper) audience.

Discussion

Historically, the algorithm for technology-based L2 learning has been moving from (a) theory-based ideas to (b) conceptualization of principles to (c) aspects of CALL to (d) materials and practice. In this way, the resulting CALL instructional strategies have been relevant to a particular theory. However, while each theory concentrates on a specific phenomenon, activities afforded by technology, as advocated by Chapelle (2009), “can span a broad range of learning opportunities” (p. 747). Since there is no SLA metatheory that blends multiple viewpoints, current learning practices may take for granted many digital affordances, thus disadvantaging learners in the provision of more learning opportunities. Mirroring the need in SLA, there is, as Chapelle (2009) argued, a “need for an integrated set of theoretical perspectives of what comprises exemplary language learning materials” accomplished by technology (p. 748).

Despite the developments and transformations in SLA, the distinctions among theories, models, and hypotheses, “as well as other technicalities . . . have not been a central concern” in CALL, with the goal of today's CALL research, as Chapelle (2009) has urged, being pragmatic, to be carried out in any manner useful for creating learning opportunities (p. 742). CALL designers are interested in collecting ideas about how SLA occurs regardless of the particularities. These ideas can then inform decision-making regarding the design of L2 digital

tools. Given that the proposed S.M.A.R.t anticipates providing L2 learning opportunities, the evaluation of its teaching potential needs to be done both holistically as well as from the perspective of specific theoretical implications, which can be a challenge. Chapelle (2009) has suggested six overarching principles as a means for such evaluation that encompasses diverse theoretical perspectives; however, she has also warned of the dangers of overgeneralization from such a holistic approach. The principles comprise (a) *language learning potential*, which calls for examination of the quality of input, interactions, and practice; (b) *meaning focus*, referring to the need for rich, interesting input for meaning comprehension and production; (c) *learner fit*, which relates to the language complexity and its appropriateness to learners' emerging L2 repertoires; (d) *authenticity* — as a match between in and out-of-school language practices; (e) *positive impact*, viewed as a benefit — linguistic or experiential — resulting from working on tasks; and (f) *practicality*, referring to learners' access to the task and skills needed for accomplishing it.

With the consideration of the six general principles as providing some groundwork, the designing of the S.M.A.R.t will adapt the same pragmatic approach, that is, to be carried out in any manner that creates learning opportunities. As mentioned, this can be done by first collecting ideas about how SLA occurs and then extrapolating those ideas into creating CALL-based pedagogical materials. In his book's closing paragraphs, R. Ellis (2015), in addition to the mentioned 'top-down' route, proposes that another way "of making use of SLA for language pedagogy is to take pedagogic issues as the starting point and then scrutinize them from the perspective of SLA" (Location 7081). Such an approach involves reviewing different pedagogic proposals, guides, and heuristics from which to extract key pedagogic themes, topics, and issues (e.g., how to teach grammar or vocabulary, the importance of *authentic* contexts and *mediational*

means); these and beyond, which, according to Hedge (2000), constitute “persistent concerns in the professional practice of teachers” (p. 1). Once established, the process needs to reverse, that is, to proceed to consult relevant SLA findings on each issue (R. Ellis, 2015).

Directing the Designing

Developed by Bernard Mohan and published in the late 1980s, the Knowledge Framework (KF), a pedagogical heuristic, is a method that connects language, content, and scientific ways of knowing and doing (Mohan, 1986; 2001). Aimed to help L2 learners to keep up (both *academically* and *linguistically*) with curricular demands in K-12 classrooms, it has been extensively used as a pedagogical guide by subject-area and language teachers in creating materials that integrate content with language (Slater & Gleason, 2011; for a comprehensive review of the literature on the KF, see Slater, in press). Developing learners’ *academic discourse* and teaching them the *ways of thinking* is another goal of the KF. Since language is the primary means by which the two constructs are communicated, the KF reveals different patterns of knowledge through distinguishable linguistic instantiations and shows how educating learners on these connections can help them become competent members in academic or any other practice communities (Mohan, 1986).

In this sense, each content (e.g., history, biology, environmental science) teacher is also a language teacher, and each L2 instructor teaches the language through providing content of any kind (e.g., storytelling, animals, weather phenomena). Therefore, L2 learners in a science class can learn the profession while increasing general and field-specific linguistic repertoires; those L2 learners whose focus is the language for socialization can learn it while simultaneously developing thinking skills necessary for performing day-to-day social practices.

In the KF, the teaching and learning involves a cyclical (e.g., via teacher–student interaction), semiotically mediated process (via key visuals, multimodal resources, etc.) for gaining theoretical understanding (*Theory*) about concepts or things (*Content*) and for enacting (physically, mentally, or verbally) such knowledge to conduct social activities (*Practice*) — all while deploying the language features (e.g., L2 grammar, lexis) relevant to the Content (e.g., *crocheting*) and appropriate to either *Theory* or *Practice*. Aside from developing knowledge about *Content* and vocabulary (lexis) associated with it, the learner learns the patterns (*Structures*) of knowledge (*Knowledge Structures*, or *Ks*) and their linguistic instantiations, and thus can use these as an aid to learning other subjects and topics (i.e., *Content*). Most L2 learners with either previous schooling or individual experiences are likely to possess the knowledge of *Theory* and *Practice* structures as a semiotic resource in their L1s (e.g., as declarative or procedural knowledge); therefore, they can retrieve that knowledge to use as a bridge to their emerging L2 repertoires. Chapter 2 will elaborate on Mohan’s KF from the perspective of its integration with the S.M.A.R.t.

At this point, by using the KF as an anchorage for the S.M.A.R.t, establishing the interface between SLA theory and practice takes the following direction:

1. The KF is analyzed to derive its key ideas/factors/principles — as *Themes*. These are shown in the first timeline arrow in Figure 2.
2. Expanded upon and more articulated, these *Themes* will provide ideas as to how they can be extrapolated into digital integration — i.e., through intended S.M.A.R.t affordances (the second timeline arrow).

3. To carry out the previous step, relevant SLA theories and empirical studies will be consulted (the third arrow in Figure 2) to inform the S.M.A.R.t of (a) the best strategies for integration of the anticipated *Affordances*; (b) the manner they will need to be digitally modified before integration; and (c) any variables determining the appropriateness of individual *Affordance*'s deployment (e.g., L2 learner-related or contextual factors).

4. These will be demonstrated via miniature screenshots illustrating what a hypothetical user sees through a VR-headset during a task at the execution of a particular affordance (the fourth step in Figure 2).

Figure 2

Timeline for Establishing Theory–Practice–Technology Links



Note. See Table 6 for the complete list of the intended Affordances.

It may be assumed at this point that, relative to the KF, the S.M.A.R.t is a 'layer' of digital affordances applied in order to potentiate the KF's learning impact and, at the same time, provide students with learning opportunities. In pursuance of the suggestion by R. Ellis (2015), therefore, in implementing the *Template* (arrows 3 and 4), any relevant theory is invoked as needed for insights into how SLA occurs and then extrapolated into the S.M.A.R.t-operationalized principles.

The Issue

It has been stressed before that the absence of an SLA ‘metatheory’ is partly subsequent to the divergent views shaped historically by different underlying epistemologies. Hence, the selection of the Knowledge Framework necessitates a discussion of three important aspects: (a) its ‘identification’ within SLA; (b) why the choice of the KF is justified; and (c) how the pragmatic approach attempts to mitigate SLA’s theories categorization that may otherwise detrimentally affect aggregated perspectives on learning.

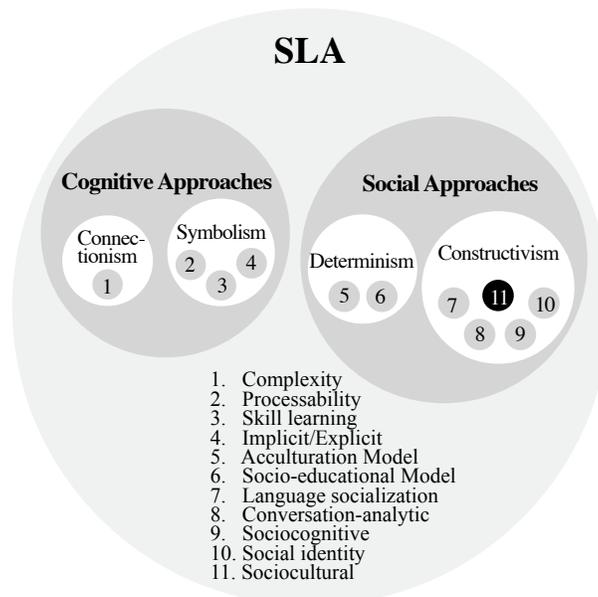
The Knowledge Framework draws on the principles of the Systemic Functional Linguistics (or SFL, devised by M. Halliday, 1994) — a linguistics sub-field theory — in which language is a semiotic resource for making meaning about and acting on the world. SFL, according to Mohan, Leung, and Slater (2010), “aims to describe . . . the linguistic options . . . to construct *meanings in particular contexts* . . . [and] provides tools to investigate . . . how wording constructs *meaning in text and context*” (p. 136).

The KF also draws from subfields of sociology, education, and psychology, such as Vygotsky’s 1934 theory of constructed knowledge through social interactions, practices, and mediational means. Vygotsky’s Social Constructivist Theory is recognized as the sociocultural theory, as far as second language learning is concerned (R. Ellis, 2015). This seems to be reflected within the KF, where its author, B. Mohan (2001), writes that the “Knowledge Framework is a view of language as discourse in the context of social practice” (p. 127). The adaptation of the SFL view of language as a social enterprise and the Constructivist’s view of knowledge as socially constructed suggests that further inquiry into SLA as to how L2 learning

occurs must be made from within the sociocultural SLA perspective. See Figure 3 for visualization of classical SLA classification of different theories.

Figure 3

The Multiplicity of Views and Approaches to Understanding SLA



Note: The most-inner circles aim to capture a variety of theories within an overarching SLA strand, with the black circle depicting relative positioning of the Sociocultural SLA within Constructivism (No. 11).

The overarching view of sociocultural SLA regards learning as a process, which contrasts it with the cognitive SLA's view of learning as a product. Adapting Vygotsky's (1934/1986) constructivist philosophical position of knowing, sociocultural SLA is concerned with learning as interaction occurring within social contexts, and thus researchers try to understand how L2 learners make use of the assistance available to them during mediation.

On the one hand, sociocultural SLA is in much disagreement with historically dominant cognitive SLA, in many aspects. Dale Schunk (2012), for example, indicates that constructivists do not explicitly deal with memory, and they "reject the idea that scientific truths exist and await

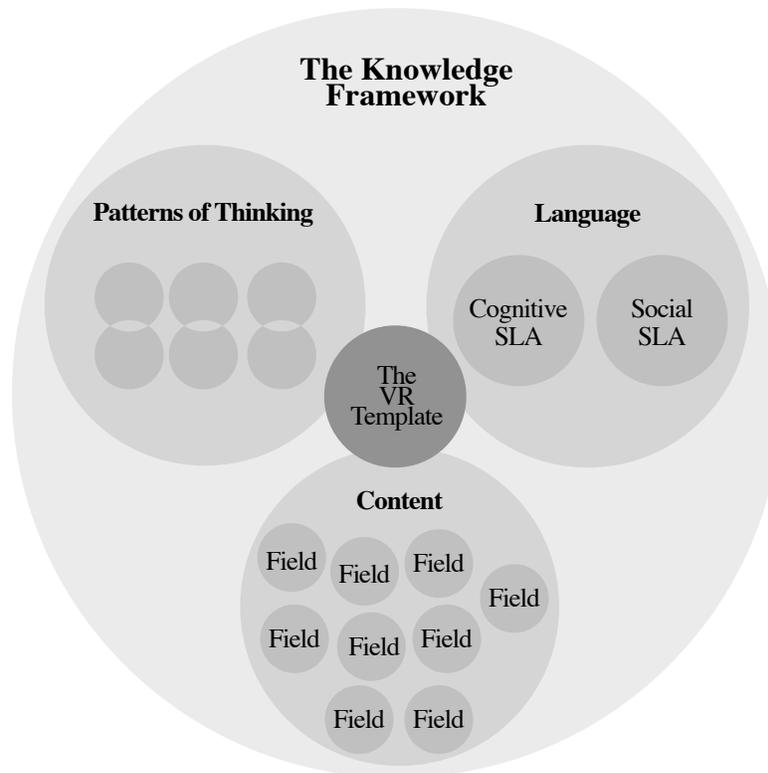
discovery and verification” (p. 230). In general, the principle is that L2 learners are likely to retain information if its meaning is personally relatable to them (Schunk, 2012). On the other hand, sociocultural SLA does not doubt the value of the cognitive aspect. In fact, in contrast to other socially oriented SLA theories, and unlike cognitive SLA models, sociocultural SLA, as R. Ellis (2015) points out, insists that “social and cognitive processes are not distinct and separate, but two sides of the same coin” (location 5098). Since new knowledge (e.g., content, concepts, and skills), language, and metalanguage are all introduced during and through the very social practices (e.g., L2 instruction), they are ultimately internalized (learned/ acquired/ attained) as mental representations; therefore, learning per sociocultural SLA spans both the social and the cognitive dimensions of learning. In the KF, this is reflected throughout, with Mohan (2001) emphasizing the need for ‘cognitive’ factors in learning: “explicit and systematic language teaching . . . is required . . . [with] approaches . . . which explicitly incorporate content” (p. 167).

It is the consideration of both *Social* and *Cognitive* faculties that has resulted in an increased interest among researchers and L2 educators in sociocultural SLA. In addition, the biggest criticism of social theories is that all have failed to provide any evidence of how ‘learning opportunities’ result in lasting L2 learning, irrespective of the contexts. R. Ellis (2015) contrasts that by saying that “[o]nly sociocultural researchers . . . supplement the qualitative data” to demonstrate how “learning-as-participation can lead to learning-as-change,” suggesting that “[i]t is the most established of the ‘social’ theories” where “theory and the practice of teaching are mutually informing” (pp. 297–321; see also Lantolf’s 2011 notion of ‘Educational praxis’).

At the consideration of these factors, the Knowledge Framework is seen as a practical pedagogical approach that seems to subsume both SLA dimensions. Importantly, it proposes a broader perspective on L2 *Language* learning through the integration of the very *Language* with the KF's key elements, that is, *Content* and *Patterns of Thinking*. See Figure 4 that illustrates a reconceptualization of the Knowledge Framework for the purposes of this creative component project. It is this pragmatic approach that provides justification to consult any relevant SLA theory as needed for the solution's *implementation*. Embodied into the KF's teaching method as a digital means, the S.M.A.R.t is anticipated to potentiate the KF pedagogy in more diverse and contemporary ESL contexts for academic, professional, and everyday needs.

Figure 4

Justification of Using the KF as a Theory–Practice, CALL-Afforded Bridge



Implementation

Once all the affordances are ascertained, they will be carried out using specialized hardware and software. The resulting computer application is launched on a VR headset, as will be showcased in Chapter 3. Not to lose sight of the goal of this paper, all the technicalities are omitted; but the following list of steps reflects the nature of the work involved:

- capturing panoramic visuals to recreate an “action situation” (as per Mohan, 1986)
- recording and mixing audio (e.g., pronunciation, instructions, contextual artifacts)
- composing overlays (content glosses, the language of KSs; navigational cues, etc.)
- creating visuals (“key visuals” as per Mohan, 1986; 2001: charts, graphs, etc.)
- creating visual ‘prompts’ (e.g., for locomotion, to mark choices, to invoke cues)
- incorporating the affordances into the dedicated VR application

VR is a novelty platform currently used for media consumption and entertainment. Computer-simulated VR experiences replicate, replace, or augment the real world through the use of multimodal semiotic resources (Intel, n.d.). A typical VR system uses a head-mounted display with a screen (VR headset) to project or generate visuals, sounds, and other sensory input. The effect creates a simulated environment in which a VR headset wearer can look and move around and, depending on the sophistication of the VR system, interact with objects embedded as two- or three-dimensional models. Capable of incorporating a range of features in one place, VR-based solutions are viewed as the next generation of computer–human interaction, projected to subsume and in time supplant conventional ways of learning and doing (see for example startups of Microsoft’s HoloLens 2 (Microsoft, 2021) and Apple’s ARKit (Apple, 2021) with their visions and projections of VR application).

As mentioned, the *Demonstration* is an instantiation of the S.M.A.R.t's affordances applied to the KF in a specific context. Therefore, material makers are expected to select, adjust, and deploy those affordances that are suited to their teaching objectives and L2 audiences.

Chapter 2 begins by analyzing the Knowledge Framework with the aim being to derive its key *Themes* and to *tentatively* extrapolate them into S.M.A.R.t. It proceeds to consult SLA to extract the Key takeaways, that is, the variables to be operationalized in the S.M.A.R.t (e.g., attention, negotiation, multimodality) as well as the factors affecting these variables' incorporation into the designing of the S.M.A.R.t (types of aid, the need and condition for aid retrieval, etc.). Given the number of theories, methods, and approaches, providing a summary of each would eclipse the goal of this project. For this reason, to partially capture the complex nature of the L2 acquisition process, the review will focus on two major SLA branches (social and cognitive); likewise, the review will be to highlight the factors determining learning outcomes according to these overarching theoretical viewpoints. This will be followed by the investigations of the empirical studies that have expanded our understanding of the L2 learning process in digital contexts. Each section's closing thus consolidates the key aspects that inform the design of the *Template*. The chapter concludes with the presentation of a complete table that contains features for developing VR-mediated teaching materials using the Knowledge Framework.

CHAPTER 2. RELEVANT APPROACHES AND THEORIES

The Knowledge Framework

To approach the KF and its operating principles in more detail, an integrating idea of an activity is put at the forefront as the underlying key concept (illustrated in Table 2). At the macro level, an Activity is a social practice, that is, according to Mohan (1986), “a form of social life that has a publicly acknowledged structure and standards” (p. 49). Projected to education, this involves, as Slater and Gleason (2011) suggest, “academically appropriate ways of thinking, talking, and problem solving within disciplinary areas” (p. 7). Defined more pragmatically, an *Activity* is what people do to achieve different goals.

An Activity can be as trivial as *baking a cake* or as complex as *building a house*. It involves a combination of comprehension and action, as shown in the first column of Table 2, but it can take any form; that is, solving a problem in mathematics is also an Activity, although it does not necessitate any physical action (e.g., body movement). Activity, as R. Dearden explains, may simply “involve consciousness of one’s situation apprehended under some description” (as cited in Mohan, 1986, p. 42).

