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The theory, pedagogy, technology and design issue in Digital Language Learning (DLL)

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Peer Commentaries

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Introduction

The goal of the authors' article is to provide a theoretical synthesis and analytical framework with respect to Digital Language Learning (DLL)'s current promises, theoretical and pedagogical implications, and future directions (Li & Lan, 2021). I like the authors use Digital Language Learning (DLL) as a top-level class to include all types of language learning systems/tools supported by any existing, emerging or future digital technologies. The authors anchor the highly interdisciplinary nature of DLL to discuss how existing and emerging technologies would impact the design and development of digital language learning applications from four different metrics including cognitive, social, affective and neural dimensions. The inclusion of the neural dimension is the highlight of this article. I fully agree with the claim made by the authors that we need to understand how human brain works from an integrated network perspective which include the linguistic system, memory system, emotional system, and theory of mind all working together to better facilitate L2 learning and bilingual representation. The article then adopted the four dimensions of cognitive, social, affective, and neural as an analytical framework to explore the technological and theoretical perspectives of DLL from psychology, education, linguistics, and neuroscience perspectives.

According to the paradigm shift from teacher-centered approaches to student-centered learning for language learning in the past decades, the authors predict that DLL in the third decade of the 21st century will further focus on new technological driven innovations. Three specific DLL applications were chosen by the authors to provide in-depth analysis about the different technologies used and design issues. These three DLL applications are Mobile-Assisted Language Learning (MALL), Virtual Reality (VR) and Game-based Language Learning. The authors also emphasize the ultimate goal of DLL is to provide personalized learning by applying big data, machine learning and AI techniques.

In addition to the high-level summarization of the article as described above. I am trying to add some additional values to the article by providing (1) a summary table of the theory, pedagogy and strategy used in DLL with respect to the four dimensions. (2) A consolidated list of the technology used and design issue with respect to different DLL applications. And (3) a brief review of Robot-Assisted Language Learning (RALL) to make the descriptions of technology-supported DLL applications more complete for the article.

The theories related to the four dimensions of DLL

As stated by the authors that the goal of their article is to provide a theoretical synthesis and analytical framework with respect to DLL's current promises, theoretical and pedagogical implications, and future directions. The authors have done a great job in describing the theoretical and pedagogical implications within each of the main components in Section 3 and Section 4. I think it would be a good idea to compile a table by summarizing the theory, pedagogy and strategy used in DLL with respect to the four dimensions discussed in Section 4. A reader could refer to Table 1 to get an overall picture.

Regarding the four dimensions which the authors adopted as a framework to analyze the important features and affordances of digital technologies in relation to the effectiveness of digital language learning and student performance in general, I particularly want to emphasize the importance of the neural dimension. Traditionally, assessment of performance in education usually only taking account of the three measures which are cognitive, social and affective dimensions. One of the reasons which the authors have already described in the article is that learning a new language through innovative technologies may also trigger positive changes in the learner's brain structure and function, however, researchers and educators' knowledge and understanding in this regard are still very limited. Another reason is the more we know about how the human brain works in terms of language learning and knowledge acquisition, the more we could leverage the power of AI to boost human capacity and potential. Understanding the brain's structure and function is the key to build the interface for the

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Table 1. The theory, pedagogy, and strategy used in DLL with respect to the four dimensions

Dimension	Theory/Pedagogy/Strategy
Cognitive dimension	embodied cognition, working memory capacity, encoding-specificity principle, multimedia learning theory, multimodality theory, multiple representation, memory retention and recall
Social dimension	sociocultural theory, active social learning, input and interaction hypotheses, Interactivity, agency, learner autonomy, student-centered learning
Affective dimension	motivation theory, sustained attention, contingent response, reciprocal interaction, social-affective cue, facial expression effect, learner characteristics
Neural dimension	multisensory information, attentional control, emotional and reward processing, embodied semantic representation, sensorimotor integration hypothesis, procedural-declarative model, procedure learning, declarative learning, theory of mind

Table 2. The technology used and design issues with respect to different DLL applications

Types of DLL	Technique/Technology used	Design Issues
MALL	real-life exploration, situated learning, immersive learning, adaptive learning mechanism, IoT sensor, QR-code, NFC tag, automatic speech recognition	small screen size, limited wireless bandwidth, short attention, easy distraction, learner preference
VR	immersive/non-immersive VR, simulated immersion, contextual learning, role playing, head-mounted displays (HMD), manipulating virtual object	small sample size, lost orientation, dizzy, generalizability, age consideration
GBLL	gamification, serious game, game reward, feedback, badge, autonomy, social interaction	balance between gaming and learning, virtuality versus reality, game dynamics
Personalized learning	learner profile, personal characteristics, intelligent tutoring system, machine learning, automatic speech recognition, educational big-data, learning analytics, behavior analysis	interplay of personalized learning design with interaction among cognitive, social, affective and neural dimensions
RALL	social learning, contextualized learning, authentic learning, situated learning, embodied cognition, AI, machine learning, chatbot, tangible object and IoT sensor	the valley of fear, task technology fit, voice interference, novelty effect, over facilitation, cognitive overload, privacy concern

brain to directly communicating with AI intelligence. Readers who are interested in exploring more detailed information could refer to the Neural Link website at https://neuralink.com/.

The technology used and design issues need to be considered in the development of DLL

To provide readers a more synthesized view of the technology used and design issues with respect to different DLL applications, a summary table is presented in Table 2. I believe it is a good idea to also add personalized learning as the fourth application to echo the importance of the end goal of all DLL applications. I have also added Robot-Assisted Language Learning (RALL) as the fifth application to reflect the emerging trend of RALL research and development in recent years. It could also contribute to the completeness of the original article written by the authors.

RALL: Robot-Assisted Language Learning

From a review of RALL studies published in the literature (Tlili, Lin, Chen, Huang & Kinshuk, 2020), it was found that a total of 24 language teaching methods being adopted by RALL. The Communicate Language Teaching (CLT) has the highest adoption ratio among the 24 methods, the second one is Teaching Proficiency through Reading and Storytelling (TPRS) and then the Total Physical Response (TPR) and the Audiolingual Method (ALM). One thing should be noted is that improving leaners' listening and speaking skills are the major goal while writing skill seems to be the least consideration when adopting robot for language learning (Cheng, Sun & Chen, 2018). I believe this is due to the profound advantages which a social robot can offer in language conversion and interaction through exercising listening and speaking skills.

Regarding the roles a robot can play, there are four different roles found in the literature including learning companion, learning peer, teacher/tutor, or teaching assistant. The most common role is learning companion and the least one is learning peer which is a promising research topic to be explored in the RALL research field. To leverage the abundant digital learning materials which are already available on the Internet, it is recommended that an educational robot can use a Tablet as a teaching aid to show relevant digital contents to learners just like a human teacher teaching in a traditional classroom using a Tablet to share information to the projected screen or to all students with their own Tablets.

Last but not the least is how to apply multimodality theory (Cheng, Wang, Yang, Yang & Chen, 2020) in designing meaningful learning activities in RALL. Instructional designers should pay attention to the Task-Technology FIT issue for better matching different technologies to present different modes of learning contents. This echoes the authors' statement described in the conclusion that significant work remains to be done to understand the mechanisms under which DLL might simulate language learning

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