Table 2

An Activity Enacted through Interaction of Content, Language, and the KSs

	An Activity Aspects <i>1</i>	The Six Knowledge Structures <i>2</i>	The Knowledge ‘Dimension’ <i>3</i>	Teaching/Learning Modes <i>4</i>	Knowledge Communication Media <i>5</i>	Social Artifacts (Actual or as a Learning Aid) <i>6</i>
<i>a</i>	Theoretical	Classification Principles Evaluation	Conceptual	Expository	Language: General Reference (e.g., <i>animals, instruments</i>)	Charts, tables, graphs, etc. 
<i>b</i>	Practical	Description Sequence Choice	Situational <i>Action Situation</i>	Expository <i>or</i> Experiential	Language: Specific Reference (e.g., <i>the giraffe, the pliers</i>)	Authentic, recreated, simulated objects, phenomena, events, experiences, etc.
<i>c</i>	Action	KSs afford the baking	Both are engaged	First-hand experience	Action discourse <ul style="list-style-type: none"> • simple speech acts • may not invoke actual language production 	Authentic objects (living and inanimate), phenomena, events, experiences, etc.

Therefore, each Activity has both theoretical and practical aspects to it. The *Theory* part refers to the general knowledge about an Activity and comprises knowledge structures of *Classification, Principles, and Evaluation*, as visualized in Figure 5 (see also row *a*, column 2 of Table 2 for relating to other constituents). The *Practice* aspect refers to a specific, situation-dependent knowledge that is informed by the *Theory*; it includes the structures of knowledge of *Description, Sequence, and Choice*, as shown in Figure 6 (also in row *b*, column 2 of Table 2).

Figure 5

The Facets of Theoretical Knowledge

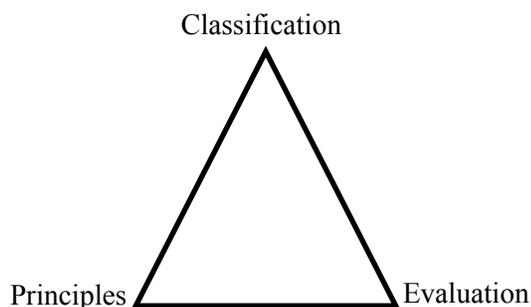
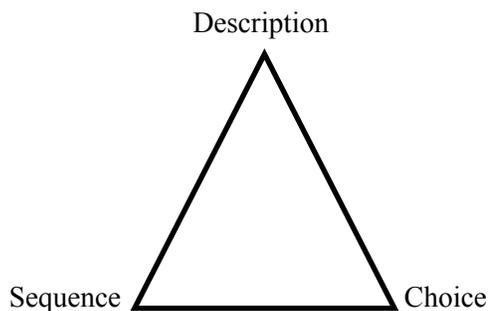


Figure 6

The Facets of Practical Knowledge



In the KF, this contrast between *Theory* and *Practice* is organized as three corresponding pairs of a total of six Knowledge Structures (*KSSs*), as shown in columns *b*, *c*, and *d* of Table 3. Each KS is associated with particular thinking skills (column *a*), and each is instantiated in language through content-specific vocabulary and linguistic constructions⁵ (column *e*). In this way, each pair creates a link where

- Description implies Classification (column *b*)
- Sequence is determined by Principles (column *c*)
- Choosing implies Evaluation (column *d*)

⁵A linguistic construction is an L2 target feature pertaining to vocabulary, grammar, ready-made chunks of speech, etc.

Table 3*Semantic Patterns of Discourse and Thinking Skills Within the Knowledge Structures*

Thinking skills	Three Pairs of the Knowledge Structures			Language
a	b	c	d	e
<i>Theory relevant</i>	CLASSIFICATION <ul style="list-style-type: none"> • Classify • Categorize • Group, etc. 	PRINCIPLES <ul style="list-style-type: none"> • Explain • Adjudicate • Rationalize, etc. 	EVALUATION <ul style="list-style-type: none"> • Rank • Judge • Criticize, etc. 	
	<ul style="list-style-type: none"> • Primary verbs • Conjunctions • Taxonomic lexis • Passives 	<ul style="list-style-type: none"> • Action verbs • Adverbials • Cause-effect lexis • Passives+Agency 	<ul style="list-style-type: none"> • Mental verbs • Comparative lexis • Evaluative lexis 	<i>General reference</i>
<i>Practice relevant</i>	DESCRIPTION <ul style="list-style-type: none"> • Describe • Identify • Locate, etc. 	SEQUENCE <ul style="list-style-type: none"> • Arrange • Track • Direct, etc. 	CHOICE <ul style="list-style-type: none"> • Decide • Select • Voice, etc. 	
	<ul style="list-style-type: none"> • Primary verbs • Coordinating lexis • Attributives • Compare/contrast 	<ul style="list-style-type: none"> • Action verbs • Temporal conj. and advl. • Sequential lexis 	<ul style="list-style-type: none"> • “Sensing” verbs • Alternative conj. • Contrasting lexis 	<i>Specific reference</i>

These relationships can be described as follows.

Classification/Description: The Practice of Describing an object (e.g., an apple) infers an understanding (Theory) of different kinds of apples and their sorting by taste, color, size, and so on.

Principles/Sequence: Doing things in a particular order (Practice) requires an awareness of the potential cause-and-effect relationships (derived from the theory of Principles) among all elements involved in a process.

Evaluation/Choice: Of the available options, the decision-making process (Practice relevant) will require an ability to evaluate and quantify different characteristics of phenomena under consideration (Theory).

Depending on the nature or goal of an Activity, some of the KSs may be more manifested throughout or at a particular phase during the execution of an Activity. An example of a simple Activity can be illustrated as follows. A baker who knows

- different kinds of cakes (*Classification*)
- what hot temperature does (*Principles*)
- favorite textures, flavors (*Evaluation*)

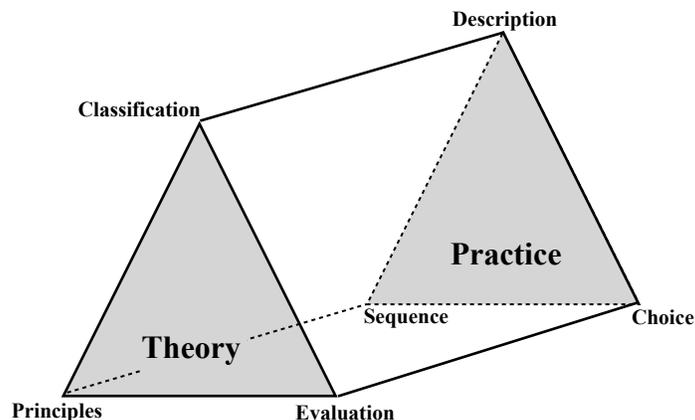
is able to

- pick up particular ingredients (*Description*)
- fix the batter and bake it for 40 min. (*Sequence*)
- for a spongy cake (*Choice*)

to ultimately enact these *Theoretical* and *Practical* KSs and do the Action — that is, do the actual baking — whether at the time of Describing, Sequencing, and Choosing, or at any time later (see row *c* of Table 2). While this Activity culminates in performance (Action), as mentioned earlier, other social practices may neither involve nor need an actual physical realization. Regardless, a mindful completion of an Activity becomes possible at the enactment of the general, theoretical knowledge and contextual, practical knowledge. Being able to carry out an Activity thus requires learning it, that is, as Slater phrased it in a class lecture, learning that “involves ways of doing and ways of knowing” (personal communication, October 2019). Figure 7 illustrates the combination of Theory and Practice dimensions needed for an Activity enactment.

Figure 7

The Knowledge Dimension of an Activity and Its Enactment



Achieving this goal has been the area of all curricula, by which learners are initiated into culturally determined activities to participate fully thereafter as new members. Instructional practices, however, vary in how they communicate prerequisite knowledge to the students (see the fourth column of Table 2). Increasingly, as societies become more complex, education roots teaching and learning in reflection discourse that is mediated through lectures, textbooks, and classroom discussions. This is particularly the case with higher-level programs that necessarily deal with the *Theory*-level thinking skills that refer to universal concepts or symbolic aspects of a topic, that is, the Knowledge Structures of *Classification*, *Principles*, and *Evaluation*. Essentially verbal and explicit, such expository pedagogical approaches seem the most appropriate. To help students grasp conceptual understanding, it is important that expository modes engage additional semiotic resources as a learning aid, such as symbols, pictographs, charts, tables, or graphs (see examples in the sixth column of row *a*, Table 2).

While verbalism of the expository learning is essential for understanding higher-level knowledge structures, according to Mohan (1986), educational practices that are based on

“mechanical memorization of sentences and undigested information” are not appropriate for teaching content and language associated with *Description*, *Sequence*, and *Choice*. As *Practice*-level knowledge structures, all three need to be associated with life experiences and practical knowledge (p. 45). For an *Activity*, a social practice, to take place, Mohan (1986) argues that “words and information need to be integrated with thought and action” (p. 45). This is particularly critical to L2 learners, whose instructional settings favor verbalism and ignore its relation to an *Activity*. Mohan’s (1986) critique is that, effectively, L2 students are “presented with talk and writing but not with anything to talk or write about” (p. 46). Corrective to verbalism is his idea of presenting information to students along with access to experiences, data, contexts, and other social artifacts of authentic environments (Mohan, 1986). See row *b*, column 6 of Table 2.

Thus, to extrapolate theoretical knowledge to the practical aspect of an *Activity*, a different teaching approach, experiential, is more appropriate (row *b* of Table 2). Some examples of such a teaching technique include experiences in a lab or a workshop, field trips, direct contact with the data, and demonstrations. They are experiential because learning occurs through *action*, where the *Description*, *Sequence*, and *Choice* KSs are particular instances, referring to specific things, phenomena, or events. These can be represented, according to Mohan (1986), “by pictures, films, . . . direct experiences of the things and events themselves” (p. 42). However, this does not mean that the learner has to be actively engaged in learning tasks rather than being a passive receiver. Engagement can be achieved and mediated through recreated objects and phenomena or simulated events and experiences. Mohan (1986) mentions that “[r]ole-playing and simulation games offer ways of recreating a practical situation...” (p. 41). In teaching and

learning environments that adapt experiential ways to teach an *Activity*, these facilitating semiotic representations should not be viewed as an alternative to talk but as a context for it.

While the six patterns of how knowledge is constructed allow content-oriented educators (in formal and out-of-school settings) to focus on the cognitive aspect of a topic, L2 educators can emphasize the language aspect. For many L2 learners — particularly those involved in academic studies — each aspect becomes crucial for keeping up with multifaceted curriculum objectives. In this way, the many facets of the KF achieve several goals, suit different audiences, and account for a range of academic, professional, social, and leisure purposes.

Following the idea to examine *Activities* (as social practices) and the uses of the KSs, while also advancing suggestions in Slater and Mohan (2010) concerning the applicability of the KF across registers, Slater and Butler (2015) have investigated language and academic literacy development practices in two different contexts. Their analyses included discourses from the physical education and the science classes — disciplines perceived by many as distinct from any angle. Indeed, different in content, each class used different ways to talk about it; however, Slater and Butler (2015) also observed that “the thinking skills and the corresponding language ha[d] many core and important similarities.... cyclically moving from description/classification to sequence/principles to choice/evaluation,” suggesting that “the use of language in teaching one field . . . connects to the teaching of any other social practice” (p. 24).

As mentioned earlier, the all-encompassing concept of an *Activity* extends to all kinds of social practices. Language learners of different *ages*, with different *goals*, in different learning *environments* need the ingredients for unconditional, competent participation in *Activities* at any

level — at *home*, at *school*, or in *business*. The KF is a well-rounded, systematic pedagogical model that affords such ingredients. The following table foregrounds the KF features.

Table 4

A Summary of the Distinct Characteristics of the KF

Scope	Relevance and Suitability
General purpose	A Pedagogical heuristic; a tool for developing materials
How it has been used	Teaching L2; Teaching content Teaching appropriate ways of doing Teaching appropriate ways of thinking
Applicability	Cross-curricula
Target audience	L2 instructors; Content instructors; Self-education; Knowledge builder
L2 learner demographics	Relevant for any age, Adaptable to any cultural backgrounds
Student target goals	Professional; Academic; Socialization; Participation in various practice communities
Foundational construct	Activity as a social practice
Teaching approach	The synergy between Expository and Experiential learning
Mediational means	L2 instructor; Language as a social semiotic; Social artifacts; Multimodal resources of meaning
SLA representative	Addresses both Social and Cognitive domains of learning

Following the timeline illustrated in Figure 2, The ‘Key takeaways’ lists the *Themes* and other key ideas, factors, principles, and considerations derived from the KF to be extrapolated to the S.M.A.R.t, subject to SLA investigation before integration. For a complete set of the S.M.A.R.t’s design features put to effectuate corresponding KF *Themes*, see the comprehensive Table 6 at the end of this chapter.

Key takeaways

- “[R]ecreat[e] a practical situation” (Mohan, 1986, p. 41)
- Simulate authentic environments
- Provide multimodal social artifacts as mediational resources
- Incorporate *Key Visuals*
- Put the language (and its form) aspect at the forefront
- Connect the language (and form) to the meaning
- Incorporate topical vocabulary
- Represent the six knowledge patterns linguistically
- Unify the KSs, (meta)language, and content in relevant contexts
- Consider students’ L2 resources and needs for determining priorities (meaning or form)
- Consider students’ age for determining a task type
- Account for students’ curricular objectives for deciding on a topic
- Enact an Action Situation that is interesting/relevant to L2 learners (e.g., a tour)
- Mediation via the teacher through discourse
- Delegate to the Teacher a role of a moderator and navigator to the provided artifacts

Key constructs

Knowledge Structures; Thinking Skills; Key Visuals; Social artifacts; Authentic environments; Experiential learning; Cyclical mediation; Action Situation.

Second Language Acquisition: An Overview

Drawing from various disciplines, particularly from psychology, early intellectual output was premised on L1 research. The efforts eventually resulted in a separate interdisciplinary field

devoted to understanding how people learn an L2. Initially cognitively oriented, later intellectual developments embraced the insights from other disciplines such as sociology and education, as well as from subfields of linguistics such as SFL and neurolinguistics. Having vastly evolved in the last few decades, SLA's current central concern is to understand how people of different ages learn an additional language, which includes ascertaining the factors that influence learning experiences and, ultimately, linguistic outcomes.

The multifaceted nature of L2 learning has resulted in a proliferation of various approaches, ranging in focus from cognitive to environmental to social. Characterized by distinct agendas, objects and methods of investigation, and key terminologies and concepts, each approach directs further research whose implications ultimately result in different, often contrasting, L2 pedagogies. At the same time, the field recognizes that continuous changes resulting from globalization, migration, and technological evolution, demand alternative, aggregated perspectives on teaching practices.

Social Aspect: Learning as a Process

Socially oriented SLA theories put an emphasis on the role of settings, contexts, and semiotic resources that are all dynamically constructed and negotiated through mediation during social practices among L2 learners and L2 'experts' such as teachers, peers, and parents (Hall, 2019; Schunk, 2012). Therefore, among the critical factors impacting the learners' cognition (e.g., for successful L2 learning) are the tools present in social environments. Social artifacts, language, and social institutions can all be such tools, among many other things, both physical and conceptual (Schunk, 2012). In the contemporary sense of the term, Hall (2019) provides a comprehensive description of this construct:

In addition to linguistic constructions, mediational means can include computational . . . , graphic resources . . . , drawings, artifacts and tools such as books, clocks, hammers, . . . and writing devices. Even physical objects and their *spatial arrangements*, . . . and environmental structures such as road signs, traffic lights, and street grids mediate individuals' participation in their social worlds (location 1696, Mediational Means, first paragraph).

Provided these semiotic mediational means are available to L2 learners when they engage in social practices and interact with other humans or object (i.e., experts, models, or exemplars), learners gradually internalize and transform these interactions and the tools being employed, making the outcomes from such experiences learners' own repertoires of knowledge, including linguistic. This results in L2 socialization in the target environments — when L2 learners become competent participants as experts. Projected to formal settings, for example, when L2 instruction involves some kind of explicit exposure to metalanguage, R. Ellis (2015) suggests that the development of grammatical knowledge occurs by “explain[ing] in detail the link between form and semantic/functional concepts” (p. 335).

Clearly, the role of mediation and mediational tools can be manifested through their availability. However, the mere presence of mediational resources (even when offered in a systematic way) does not guarantee a successful L2 learners' transformation of new knowledge and socialization. What is important, among other things, is, as Hall (2019) puts it, “their contexts of use, how their uses recreate their meanings and how, as mediational means, the resources mediate the processes and outcomes of socialization” (Location 1753, Mediational Means).

Socialization in Context

Okuda and Anderson (2018) investigated whether or not academic writing centers provided necessary language support to and afforded socialization of international students that would enable their equal academic membership. The researchers analyzed academic socialization experiences discourse collected from the participating students' collaborations with *expert peers* and found that most of the participants reported negative experiences. The international students reported that the assistance was superficial (mostly done through motivation-raising strategies), too general (i.e., *expository*), and provided unproductive feedback. More specifically, the help misaligned with the desired expectations. It failed to address the students' specific *linguistic* and *content-related* needs related to (a) the field of study (e.g., content knowledge, content vocabulary); (b) academic discourse writing practices (e.g., specific genres and registers); (c) socialization (which precluded students' integration into local discourse communities); and (d) linguistic performance (e.g., English grammar, morphology, communicative performance).

A similar finding is Schumann's (1978a; 1978b) studies of six L2 students whose learning situation was "good" except for one student for whom it was "bad." Due to the large size of the class, the social and cultural diversity of the students, and their lack of need for assimilation, the male Participant under investigation in the study "displayed negative attitudes and little motivation to learn English" (1978a, p. 34). As he did not develop the need to communicate with his peers, his acculturation did not occur, and he hardly developed linguistically during the ten-month-long study (Schumann, 1978a).

In general, it is that side of the socially oriented SLA theories that have caused much criticism from cognitively oriented approaches to learning. That is, the focus on merely

providing learners with participation opportunities (i.e., engaging in social practices, practicing communication) overshadows the cognitive dimension of learning, which, in social SLA, is still under-theorized (R. Ellis, 2015).

Key takeaways

- Supply teacher-specific, individualized feedback meaningful to the students
- Provide Social Artifacts; allow for interaction/engagement with them
- Diversify meaning-making resources; make them relevant to contexts and content
- Show relationships between social artifacts and language
- Orient L2 learners inside teaching contexts: explain, describe, show, ask, etc.
- The instructor (as a moderator) needs to invoke the pre-supplied aid, navigate students, and draw their attention by explaining, describing, showing, asking, etc.
- Instructor's discourse can be supplied with textual/audio prompts for subsequent retrieval
- Stimulate learners' output

Key constructs

Mediational resources (means); Social artifacts; Mediational process; Negotiation of meaning; Participation/Practicing/Doing.

Cognitive Aspect: Learning as a Product

The general approach of cognitive SLA deals with linguistic *input, processing, and output*. In general, such approaches mainly neglect contextual and interactional facets of learning (Firth & Wagner, 1997; see also Block, 2003). Similarly, Block (2003) points out that while the linguistic 'competence' aspect is represented, the *communicative* competence is out of much

focus in cognitive SLA, with many models disregarding the social dimension of learning altogether.

Cognitive SLA distinguishes two main separate linguistic systems, explicit/declarative and implicit/procedural (R. Ellis, 2015). While L2 instruction is effective in both, the intended outcome from the explicit instruction has been found to be lasting, suggesting its superiority, although the length of the instruction has not been found to facilitate better progress (Norris & Ortega, 2000).

At the same time, implicit instruction leads to L2 internalization generally unachievable through explicit instruction. From that view, the linguistic repertoire that has become internalized may exhibit some characteristics (e.g., fluency) that are associated with high language proficiency. In addition, for many learners, achieving an L2 internalization may be precluded by the existence of other factors, such as age, frequency of language exposure, or L1-related characteristics (e.g., L1/L2 pair). DeKeyser (2003), however, argues that *proceduralized* explicit knowledge is functionally close to *implicit* knowledge. For adults, who are unlikely to internalize linguistic constructions from *implicit* instruction, the general understanding is that learning linguistic constructions *explicitly* is a more productive and faster approach (R. Ellis, 2015).

What is important is that explicit learning always involves awareness — a cognitive capacity that may not be employed effectively by all L2 learners, such as those of young age or who have had limited experiences with formal education. To raise awareness, instruction techniques need to direct attention to target forms that are predetermined and planned (i.e., it is the focus of the activity). Many cognitivists, however, admit that such instruction can be obtrusive, as it creates interruptions of communicative meaning; in addition, it presents L2 target

forms in isolation (R. Ellis, 2015). To remedy this, instruction that targets L2 metalanguage should consider systematic, controlled practice of the forms by means of meaning-oriented activities. This is particularly important with young learners, whose lack of analytical skills requires close associations with the physical world to make meaningful connections between form and function.

In contrast with explicit instruction, as Ellis (2015) explains, “implicit instruction caters to incidental acquisition . . . [by] attract[ing], rather than direct[ing], attention to form” and is therefore easier for younger learners or those with linguistic needs not requiring a high level of accuracy (p. 358). In the process, learners pick up L2 features (e.g., a derivational suffix) without deliberately attending to and learn the form. Like with the explicit instruction, noticing occurs during incidental acquisition as well (R. Ellis, 2015).

Whether by the means of explicit or implicit instruction, for the target feature to be noticed by L2 learners and become available for further attainment and mastery, it needs to be detected or made salient (e.g., via input enhancement). Detection is a key construct in many cognitive SLA theories; it is considered to be one of the prerequisites to L2 learners’ attention. In other words, what the learner cannot detect cannot be processed and hence learned. Provided that such a cognitive registration of target information does occur, its rehearsal needs to incorporate strategies by which learners *notice* the gap between the provided input and their own production for the learning to become possible (R. Ellis, 2015).

Schmidt (2001) expounds the *noticing* construct by saying that it is a complex dynamic mechanism that includ[es] “alertness, orientation, detection . . . , selective attention, facilitation, and inhibition” (pp. 28–29). When engaged, these key elements enable the development of form–

meaning *mappings* in the learner's mental representation of information (Schmidt, 2001). For example, developing syntax necessitates learners' continuous attending (whether through a deliberate attempt or by instructional strategies) to the word order as well as to the meanings associated with the words. Despite the differences among learners in the learning strategies they employ, some researchers have claimed to identify general tendencies in how all learners allocate their attentional resources. For instance, VanPatten (1990; 1996; 2007), through his *input-processing principles*, proposes a number of strategies instructors can use for orchestrating L2 instruction and for developing materials by considering how different students allocate their attentional resources during learning events (e.g., learners process input for meaning before they process it for form; when they attend to a particular aspect of language such as vocabulary, they tend to neglect other aspects such as grammar). See also Sharwood Smith (1986), distinguishing between *processing* of new input for comprehension and *processing* it for acquisition — two purposes that need to be considered while creating teaching materials.

The discussion of such concepts as attention and salience is often presented in combination with another factor — cognitive load. That is, there is always an inner fight for the cognitive resources to engage during learning. For instance, drawing learners' attention to target L2 features compromises comprehension of content; the opposite would be a meaning-oriented task where productive attention to form is unlikely (R. Ellis, 2015). Therefore, instruction that alternates students' focus to different constructs can benefit by strategically allocating students' cognitive capacity.

Considering the scope of this project, the discussion of *cognitive* SLA has been limited to investigating only major factors that affect learning, with the particular focus on determining

those applicable to the execution of the S.M.A.R.t's anticipated affordances based on the available to the author resources. Conceptually, however, depending on the sophistication of the digital tool to be used, the application of both cognitive and social SLA can span a much broader range of theories with shared, similar, or even competing views.

Key takeaways

- Provide multiple input modes to assist *comprehension of content and language*
- For adults, use *metalinguage*, employ *explicit* instruction
- For the young (or those not needing metalinguage), prioritize *meaning*
- Introduce target forms as *formulaic chunks* to attend to incidentally
- Supply redundancy for the higher-level structures
- Supply formulaic chunks (e.g., patterns of language and KSs) via *textual* prompts
- If teaching content is the goal, introduce KSs (patterns) *incidentally*, with *flooding*
- With the metalinguage being the focus, introduce target constructions before the task
- Incorporate them into activity as prompts (retrieved to alleviate cognitive load)
- Modify (enhance) linguistic input, particularly for young learners
- Modification can be done through simplification, adaptation, paraphrasing, and so on.
- Engage *Key Visuals* to assist comprehension; instruct how to *interpret* them
- Connect form and function in meaningful contexts
- Divide activities into mini-tasks; *cyclically* focus on content, on language, and so on.
- Direct L2Ls' attention through artifacts: make a target feature salient

Key constructs

Awareness; Attention; Target feature salience; Comprehension for meaning or form; Formulaic chunks; Strategies for noticing; Input enhancement and modification.

Psychological Factors Affecting Learning

Approaching the psychological factors that affect L2 learners and learning can be done from three different perspectives. In addition, their discussion is necessarily tied to either cognitive or social SLA approaches discussed earlier. There are *cognitive* factors, seen as responsible for *processing* of incoming information (e.g., readiness for some linguistic constructions but not the others) as well as information storing and its retrieval (i.e., to be ready and willing to produce target L2 output). The second is *conative* factors, which are learners' abilities to set and continually and effortfully maintain a goal (e.g., through motivation, discussed further below). The last type is *affective* factors — these determine learners' positive or negative feelings associated with learning (e.g., stemming from anxiety levels or those governed by a desire to learn English construed by the learner to be an *alpha* language). Researchers who are interested in how these three types affect learning attempt to identify the factors that ultimately determine learning success and thus consider these in informing L2 pedagogies (R. Ellis, 2015).

Aside from an internal, ongoing conflict within psychological SLA theories (mainly related to the issue of the 'whole learner'), the general, uncontested understanding is that (a) the stimulus to which L2 learners are exposed is judged for how new it is, (b) how meaningful and consequential the outcomes from the stimulus (e.g., a boring but gainful task; an interesting but useless activity; a challenging but authentic participation in action) and its application are or may

become, and (c) whether or not learners feel capable of accomplishing a learning task even before they make any attempts towards undertaking it (Schumann, 2004). Provided that all conditions are met, the learners' judgments are positive, and numerous other intricacies are being considered and dynamically controlled for, the circumstances will be set to allow L2 learners to *become inclined* to learn.

In addition, (a) *motivational*, (b) *behavioral*, and (c) *attributional* orientations of *motivation* help explain L2 learners' acquisition progress depending on the (a) reasons *to need* or *want* to learn; (b) efforts exerted and their immediate impact, and (c) self-evaluation of the achievements, with the latter being influenced by teacher's feedback as well as perceptions of such feedback as either positive or negative irrespective of the intent (Bandura, 1986; Mace, Belfiore, & Shea, 1989).

Despite an acknowledgment that the rate of L2 knowledge gains is much higher among those learners who are highly motivated to learn and have the necessary aptitudes for that, researchers have also called for a re-conceptualization of *motivation*, as a construct, from its view as a universal set of predetermined and invariable qualities to its understanding as a highly situated phenomenon that is shaped by the particular instructional settings and how differently individual learners react to these (Schunk & Zimmerman, 1996).

According to Tudor, "learners are complex human beings who bring with them to the classroom their own individual personality" (as cited in R. Ellis, 2015, p. 88). Until very recently, the general SLA approaches (including socially and cognitively oriented) that aimed to consider and apply a psychological aspect of learning have aimed to investigate the aforementioned factors as isolated, autonomous units which, when combined, were seen to

complete the picture. In the process, however, all theories seem to have lost sight of an L2 learner as a unique learner. That is, as R. Ellis (2015) puts it, factors that affect individuals should not be investigated as modular units that have a cumulative aftermath effect. Even in the same teaching environment, with all else being equal, the set of instrumental psychological factors is likely to be very different for each learner. Most recently, researchers have embarked on a task to study the ‘whole’ learner by investigating *all the variables* affecting learning as interconnected and interrelated elements, and that any change in one results in many changes in the others. However, as per R. Ellis (2015), thus far, the “challenging undertaking” of such theories seems to provide evidence that “much of the variation evident in learner language is . . . largely . . . chaotic [,] . . . unpredictable [,] . . . and acquisition is non-linear” (p. 137; p. 422).

Key takeaways

- When ‘pushing’ for L2 output, integrate questions as prompts (so that the learners can ‘feel safe’)
- When ‘stimulating’ output, let learners see the progress (gap-noticing, correction)
- Provide feedback (via instructor or automated)
- The feedback from the instructor should be *positive* (communicated orally)
- Negative feedback should be ‘encountered’ by the learner while performing a task
- Integrate a feature for *negative* feedback (e.g., unpleasant sounds, screen flash, etc.)
- Change contexts frequently to avoid lessons to become boring
- Keep students’ interest in learning by integrating content meaningful to them

Pragmatic Approach to Learning

With the recognition of L2 learning as such a process that cannot be adequately understood and approached with a narrow scope of an individual theory, a number of researchers from different SLA ideologies initiated the “Transdisciplinary Framework” (Douglas Fir Group, 2016). Formed to collect insights from the accumulated efforts across ten SLA theories to inform L2 pedagogies, such a synthesized intellectual effort acknowledges the distinctiveness of theoretical ideologies; however, its proposals are pragmatic and problem-oriented. In this way, this Framework’s overarching strategy in addressing L2 learners’ goals aims to consider cognitive, social, and other factors that are shaped by the micro-, meso-, and macro-, interdependent aspects of social activities in which L2 learners are involved (Hall, 2019).

Still an emerging conceptualization, as of this writing, the Framework’s current progress seems to be somewhat stagnated. In his latest review of the Framework, Atkinson (2019), one of the founders, seems to suggest that initially engaged contributors have started to lean towards the concerns stemming from ‘their own’ SLA theories. Atkinson admits that unified SLA may be “outmoded and simple-minded — an Enlightenment fantasy,” with its current development being reminiscent of a “multiperspectival Picasso face-like theoretical presentation” (p. 114). Nevertheless, he suggests that it is that kind of “state of the art” that the field now needs, encouraging other scholars to continue the mutual effort (Atkinson, 2019, p. 114). The remaining sections of this chapter have been largely influenced by the ‘Transdisciplinary Framework’ approach.

Multimodality

Multimodality is the multiplicity of semiotic resources for making meaning that humans use through their actions or social activities (Kress, 2014). Since these resources can be anything that is used with a communicative purpose, it opens unlimited opportunities to approach L2 learners. As Table 5 illustrates, there are many kinds of cognitive resources from different perspectives. It is likely that L2 learners from varying backgrounds and with dissimilar experiences have different repertoires of these resources and use them strategically for interpreting, making, and communicating meanings (Hall, 2019). The more L2 learners participate in diverse social activities, the richer their meaning-making repertoires become. Hence, teaching activities that afford social practices with the use of multimodal semiotic resources can enrich teaching and learning practices.

Table 5

The Multiplicity of Semiotic Resources as Meaning Potentials

Social Artifacts			
<i>CREATIONS</i>	<i>OBJECTS</i>	<i>REPRESENTATIONS</i>	
	Human-made	Pictorial	Audio Graphic
	• infrastructure	• images	• music • diagrams
	• handicraft	• emojis	• sounds • maps
	• art/articles	• signs	• noise • illustrations
<i>CONSTRUCTS</i>	<i>INSTITUTIONS</i>	<i>KNOWLEDGE</i>	<i>CONCEPTS</i>
	• relationship	• facts	Spatial Temporal
	• beliefs/values	• information	• size • finished
	• worth/appraisal	• theories	• proximity • ongoing
	• objectives/goals	• understanding	• arrangement • upcoming
	• customs	• procedures	• distribution • chronology
<i>COMMUNICATION</i>	<i>METALANGUAGE</i>		<i>PARALANGUAGE</i>
	Interactional	Lexical	Nonverbal cues
	• actions	• words	• facial motion
	• turn-taking	• collocations	• body posture
	• routines	• phrases/clauses	• gazes
	Grammar (function)	Orthographic	Non-lexical components
	• ideational	• typescript	• intonation
	• interpersonal	• punctuation	• speed
	• textual	• spelling	• emphasis

Note: In communicative contexts, the meanings generated by any of these modes are interwoven with the meanings produced by other concomitant modes, and such interactions themselves create additional meanings.

Technology such as smartphones and the Internet has further broadened the scope of resources L2 learners use to interpret and make meaning. Since many of these semiotic resources are already in the learner's L1 repertoires, they can be engaged and used as a learning aid to link the existing meanings to the emerging L2 ones. Sauro and Chapelle (2017) have endorsed such pedagogies that recruit and fully engage with L2 learners' diverse semiotic repertoires as well as for "pedagogies that ... facilitate communication, collaboration, critical thinking, and problem-solving in linguistically and culturally diverse digital contexts" (p. 468).

Key takeaways

- Integrate diverse meaning-making resources, subject to the S.M.A.R.*t* limitations

Digital Affordances

Digital tools include a variety of technology applications (both hardware and software) that can be used for L2 instruction. These range from traditional means, such as drill-and-practice vocabulary or grammar exercises, to modern manifestations mediated through virtual environments (Lamy & Hampel, 2007; Shield & Kukulska-Hulme, 2008). Recent digital advances that supply authenticity are capable of engaging L2 learners in high-quality discourse exchanges that are also relevant to learners' social practices beyond school. In her practical guide to integrating modern technology into L2 instruction, González-Lloret (2015) gives reasons how using technology can blend multiple perspectives of learning spanning social, cognitive, and psycholinguistic dimensions:

The innovative blend of tasks and technology . . . can bring about unique affordances for learning by . . . raising [students'] motivation to take risks and be creative while using language to make meaning; by minimizing their fear of failure, embarrassment, or losing face; and . . . by promoting their active engagement in learning and following a philosophy of education that promotes learning by doing. (p. ix)

But see Chapelle (2009), who warns of the “need . . . to . . . make sense of the intensively interactive and linguistically rich environments afforded by technology” (p. 741). There are many good reasons to use VR platforms. By design, these are multi-sensory environments that (a) simulate authentic social practices; (b) provide first-person perspective experiences; and (c) afford multimodality, (d) mediation, (e) problem-solving, and (f) complex forms of collaboration. While some digital tools can indeed be beneficial in one context, they are harmful in many other settings, such as when a technology feature poses a risk to compromise users' privacy or when it enables cyberbullying (Baker, 2018).

Beyond that, there are other circumstances that may render digital tools less effective than anticipated. For example, in Stockwell's (2010) study, the majority of the participants admitted to having used their gadgets for social interactions, for playing games, or for other unrelated activities during lessons. Some students in Park and Slater's (2014) study did not feel too enthusiastic about “bringing [personal gadgets] into the classroom context” (p. 104).

Hence, as VR-platform is essentially a mobile entertainment device, its integration into the classroom requires preplanning. Extrapolating from Chapelle's (2003) suggestions, with the focus on the S.M.A.R.t, it is important to understate what its affordances should be for “the most successful software design strategies”; with the focus on the learners, it is important to know

“successful strategies for using software”; focusing on the *Task*, it is important to know the best SLA-informed practices (e.g., *negotiation of meaning*) for balanced L2 learning (p. 82).

Key takeaways

- Employ the S.M.A.R.*t* in L2 tasks as a tool with an instrumental role
- The S.M.A.R.*t*'s purposes are the *K*Ss/*Thinking Skills* patterns, *Content*, and *Language*
- Simplify learner–S.M.A.R.*t* interaction, that is, minimize engagement with it

Learning in Media Environments

Although there are unlimited *Attention*-triggering strategies, and previous research has demonstrated the benefits of technology in using these, there are many debilitating factors to consider. For example, a failure to notice the target linguistic feature (*TLF*) in a media environment will preclude its further analysis, integration, and use (Chapelle, 1998). To illustrate, in Rott (2007), where L2 texts were simplified and enhanced in different ways (e.g., four glosses, two highlights, one boldface, redundancy) to induce learners' *Attention* to the target vocabulary (*TLF*), supplying texts with definitions was found to be the best strategy, while neither bolding of the *TLFs* alone nor their redundancy had much effect. Rott's study added to the pool of previous findings confirming that supplying new linguistic units with definitions, translations, or visual alterations facilitates lexical development and helps comprehension. When participants needed to know the word meaning, they paid attention to the respective *TLFs* prompts and were able to link the forms with the meanings, which resulted in better word acquisition and better retention. However, doing so might have interfered with content comprehension — as the learning activity was likely interrupted, thus further calling for research to determine an ideal ratio of enhancements (Rott, 2007). However, Ellis (2015) doubts that any

Noticing can occur unless the enhancements are designed to be summoned only when needed. Similarly, Chapelle (2003) suggests that to induce learners to see the target feature, “the task would need to build in *reasons for looking* at these features” (p. 44).

In a study similar to Rott’s, Ibrahim’s (2018) goal was to investigate the effects of displaying digital information for lexical attainment, in addition to understanding the learner’s attitudes towards novelty technology. For the study, an Augmented Reality (AR) interface was devised by which real objects were marked to become salient to the participants wearing an *AR*-headset. To specifically link the *enhancement* attribute to the learning outcomes, the researchers engaged tracking capability — measuring attention through either head (for AR) or eye (for flashcards) movements. Both groups had to use both modes, and despite having devoted equal attentional resources to each, the sessions with the AR allowed the students to retain more *TLFs* and to recollect them with a higher accuracy than when they memorized from flashcards. All learners found the AR learning experience more engaging and helpful — that it allowed them to recognize the position of the objects and which words they correlated with; the physical objects had information in multiple modalities right above them, so they did not have to look that information up to better understand the meaning.

Engagement, Immersiveness, and Interactivity

Engagement, attention, and interactivity were the objects of investigation in deHaan et al.’s (2010) study in which a video game was used to evaluate its impact on L2 learners. The participants who played the game by manipulating the objects performed worse than those who only played it by watching the screen: the ‘Players’ understood less game-related content, remembered fewer words, and expressed frustration from computer interaction. Because the

Players simultaneously had to process different types of information as well as to physically navigate the game's characters, their attention shifted from the target language to the gameplay, thus resulting in less linguistic input. Because of poor comprehension, they failed to integrate and meaningfully use the target vocabulary when recasting the plot. deHaan et al. (2010) also targeted the negative associations about *interactivity* found in previous studies. Instead of a broad evaluation of this media *feature*, however, the study aimed to find out particular *interactivity* faculties as debilitating, thus suggesting that interactive elements, if enacted through physical action, should give L2 learners the agency, choices, and autonomy — all integrated around meaningful tasks, such as those implemented through immersive virtual environments.

Quite contrasting results were in Mohsen's study (2016) comparing two learning groups in different modes supplied with various multimodal prompts. In the *Interactive* simulation, the experimental group took the role of a 'surgeon'; the other group merely observed the mock-up action from a screen. Although there were many multimodal prompts available in both settings, the (1) manner by which the engagement was presented in the *Interactive* learning environment, (2) how the media were used there, (3) what role the learner played, and (4) what this learner did with the language intake, made all the difference and enabled the 'surgeons' to do better in content comprehension and vocabulary acquisition, suggesting *Interactivity* as an instructional, facilitative strategy. Thus, the 'surgeons' were motivated to complete the *surgery* by accomplishing little steps, by overcoming many obstacles, and by selecting the appropriate surgical element. Although a mere simulation, it was based on the established, authentic procedure leading to such a perception whereby the "Surgeons" had to draw their attention to the language input in a meaningful way. To effectuate this, they had their own choices to act upon

what they saw and to keep trying if there was a mistake. In other words, it gave the learners the opportunities (a) to interact with the input and (b) to encounter, identify, and correct errors — variables not provided in the deHaan et al. (2019) study.

Meaningful, Purposeful Participation

Likewise, using a custom-made VR solution, Legault et al. (2019) tested the effectiveness of digitally simulated, immersive learning environments and found that multiple modes of meaning offered in it gave their participants more options to attend to the *TLFs* resulting in a superior performance. In addition to the ability to manipulate VR objects (an *interactivity* element), the participants could freely move within the environment to better observe them (a *locomotion* affordance). The authors found that the extra data provided by enriched and multimodal contexts induced learners' perceptions, connected them to real-life experiences, and enabled them to invoke more associations of meanings already stored in their brain — all leading to lasting outcomes. The authors noted, however, that the *immersiveness* seemed less helpful for the advanced participants, as they may have resorted to alternative strategies in accomplishing the tasks, suggesting that *VR/AR* (would) most benefit the younger and beginner L2 learners. Looking beyond the comprehension and vocabulary acquisition strategies, the study projects the need to investigate VR potential for other linguistic features, such as grammar and phonology.

What can be generalized from these and similar studies is that *Media Environments* can be overwhelming if not controlled for all the features available in them. Also, none of the aforementioned studies employed the strategy by which the participants had choices or agency to select from the provided media prompts (e.g., language-supplying, form-oriented, different

modes of input) when needed, thus emphasizing the role of the Instructor as a mediator as well as the role of L2 learner with more agency.

Visual Aid

Despite the benefits of using multimodal semiotic resources in L2 pedagogy, there is legitimate critique regarding the use of visuals cross-culturally. For example, in Slater's (1999) investigation of the influence of illustrations, the usefulness of a visual aid as a teaching tool was found to be dependent on the users' ability to interpret it, suggesting the need to first introduce visuals to learners before incorporation. Although, see Hammerly (1974), expressing skepticism of visuals as a meaning potential resource and particularly of those that "depict . . . abstract concepts and relationships" (p. 124). On an encouraging note, however, Slater suggests that if the learning activity is not proceeding as anticipated, the students' guesswork may become "effective at promoting oral communication" (p. 18).

Indeed, as Corder puts it, when the visuals are "different from those of the learner's culture, [their] understanding . . . is delayed" (as cited in Slater, 1999, p. 15). A resulting compromised comprehension leads to referential problems, thus entailing speech 'repair'. In other words, the learners have to commit more time and effort to negotiating the meaning of the dubious media prompt before they can accomplish the task (Berwick 1993; Brown 1991). In this way, the oral communication itself becomes a task requiring the interlocutors to initiate, modify, maintain, and negotiate meanings (Slater, 1999). During such negotiations, as per Berwick (1993), learners resort to using and exchanging a variety of available meaning-bearing resources. Or, as Slater (1999) puts it, "people will take advantage of whatever shortcuts are available," suggesting that integrating illustrations into tasks can "forc[e] the learners to negotiate meanings

from visual rather than textual information” and that “[v]isuals which are open to multiple interpretations can make the task even more interactive” (p. 18). Local environments rich in various carriers of meaning are inherently challenging for L2 populations. At the same time, this presents many opportunities beyond breaking communication barriers. Thus, simulating real-life situations that are relevant to the target culture and where L2 learners can negotiate meanings contextually is an essential condition when the objective is to enable learners’ integration into such culture. (Slater, 1999).

Key takeaways

- Create Key Visuals that are as simple as possible
- Create an Action situation typical of the target culture
- Integrate ‘interactivity’ features: if such are objects, they should be content related
- Do not specifically draw attention to contextual objects
- Limit actual physical motion and simplify manipulation with the controller
- Integrate interactivity as prompts with L2 input
- In supplying prompts (e.g., hotspots, glosses), let the learner choose from the options
- Make known that students’ choices are consequential (i.e., meaningful)

The Role of Teacher as a Mediator

Foundational to learners’ socialization is the role of exemplary mediation, which in L2 contexts can be accomplished through reciprocal teacher–student interaction. Hall (2019) suggests that to solve a problem that the novices could not solve without help, a productive interactional routine is “the specialized teacher-led three-action sequence labeled the IRF” (Location 2672). Such an exchange involves *Information* elicitation from the students (e.g.,

by asking a question or giving a directive), receiving their *Responses*, and continuous *Feedback* carried out in a manner to serve several functions such as: (a) to provide positive assessment, (b) to promote students' self-correction, and (c), as Hall (2019) emphasizes, "to follow[] up on student responses by asking them to . . . elaborate, clarify, and make connections," rather than asking them limiting yes-or-no questions (Location 2672).

S.M.A.R.t Target User

In the earlier sections, it was emphasized that, in addition to motivation, learners' *investment* is needed for impactful linguistic progress. Also discussed is the issue that language instructors are often unprepared to accommodate digital technology to their pedagogical practices. Using the analogy with L2 students' *investment*, the same holds true for L2 educators. That is, the S.M.A.R.t will likely benefit those proactive teachers who are ready to invest time, who want to improve their personal digital literacy, and who want to approach their learners more creatively.

As with most VR-based implementations, one of the innate features of this media is the ability to afford physical motion to simulate real-life movement. Recognizing that such a feature may be neither appropriate for nor desired or needed by some L2 instructors, in addition to having a S.M.A.R.t-afforded task to be launched from a VR headset, it is made to be also viewed using a web browser. In this way, while L2 students can have hands-on VR learning experiences, instructors can see and use the same digital features on a computer monitor, navigate the students' performances, and provide instruction and feedback as needed.

The following Table contains the features for developing VR-mediated teaching materials using the Knowledge Framework. In the first column are the main *Themes* derived from the

analysis of the Knowledge Framework; these were interpreted for the ideas of how they could be digitally realized (the second column). To enable the ideas' integration into the S.M.A.R.t, relevant theories and empirical research have been consulted (see Key takeaways⁶); the findings were holistically applied in order to modify the affordances during the creation of a VR-based application (these are listed in column three).

Table 6⁷

Creating a CALL–User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration into the S.M.A.R.t
Authentic environments; Target content; Appropriate contexts; Supply <i>Social Artifacts</i>	Depiction of an Action Situation Topic/Content-related objects; Ability to move; Interactable objects; Meaning-making resources; Relevant ambient sounds/ voice input	VR environments Locomotion/teleportation Navigational clues (e.g., <i>markers</i>) Highlighting of topical objects (e.g., <i>polygons</i>) Audio, photo/video prompts
Language aspect: <i>Connect Knowledge Structures, Thinking Skills, and Language</i>	Content vocabulary Linguistic structures/patterns specific to each <i>Knowledge Structure</i>	Glosses, audio/visual prompts; Polygonal hotspots; In-depth information about content Examples of <i>Language</i> with <i>Ks</i> Voiced <i>Language/Ks</i> patterns
Incorporate <i>Key Visuals (KVs)</i> associated with the <i>Knowledge Structures</i>	Supply charts, tables, graphs, etc. with context to help interpretation	Generic visuals of the <i>KVs</i> Pop-up windows in contexts
Mediation by the teacher: instruction feedback guidance, and by using social artifacts	The teacher's role is to mediate through discourse and by deploying the embedded clues (e.g., prompts)	VR or computer screen-based instruction; Audio/Video/Textual prompts with Instructions; Explanation of how to interpret <i>KVs</i>

⁶Click on the bookmark to locate the element within the document (applicable to *.pages .pdf*, and *.docx*):
(a) The Knowledge Framework; (b) Social Aspect; (c) Cognitive Aspect; (d) Psychological Factors;
(e) Multimodality; (f) Digital Affordances; (g) Learning in Media Environments.

⁷Click here to move to the demonstration containing the illustrations of the Affordances in Chapter 3.

CHAPTER 3. DEMONSTRATION

This chapter provides a brief overview of the KF to serve two purposes: (a) to familiarize the reader with how pedagogical tasks can be organized using the heuristic and (b) to demonstrate how the affordances are operationalized inside a generic scenario. Note that the generic scenario is therefore a hypothetical example aimed at showcasing the principles of affordances' application. Hence, L2 instructors are expected to modify/adapt *all* of the affordances listed in the third column of Table 6 to suit their subjects (content) and students.

How to Organize an Activity Using the Knowledge Framework

In preparation for a teaching activity using the *KF*, and to organize the teaching–learning process systematically, recommendations suggested by Mohan (1986), Slater and Gleason (2011), and outlined in Early (1989) are used to explain the cyclical mediational process for developing language, content, and concept knowledge in an integrated way. The preliminary steps involve:

- Selection of a theme or *topic* appropriate for learners (L2 repertoires, interests, etc.)
- Breaking the topic down into the *six* Knowledge Structures
- Creating guiding *questions* for each KS
- Thinking of a task or an *activity*
- Ordering the *mini*-tasks within the Activity
- *Choosing* the Knowledge Structure to work on in each *mini*-task
- Focusing on the target KS, associated *language*, and thinking *skills*
- Bringing the KS to the forefront through *Key Visuals* the social *artifacts*
- Working with the language of the KS while focusing on *content*

- Helping the students *understand* how the language is used to construct a particular KS

As the special concern for an L2 teacher goes beyond teaching subject material, that is, the aim is to help the students develop their linguistic repertoires, Mohan (1986) suggests that the structure of the topic-related information should be as clear as possible. Therefore, in planning a lesson, it is important to determine only those KSs most important to the *mini*-task itself, and to focus only on these. As the Activity progresses, other KSs can be engaged (in place of or added to) for performing relatable or different *mini*-tasks. Using such an approach lowers the language barrier, simplifies the communication, and makes the task more doable.

Mohan (1986) further recommends introducing to the students concrete examples first, as this provides plenty of access to the specifics of the task (i.e., a rich variety of objects as social artifacts) and creates opportunities for discussing the *Action Situation* experienced by the class. A *mini*-task then can proceed to the conceptual aspect when the students are ready to process and organize the known information into a coherent pattern representing a corresponding *Theory*-level structure of knowledge. An Activity that can be interesting to a class of L2 learners and adaptable to their diverse needs (while covering both practical and theoretical aspects of the KF) can be a field trip or a tour to a museum or another landmark, as suggested by Mohan (1986).

How to Use the S.M.A.R.t: A Hypothetical Scenario⁸

Transforming these ideas into a local context in order to demonstrate how the S.M.A.R.t might be used, the main topic in this illustration is *A Tour to Downtown Des Moines*, which can be further divided into multiple *mini*-tasks. For example, a *mini*-task of locating, identifying, and comparing the *buildings* (KS of *Description*) can lead to a *mini*-task of grouping and sorting

⁸The presented visuals are linked to the scaled down version of Table 6 (shown on the left side) to refer to the implemented corresponding affordances (shown on the right side).

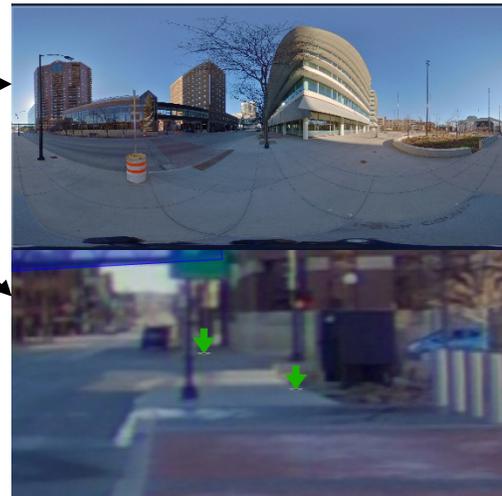
them (KS of *Classification*). At another level, a *mini*-task of locating and identifying *traffic lights, crosswalks, road signs* (KS of *Description*) will enable the students to perform a *mini*-task of classifying these objects as safety signaling devices (KS of *Classification*), to then establish cause and effect principles for crossing a street in a city (KS of *Principles*), to evaluate and rank each within the given circumstances (KS of *Evaluation*), and to finally make their informed choices for crossing the street (KS of *Choice*). Depending on the L2 repertoires available to the students, the number and complexity of such *mini*-tasks can vary, beginning from studying a single, *Practice*-level KS to gradually incorporating KSs that belong to both *Practice* and *Theory* levels.

The teacher and the students put on the VR/AR headsets displaying 360-degree visuals of the Des Moines’s downtown. The panoramas are linked to one another, allowing for teleportation⁹, as depicted below.¹⁰

Table 6

Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply <i>Social Artifacts</i>	Depiction of an <i>A Situation</i> Topic / Content-objects; Ability to move; Interactable objects Meaning making Relevant ambient voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers) Highlighting of topical objects (e.g., polygons) Audio, photo/video prompts
Language aspect: Connect <i>Knowledge Structures, Thinking Skills, and Language</i>	Content vocabulary Linguistic structures/patterns specific to each <i>Knowledge Structure</i>	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about content Examples of <i>Language</i> with <i>KSs</i> Voiced <i>Language/KSs</i> patterns
Incorporate <i>Key Visuals (KV)</i> associated with the <i>Knowledge Structures</i>	Supply charts, tables, graphs, etc. with context to help interpretation	Generic visuals of the <i>KVs</i> Pop-up windows in contexts
Mediation by the teacher: instruction feedback guidance, and using social artifacts	The teacher’s role is to mediate through discourse and by deploying the embedded clues (e.g., prompts)	VR or computer screen-based instruction; Audio/ Video/ Textual prompts with Instructions / explanations Explanation how to interpret <i>KVs</i>



⁹*Teleportation* and *locomotion* are some of the terms adapted in VR-based solutions to refer to the way by which VR users freely ‘move’ within virtual experiences without much physical motion. To perform a movement, a VR user points a VR controller at the target spot to start moving towards it (*locomotion*) or to immediately relocate to the respective area (*teleportation*).

¹⁰Click on the Visual to locate Table 6 within the document (applicable to *.pages .pdf*, and *.docx*). Click on the “Table 6” heading again to return to this location.

The description and the visuals presented below exemplify the operationalization of the *Description* and the *Classification* Knowledge Structures.

The KSs of Description

The teacher initiates a lesson by asking the students to either individually or in pairs (e.g., via an ‘*information gap*’ task) ‘walk around’ the downtown and discover as many kinds of buildings (or infrastructural objects) as possible. These can include banks, cafeterias, hotels, or grocery stores; they can also be plants, bridges, cell towers, and so on. As the students ‘travel’ from one environment to another, they will see that most objects have markings associated with the topic and the target KSs, thinking skills, and language. See the visuals below.

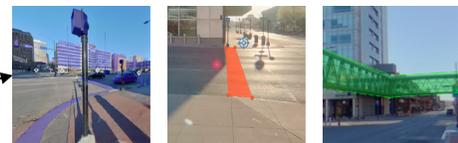
Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply Social Artifacts	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactable objects; Meaning making; Relevant ambient; voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers)
Language aspect: Connect Knowledge Structures, Thinking Skills, and Language	Content vocabulary; Linguistic structure patterns specific to Knowledge Structures	Highlighting of topical objects (e.g., polygons) Audio, photo/video prompts
Incorporate Key Visuals (KV's) associated with the Knowledge Structures	Supply charts, tables, graphs, etc. With context to help interpretation	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about content Examples of Language with KSs Voiced Language/KSs patterns
Mediation by the teacher: instruction feedback guidance, and using social artifacts	The teacher's role is to mediate through discourse and by deploying the embedded clues (e.g., prompts)	VR or computer screen-based instruction; Audio/ Video/ Textual prompts with Instructions / explanations Explanation how to interpret KV's

Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply Social Artifacts	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactable objects; Meaning making; Relevant ambient; voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers)
Language aspect: Connect Knowledge Structures, Thinking Skills, and Language	Content vocabulary; Linguistic structure patterns specific to Knowledge Structures	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about content Examples of Language with KSs Voiced Language/KSs patterns
Incorporate Key Visuals (KV's) associated with the Knowledge Structures	Supply charts, tables, graphs, etc. With context to help interpretation	Generic visuals of the KV's Pop-up windows in contexts
Mediation by the teacher: instruction feedback guidance, and using social artifacts	The teacher's role is to mediate through discourse and by deploying the embedded clues (e.g., prompts)	VR or computer screen-based instruction; Audio/ Video/ Textual prompts with Instructions / explanations Explanation how to interpret KV's

Polygon Hotspots



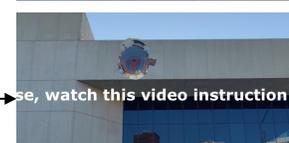
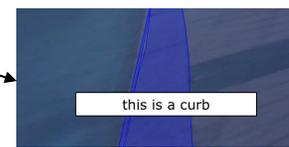
Polygon & Point Hotspots



Visuals, audio about content



Target Language prompts



Objects that are color-marked by ‘*polygon hotspots*’ direct the users’ attention to the environmental phenomena that are relevant to performing the task; similarly, various ‘*point hotspot*’ markers signal the available alternative resources of meaning. These are realized as prompts with textual, visual, or audio glosses. When activated, they reveal language related to the topical vocabulary and associated with a particular Knowledge Structure (e.g., *this is a ...*; *it has ... and ...*; *it is used for ...*; *it is located at ...*; *is made of ...*). Refer to Table 3 for suggestions regarding the linguistic constructions that can be used with a particular Knowledge Structure.

The entire class then ‘teleports’ to a particular panorama (e.g., a shared *Virtual Classroom*), where the activity proceeds to discuss what the students have found. They can detail the differences among the objects such as location, type, size, and exterior (as well as interior) elements — thus foregrounding both the *Thinking Skills* and the *Language* associated with the KS of *Description*. During the interaction, the instructor can ask the students to simply describe the objects. If the students experience difficulties with recollecting the target content language and linguistic constructions of the respective KS, they can instantly ‘teleport’ back to the object or phenomenon to access the prompts containing the necessary elements, or they can invoke a supplementary window glossary menu from within the *Virtual Lobby*. In either case, since they know that the information being asked of them is available and can be readily accessed will promote further negotiation and discussion rather than embarrassingly admitting to not knowing it. See the visuals below.¹¹

¹¹Click on the Visual to locate the full version of Table 6 (applicable to *.pages*, *.pdf*, and *.docx*).

Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply Social Artifacts	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactable objects Meaning making resources Relevant ambient sounds/ voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers)
Language aspect: Connect Knowledge Structures, Thinking Skills, and Language	Content vocabulary Linguistic structures/ patterns specific to Knowledge Structure	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about content Examples of Language with KSs Voiced Language/KSs patterns
Incorporate Key Visuals (KV) associated with the Knowledge Structures	Supply charts, tables, graphs, etc. with context to help interpretation	Generic visuals of the KVs Pop-up windows in contexts
Mediation by the teacher: instruction, feedback, guidance, and using social artifacts	The teacher's role to mediate through discourse and by deploying the embedded clues (e.g., prompts)	VR or computer screen-based instruction; Audio/ Video/ Textual prompts with Instructions / explanations Explanation how to interpret KVs

In the Virtual Classroom



Menu elements



Accessibility features



The instructor can also ask specific questions about the particulars of the objects that hopefully have been noticed (*the tallest building, . . . with a golden dome, etc.*). To lower the language barrier, if needed, the teacher can trigger additional prompts (as texts or audio) for helping with the questions.

Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply Social Artifacts	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactable objects; Meaning making resources; Relevant ambient sounds/ voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers) Highlighting of topical objects (e.g., polygons) Audio, photo/video prompts
Language aspect: Connect Knowledge Structures, Thinking Skills, and Language	Content vocabulary Linguistic structures/ patterns specific to each Knowledge Structure	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about content Examples of Language with KSs Voiced Language/KSs patterns
Incorporate Key Visuals (KV) associated with the Knowledge Structures	Supply charts, tables, graphs, etc. with context to help interpretation	Generic visuals of the KVs Pop-up windows in contexts
Mediation by the teacher: instruction, feedback, guidance, and using social artifacts	The teacher's role to mediate through discourse and by deploying the embedded clues (e.g., prompts)	VR or computer screen-based instruction; Audio/ Video/ Textual prompts with Instructions / explanations Explanation how to interpret KVs



The Knowledge Structures of Classification

After the students have familiarized themselves with the objects (personally and from the recounts by the peers), the Activity transitions to the discourse of the general, theoretical aspect,

with the teacher initiating the discussion about how the discovered objects can be grouped into more general types.

Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply Social Artifacts	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactive objects; Meaning making resources; Relevant ambient sounds/ voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers) Highlighting of topical objects (e.g., polygons) Audio, photo/video prompts
Language aspect: Connect Knowledge Structures, Thinking Skills, and Language	Content vocabulary Linguistic structures/ patterns specific to each Knowledge Structure	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about
Incorporate Key Visuals (KVs) associated with the Knowledge Structures	Supply charts, tabular graphs, etc. with context to help interpretation	
Mediation by the teacher: instruction feedback guidance, and using social artifacts	The teacher's role to mediate through discourse and by deploying the embedded clues (e.g., prompts)	

Generic visuals of the KVs
Pop-up windows in contexts

VR or computer screen-based instruction;
Audio/ Video/ Textual prompts with Instructions / explanations

Explanation how to interpret KVs



With such a bottom-up approach, the teacher *gradually* directs the students towards the *Thinking Skills* and the *Language* associated with the Classification KS. During this part of the discussion, the teacher triggers the prompts with Key Visuals that encapsulate the new information conceptually (Students can also do it later).

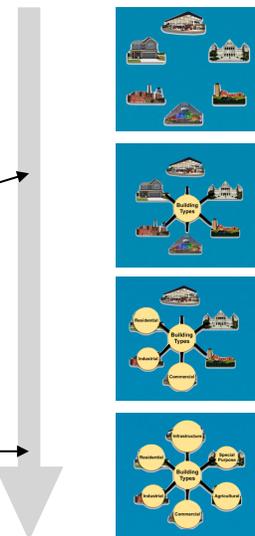
Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply Social Artifacts	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactive objects; Meaning making resources; Relevant ambient sounds/ voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., markers) Highlighting of topical objects (e.g., polygons) Audio, photo/video prompts
Language aspect: Connect Knowledge Structures, Thinking Skills, and Language	Content vocabulary Linguistic structures/ patterns specific to each Knowledge Structure	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about
Incorporate Key Visuals (KVs) associated with the Knowledge Structures	Supply charts, tabular graphs, etc. with context to help interpretation	
Mediation by the teacher: instruction feedback guidance, and using social artifacts	The teacher's role to mediate through discourse and by deploying the embedded clues (e.g., prompts)	

Generic visuals of the KVs
Pop-up windows in contexts

VR or computer screen-based instruction;
Audio/ Video/ Textual prompts with Instructions / explanations

Explanation how to interpret KVs



To help the students grasp the concepts, the teacher (in addition to her mediational instruction) may need to engage the prompts that contain the language patterns associated with

the KS (e.g., *How can the buildings be grouped? What kinds of services do they offer?*). Early on, these prompts can be triggered from within the panoramas to provide contexts. In the ‘*Virtual Classroom*’, however, the context (i.e., social artifacts) can be removed, whereby the teacher can allocate students’ cognitive capacity to more abstract knowledge structures.

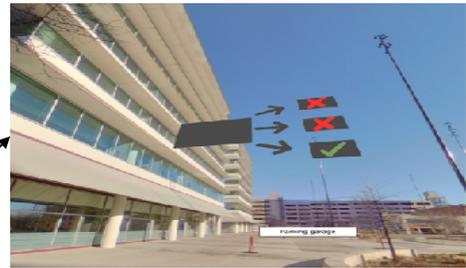
Table 6
Creating a CALL-User Interface to Effectuate the Affordances

KF Themes	Extrapolation to CALL	Integration Into the VRt
Authentic environments; Target Content; Appropriate Contexts; Supply <i>Social Artifacts</i>	Depiction of an Action Situation Topic / Content-related objects; Ability to move; Interactive objects; Meaning making resources; Relevant ambient sounds/ voice input	VR environments Locomotion/ teleportation Navigational clues (e.g., <i>markers</i>) Highlighting of topical objects (e.g., <i>polygons</i>) Audio, photo/video prompts
Language aspect: Connect <i>Knowledge Structures, Thinking Skills, and Language</i>	Content vocabulary Linguistic structures/ patterns specific to each <i>Knowledge Structure</i>	Glosses, audio/ visual prompts; Polygonal hotspots; In-depth information about
Incorporate <i>Key Visuals (KV)</i> associated with the <i>Knowledge Structures</i>	Supply charts, tabl graphs, etc. with context to hel interpretation	
Mediation by the teacher: instruction feedback guidance, and using social artifacts	The teacher’s role to mediate through discourse and by deploying the embedded clues (e prompts)	

Generic visuals of the KVs
Pop-up windows in contexts

VR or computer screen-based
instruction;
Audio/ Video/ Textual prompts
with Instructions / explanations

Explanation how to interpret KVs



Other ideas for tasks

For a more engaging activity, the students can begin by locating, identifying, describing, and categorizing infrastructural elements related to traffic (*crosswalks, road signs, etc.*) and other phenomena, doing which will involve the *Description* and *Classification* KSs in a way similar to the previous hypothetical. Afterwards, the students can engage in a simulation of ‘*walking down the streets*’ or ‘*crossing the roads, railroads, or bridges*’ (*Sequence* KS) in which the environments contain the matching digital prompts.

For example, key visuals as *arrows* and *sequence strips* can navigate and orient the students in performing the task, while the incorporated textual and audio glosses (e.g., *after...*, *when ...*, *continue...*) can supply the KS-related language and thematic vocabulary. This can lead

to the group discussion of the actions and then proceed to introduce the KS of *Principles*, with the teacher assisting the students in formulating their emerging L2 discourses.

Alternatively, and depending on the complexity of the task, as well the students' available L2 repertoires, the instructor can ask leading questions using the target linguistic constructions (e.g., *Why didn't you look to the left before crossing the street?* or *Why did you go to the corner to cross the street?*). To help the students grasp the conceptual understanding, the teacher triggers the corresponding to the KS *Key Visuals* showing the *consequences, cause-effect relationships*, etc. and employs the prompts with suitable language data (in *order to ...*, *because...*, *if-clauses*).

To address the *Choice* and *Evaluation* KSs, this same activity can continue by having the students discuss different types of buildings and businesses identified earlier as *Retail*. As the students have previously encountered these, the teacher may ask about some particulars (e.g., types of goods or services offered) and engage the students in a task of *evaluating, ranking, or criticizing* these characteristics, as well in a task to share thoughts, opinions, and choices regarding these places based on said evaluations thereby learning the KS of *Choice*.

The Appendix¹², in greater detail, illustrates the aforementioned experience from the perspective of a hypothetical user (i.e., an L2 instructor or L2 learner). The screenshots are grouped in such a way to demonstrate (a) how to launch, restart, and stop the S.M.A.R.t activity; (b) what the main menu settings and options are including using the controller; (c) how to instruct on interpreting the *Key Visuals*; (d) how to find topical objects inside the panoramas; (e) how to find and use various prompts supplied; (f) how to teleport from one panorama to another; (g) where the prompts of *all six Knowledge Structures* are, and where they contain respective

¹²See the visuals in full resolution at www.vrforenglish.com/wp-content/uploads/Appendix.pdf

linguistic constructions within; (h) how to solicit additional help, (i) where to find the *Virtual Classroom* to meet for group discussions, and (j) how the L2 teacher can gradually construct L2 learners' *Theory*-level knowledge to conceptualize the *Knowledge Structures* and to practice the *Language*.

It is worth pointing out that the demonstrated VR experience should *not* be taken as a representative of the S.M.A.R.t, nor is it its *Template*. It is simply an idea of how the S.M.A.R.t is implemented using a hypothetical scenario. Therefore, all the panoramas, texts, audio, visuals, etc., as illustrated, serve only one purpose — to demonstrate how the Knowledge Structures, the Language, and the Content are merged and thereby accomplish the CALL-mediated pedagogy of the Knowledge Framework. Ultimately, it is L2 instructors who will need to first learn how to use this heuristic for their lessons, who then can apply the S.M.A.R.t to reinforce their instruction learning potential.

For example, a driving instructor (i.e., content teacher) can capture panoramas of the vehicles (interior and exterior) and streets with all the signs to then digitally supply such mediational means with the relevant topical language (content) by incorporating into the panoramas as many linguistic units as possible while, at the same time, making sure to foreground the language of the KSs (see Table 3; see also Slater (in press), for a detailed account of the discourses afforded by the KF). In the process, the instructor may want to embed or prioritize different prompts for balanced learning. In such a way, a content instructor is also a language instructor.

In a similar fashion, a language instructor whose goal is to improve L2 learners' pronunciation may want to embed more audio prompts as exemplars. The students can play back

the respective audio prompts (that are realized through the language of the relevant KSs), practice their oral output, detect their pronunciation gaps, and try attempting to remedy such gaps during mediational collaborations with the peers. For the instruction to be more authentic, that is, a representative of the target language use domain, a similar ‘driving’ experience can be engaged to ‘take’ the students to the gas station to learn how to fill in the gas tank.

Experiencing the S.M.A.R.t: Alternative Accessibility

Given that VR is such a new concept, the author acknowledges that there are many people (particularly L2 instructors) who are unfamiliar with what *it is* and how VR-based solutions *function* in general. It thus presents challenges to demonstrate what a VR-based tool *can be* and how it *can function* through the pages of this paper that can only use a limited number of semiotic resources for meaning production and communication (i.e., almost exclusively language-mediated; see column 3 in Table 5 for a list of other mediational resources impossible for engagement). In that way, the reader may be already disadvantaged because, extrapolating Mohan’s (1986) critique to all novices, they are “presented with talk and writing but not with anything to talk or write about” (p. 46).

To somewhat remedy this, the presented *Hypothetical Scenario* (A Tour to Downtown Des Moines) can be accessed at EnglishinVR.com — a website designed alongside this project to allow curious readers to experience the S.M.A.R.t on a computer monitor.

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[dchild=1&keywords=Understanding+Second+Language+Acquisition&qid=1611260981](https://www.amazon.com/Understanding-Second-Language-Acquisition-2nd-ebook/dp/B016ZVILUI/ref=sr_1_2?dchild=1&keywords=Understanding+Second+Language+Acquisition&qid=1611260981&s=digital-text&sr=1-2)

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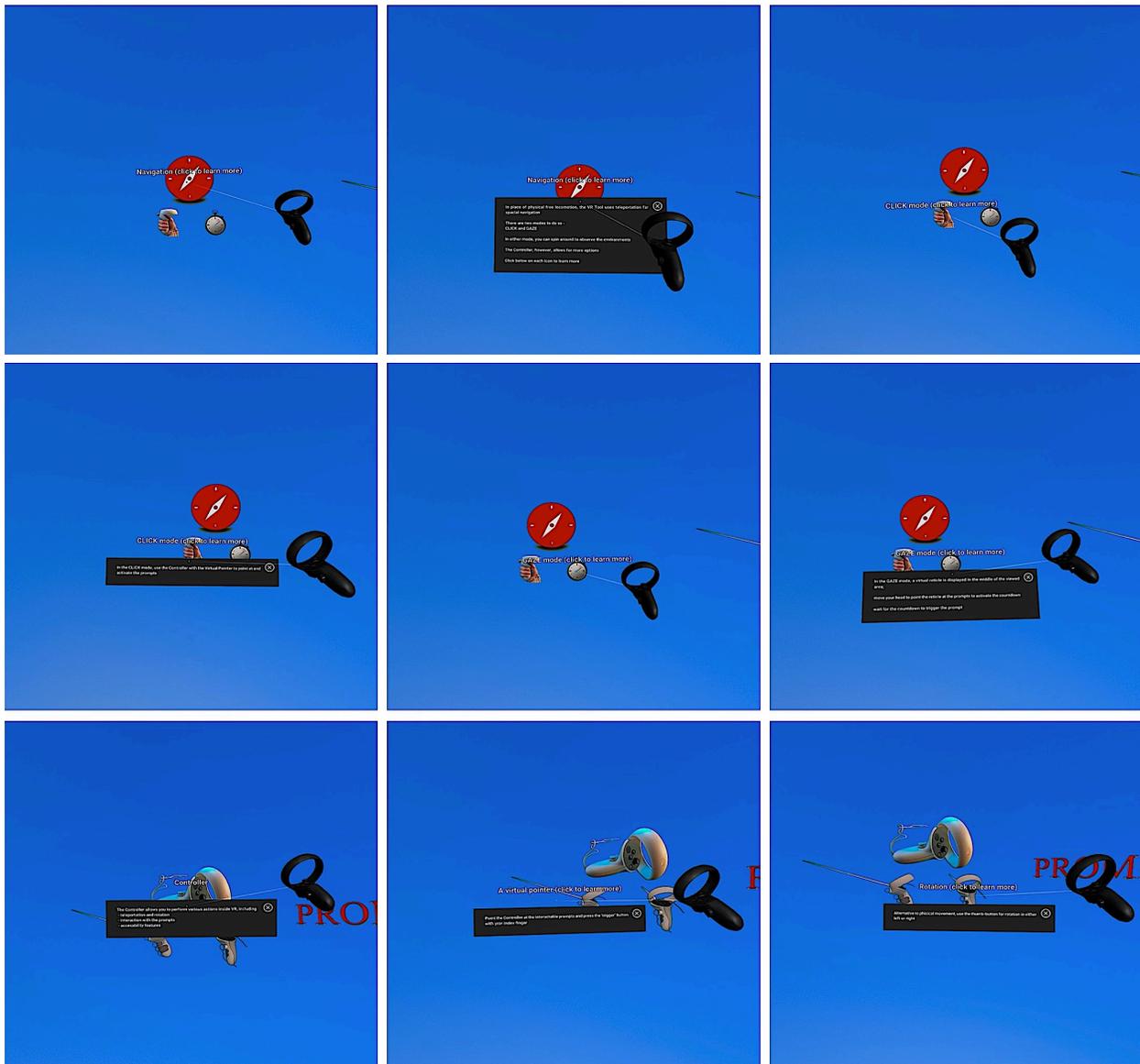
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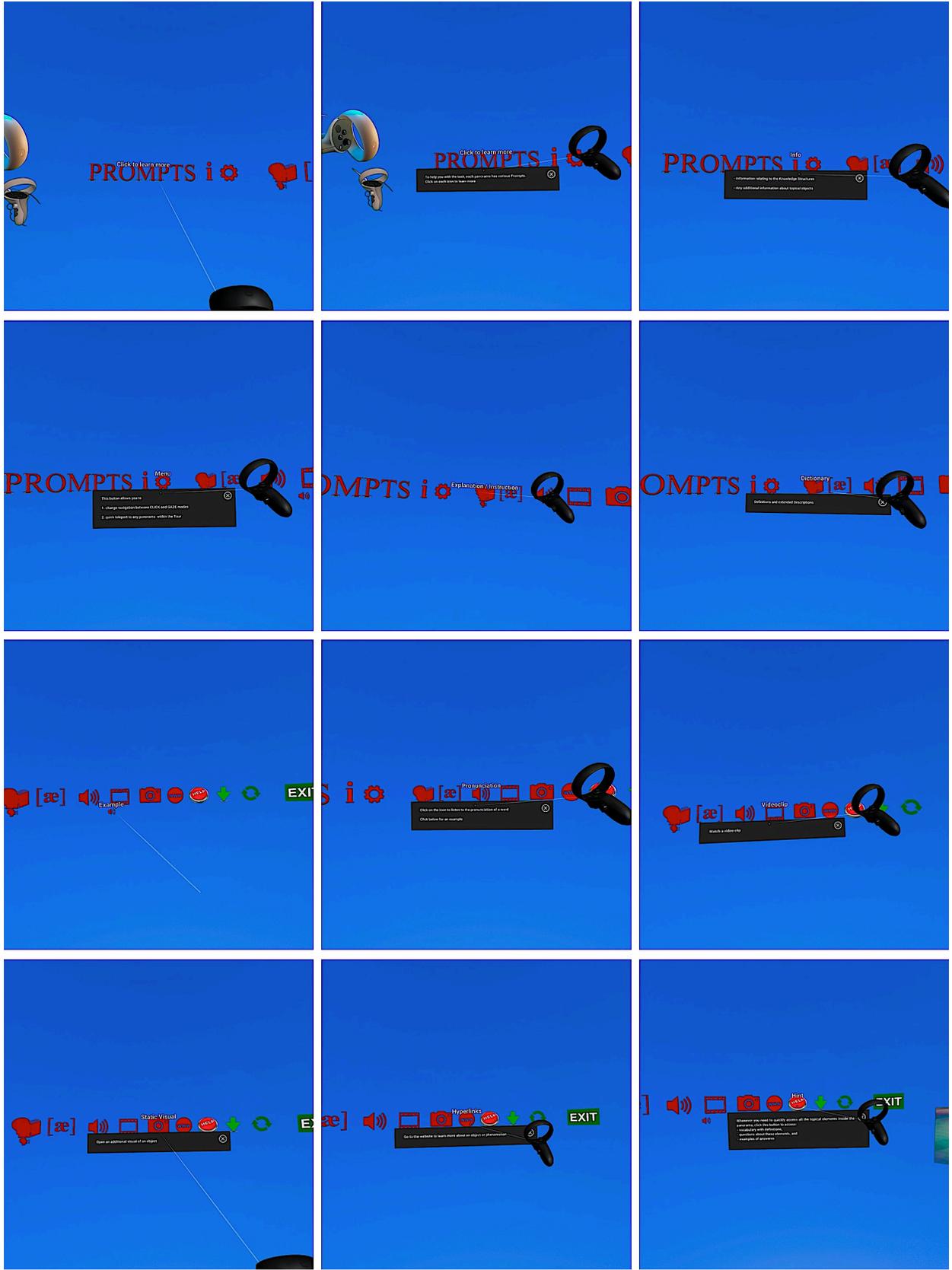
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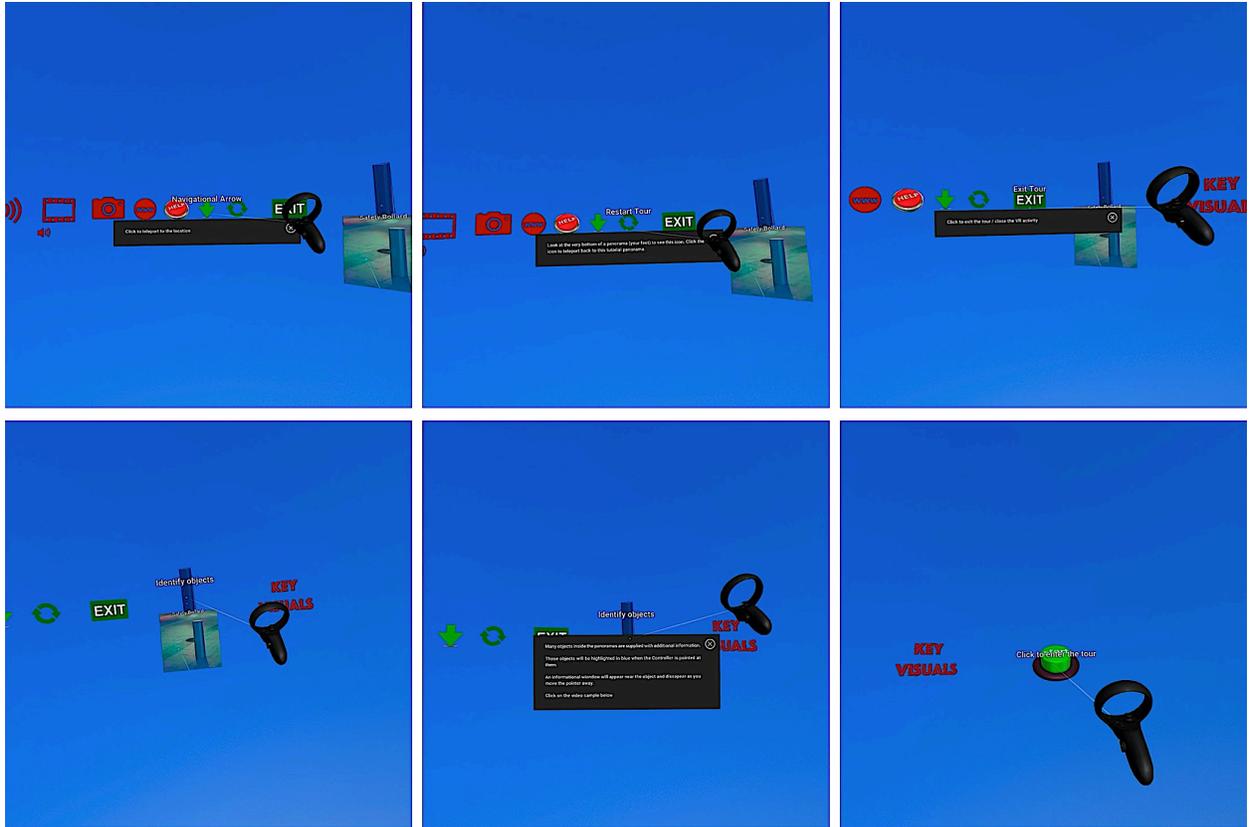
APPENDIX. SCREENSHOTS OF THE VR-EXPERIENCE¹³

1. Preliminary instruction on how to use the controller, navigate inside the panoramas, and use the prompts

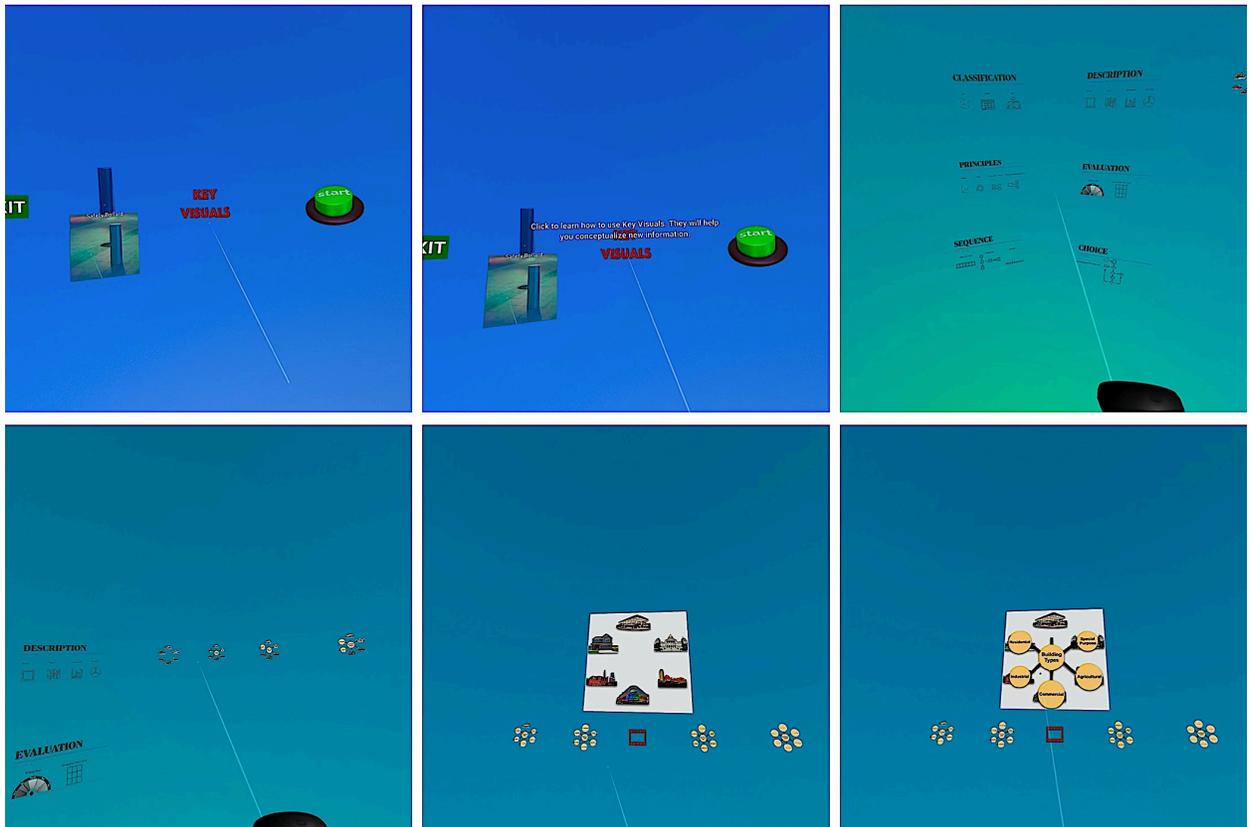


¹³See the visuals in full resolution at www.vrforenglish.com/wp-content/uploads/Appendix.pdf





2. Before proceeding with the task, the teacher initiates the students to how to use Key Visuals





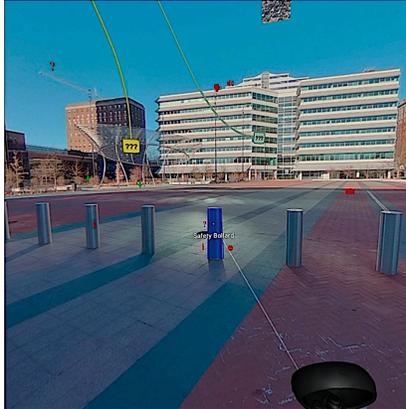
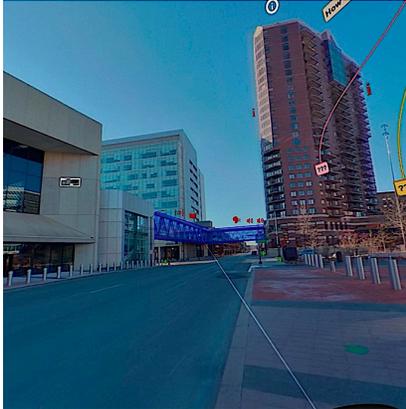
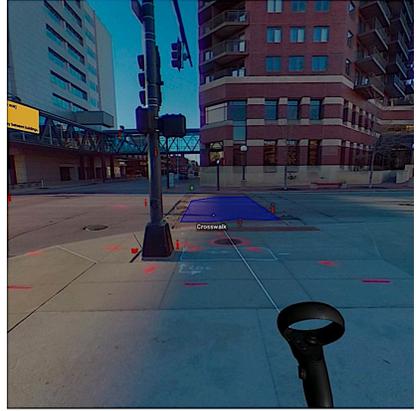
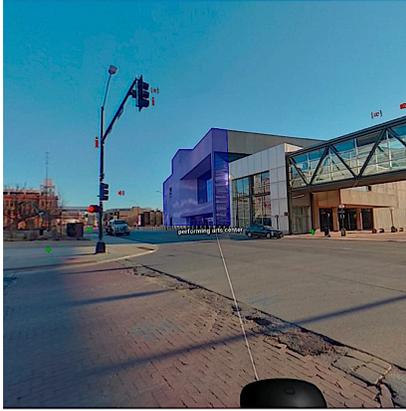
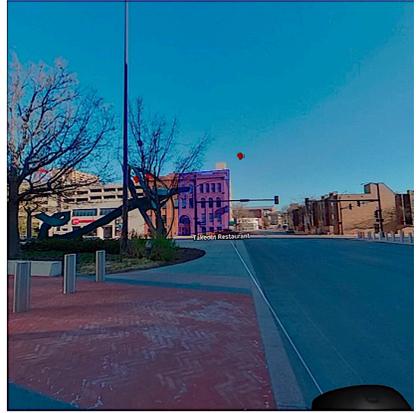
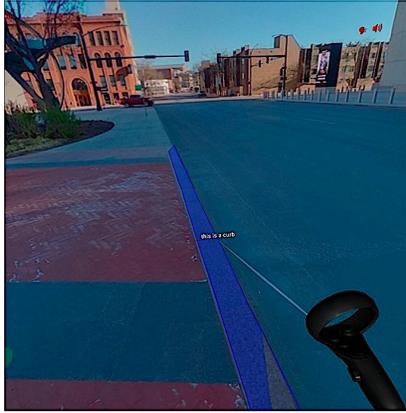
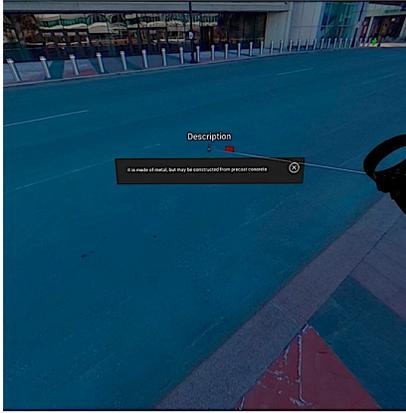
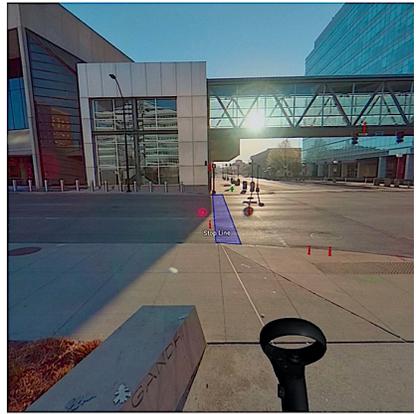
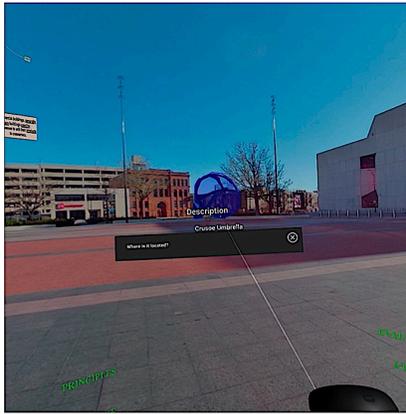
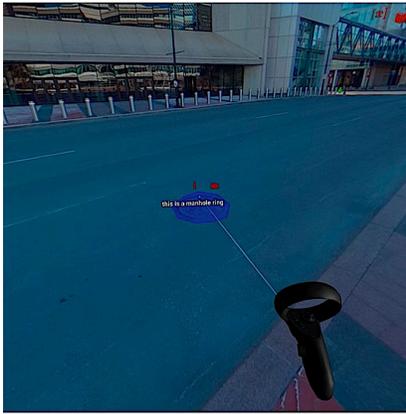
3. After familiarizing themselves with all 6 KSS, the class either starts the Activity or return to the main menu



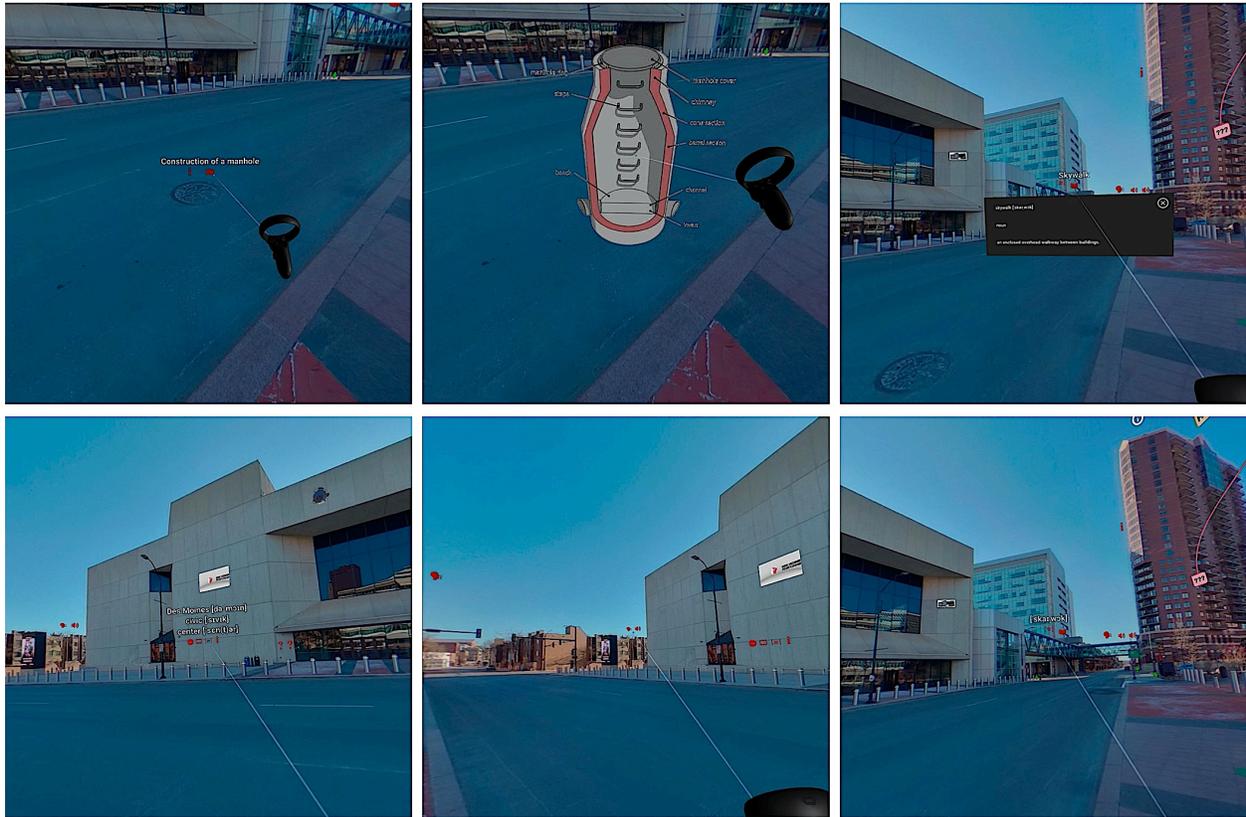
4. From any panorama, the students can return to the main menu by pressing the menu prompt at their feet



5. Many topical objects are highlighted as soon as the controller is pointed at them



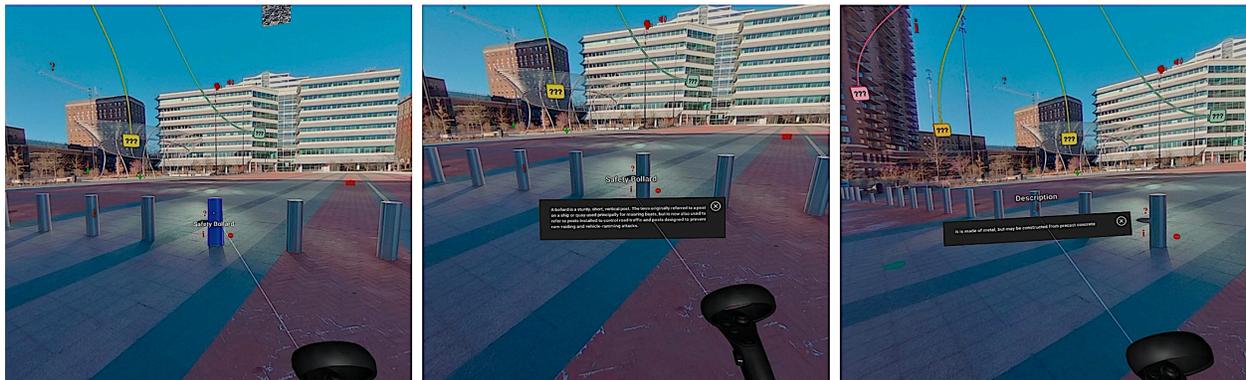
6. Prompts, when triggered, provide additional content (e.g., transcription, pronunciation, visuals)



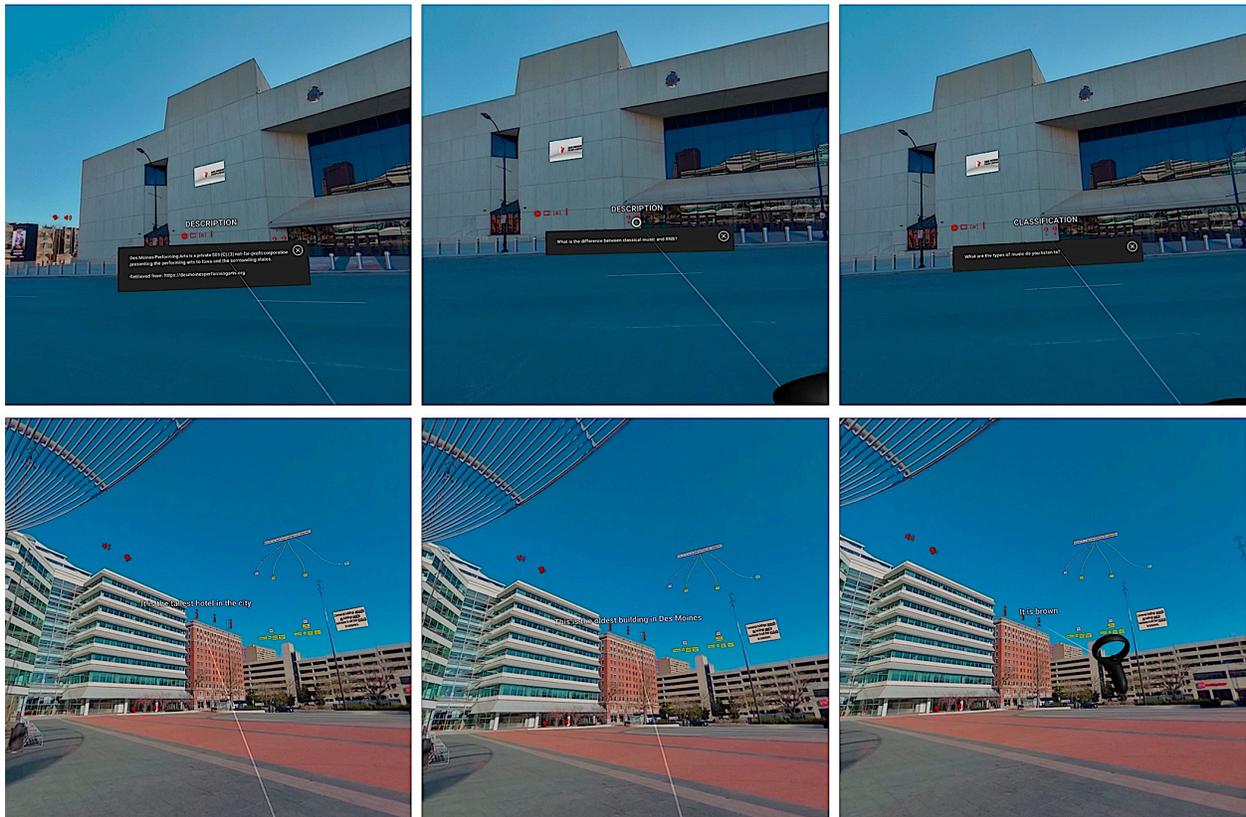
7. Navigational arrows help learners move about within the environment



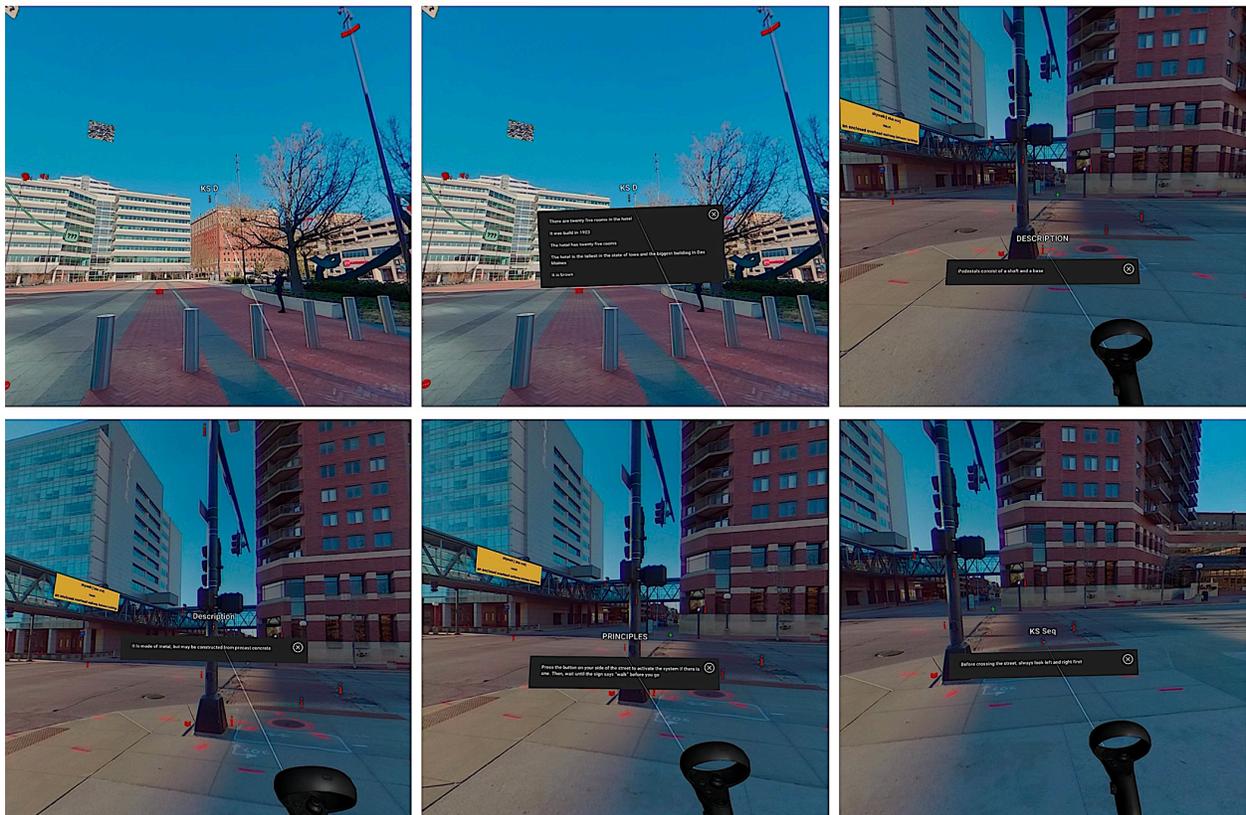
8. Topical objects are defined in various ways

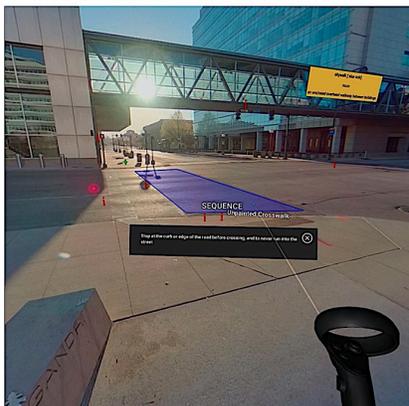
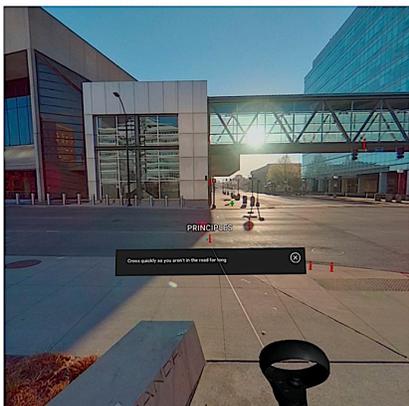
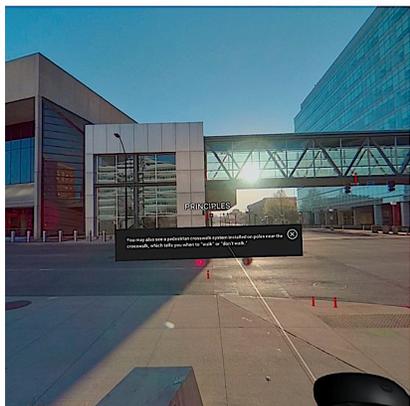
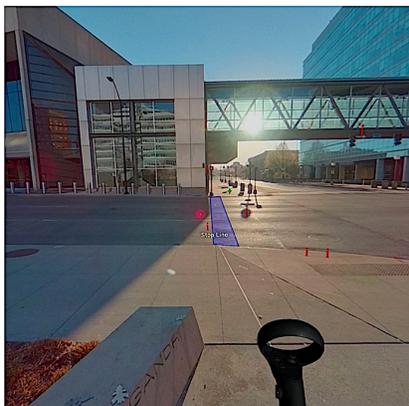
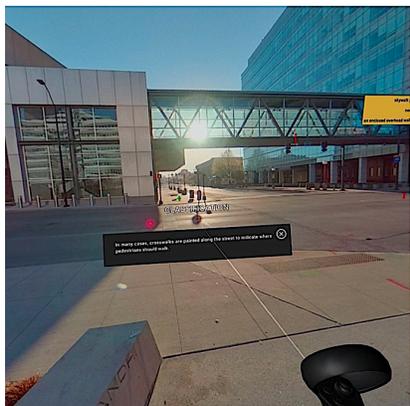
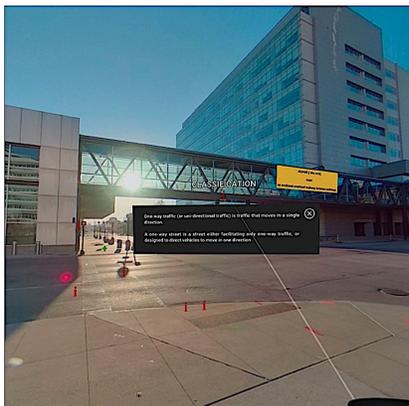
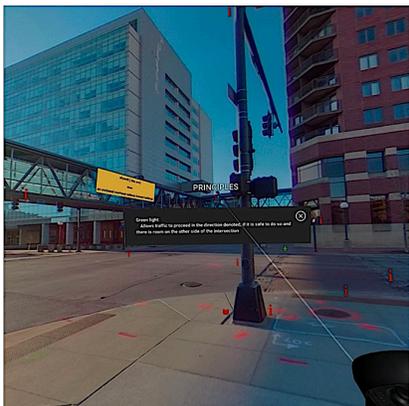
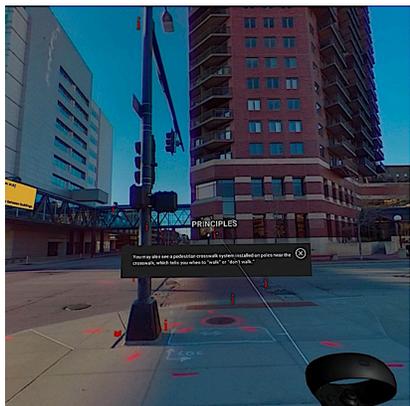
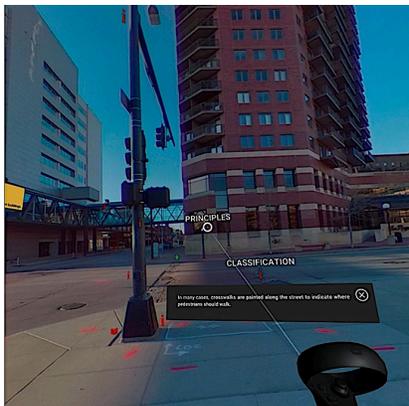
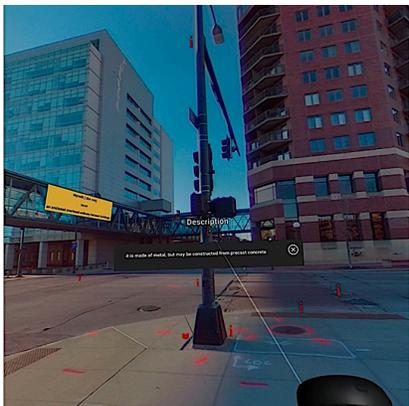
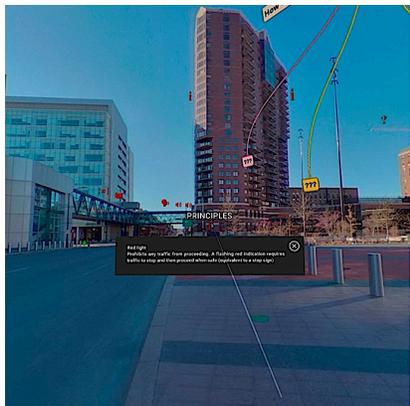


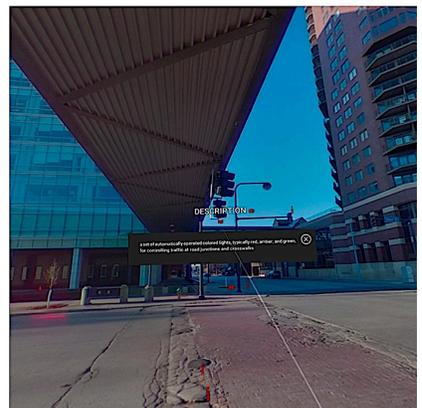
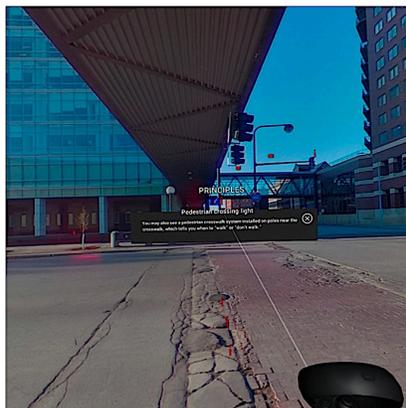
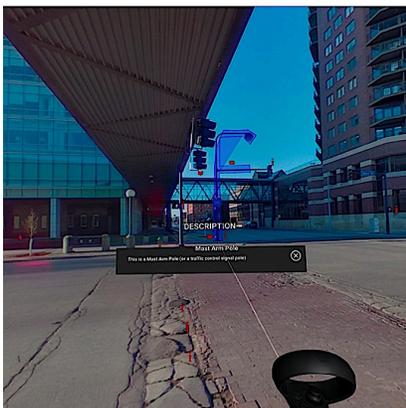
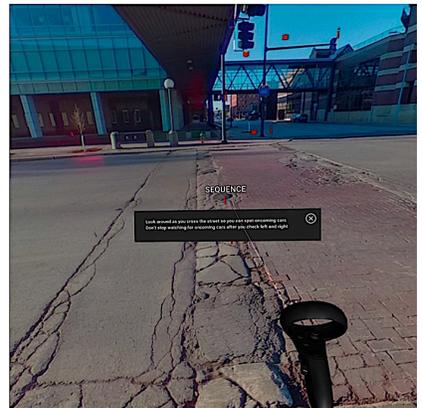
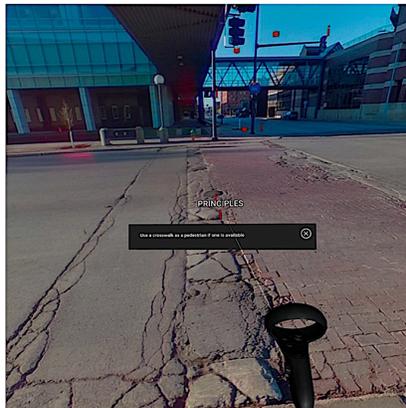
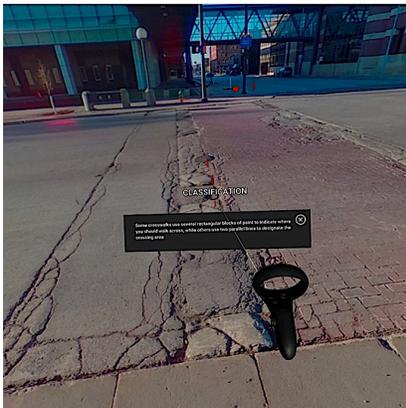
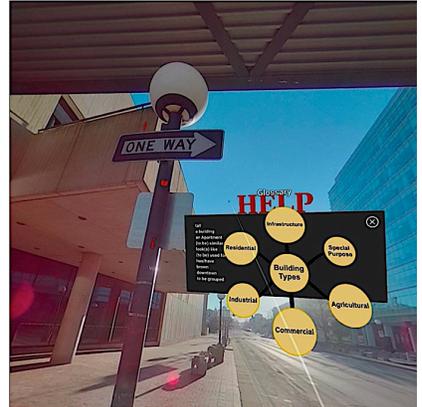
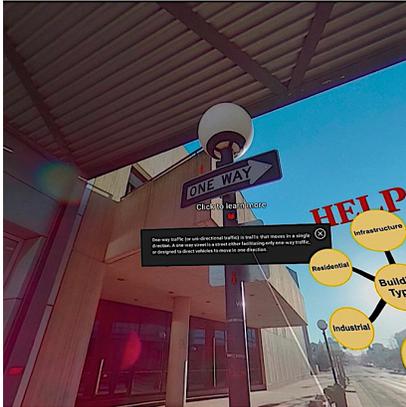
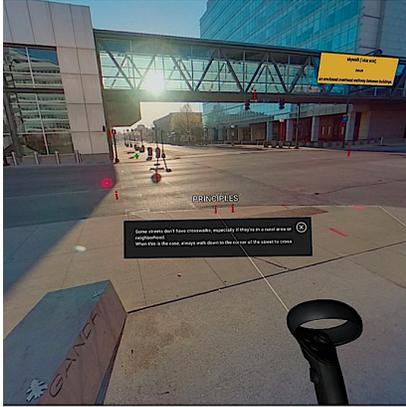
9. Explanations reveal the language (text, audio) and the KSs in a contextually relevant environment

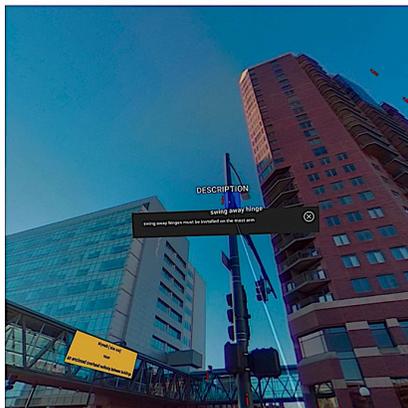
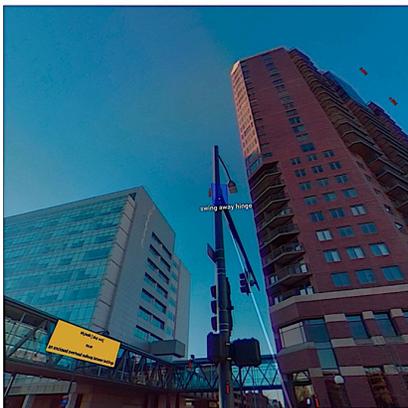
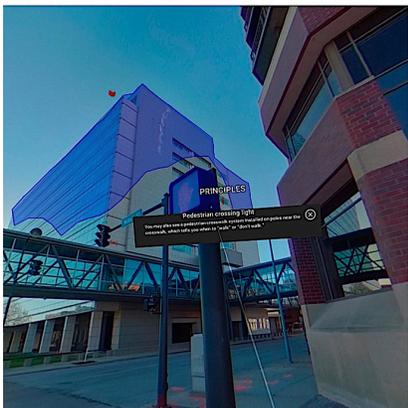
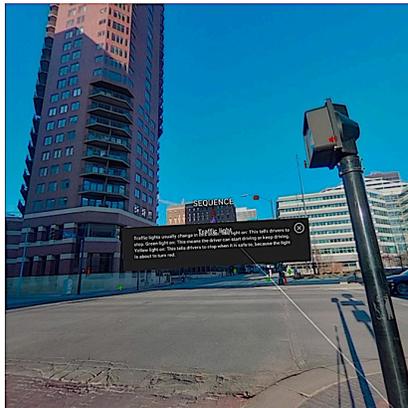
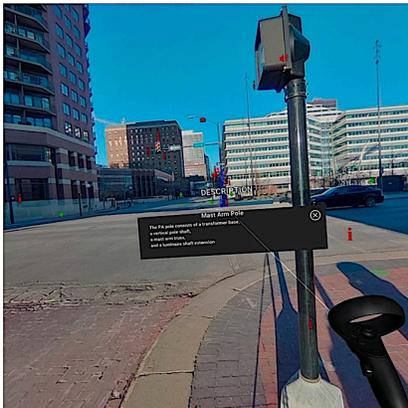
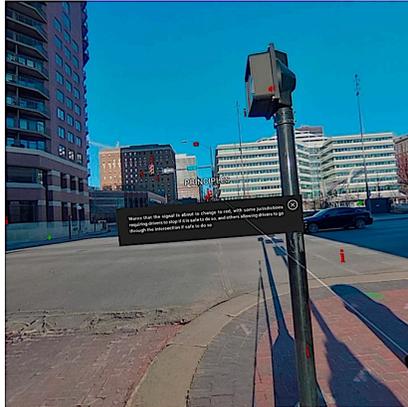
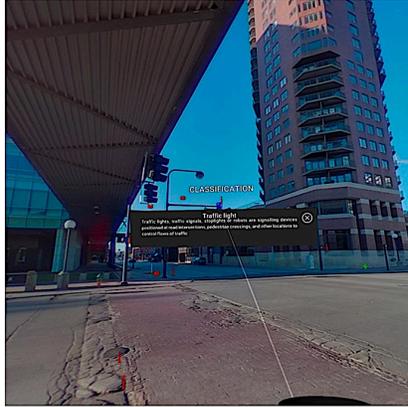
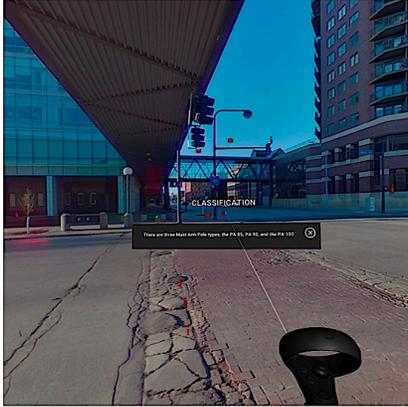


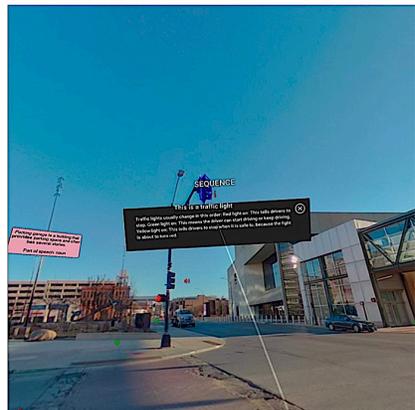
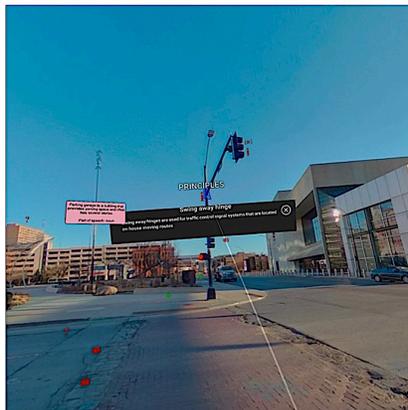
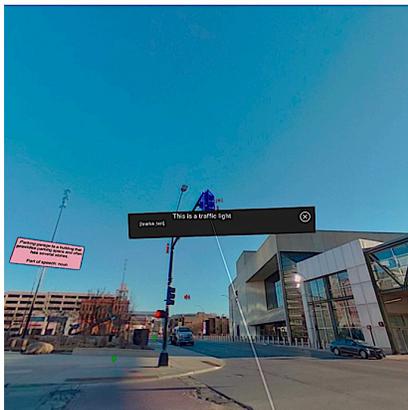
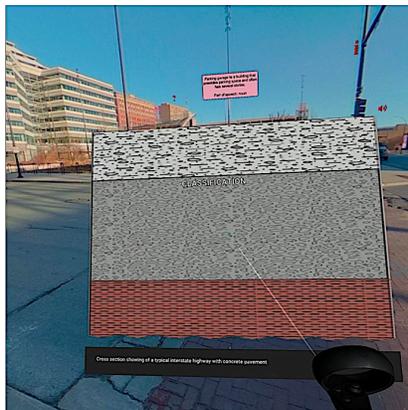
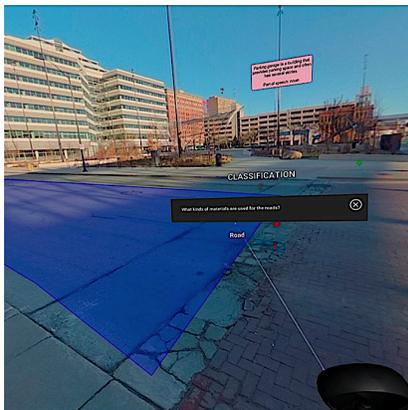
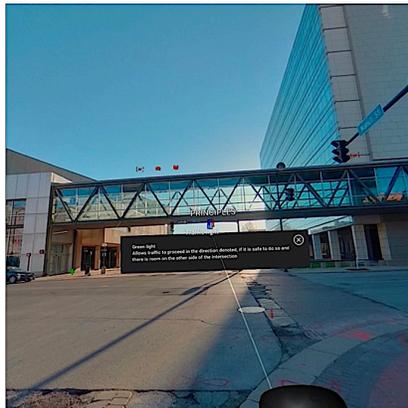
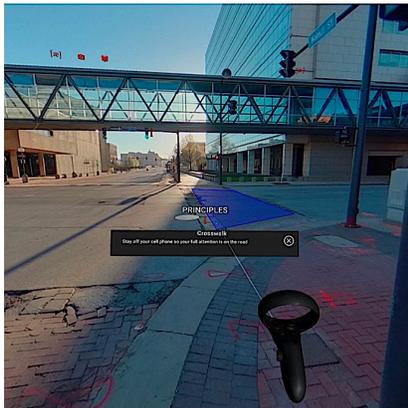
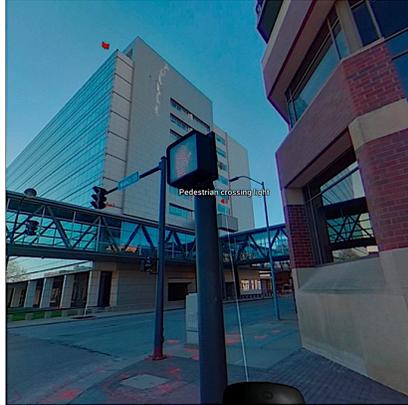
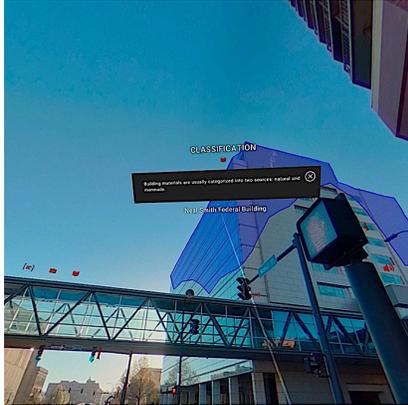
10. The KSs are marked; clicking on these prompts will invoke informational windows

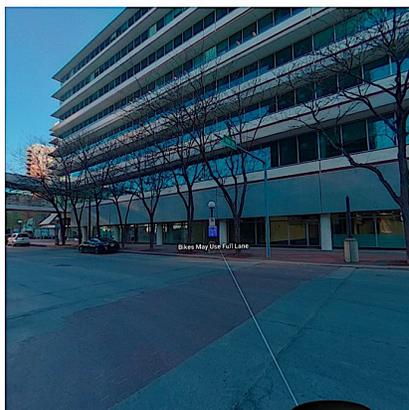
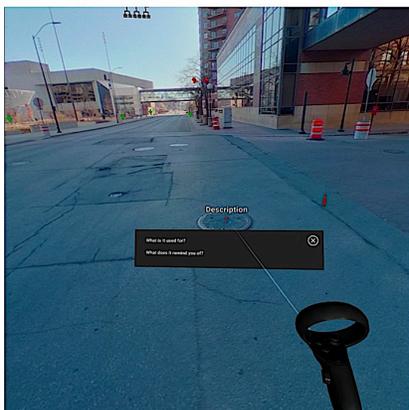
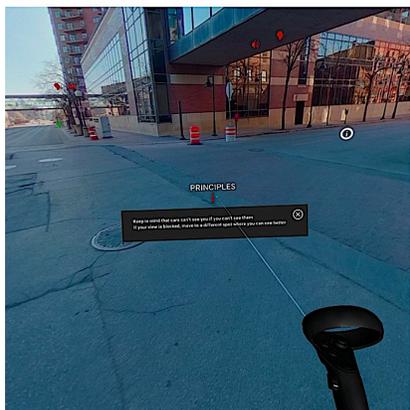
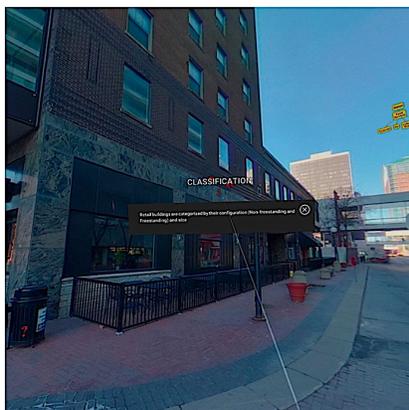
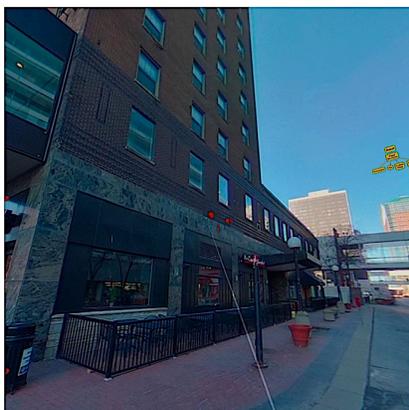
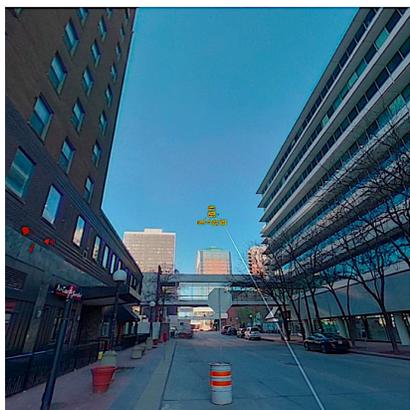
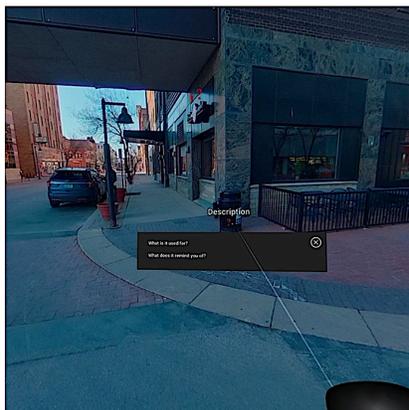
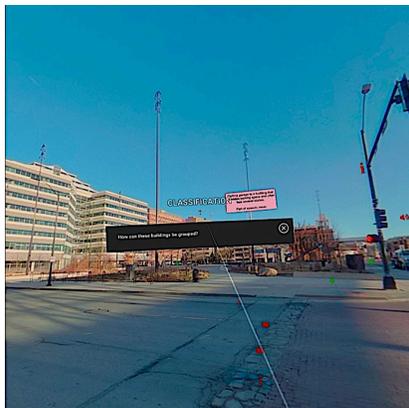
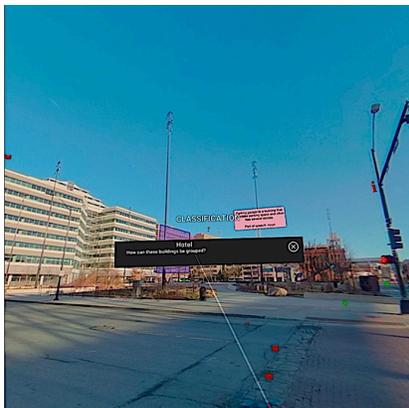
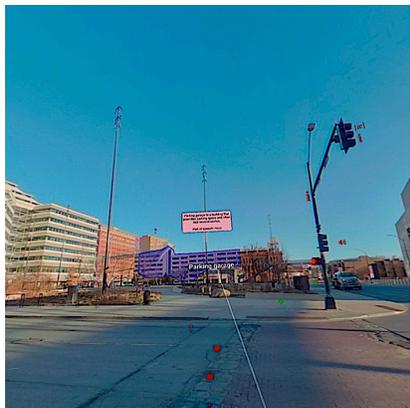


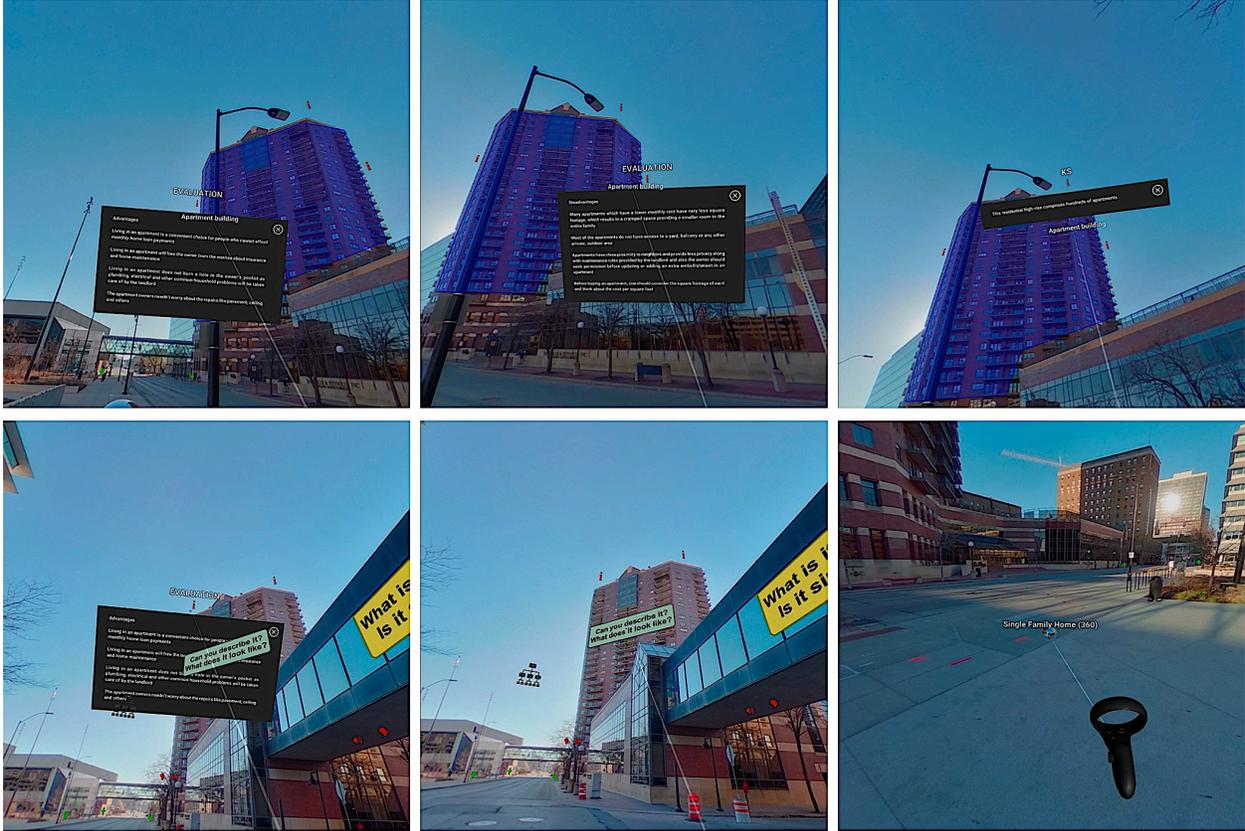






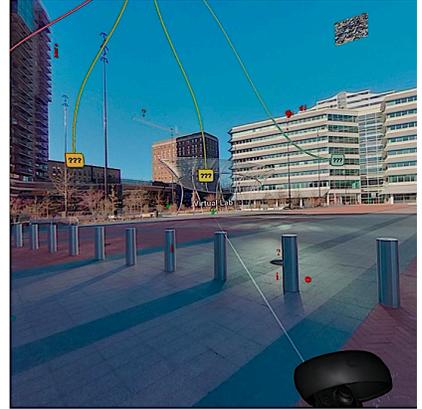






11. An apartment building is evaluated and compared against a single family home





12. The class meets in the Virtual Lab to discuss the findings and connect Practice KSS with Theory KSS

