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Leveraging Ubiquitous Technology for Seamless Language Learning: From "Move, Idioms!" to MyCLOUD

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ABSTRACT

Paralleling to the paradigm shift in language learning theories from behaviorism to a communicative and authentic learning approach, the focus of Mobile-Assisted Language Learning (MALL) is swinging to design-oriented authentic or social mobile learning activities. In a related note, the ready-to-hand access of mobile devices creates the potential for facilitating 'seamless learning spaces', marked by continuity of the learning experience across different contexts. In this paper, we propose perspectives and approaches to address the need of establishing seamless language learning (SLL) practice. Building on existing research work on MALL, the emerging approach highlights a theory-rooted socio-techno-pedagogical framework to address the challenges of the young language learners. We will describe how the notion of SLL informs a research study entitled MyCLOUD (My Chinese Language ubiquitOUs learning Days). The proposed framework could contribute to current research by exploring ways in closing the loops in both the seamless learning and language learning perspectives through enacting the on-going learning process mediated by the ubiquitous technology.

Author Keywords

Mobile-assisted language learning (MALL), seamless learning, vocabulary learning, socio-techno-pedagogical framework, design for scalability

INTRODUCTION

Learners from the Generation-Y live in a world where there is constant interplay between the physical and digital realms, and the use of technologies such as blogging, social networking and digital content remixing are integrated into their lifestyles (Looi, et al., 2010). The proliferation of Web 2.0 supported by cloud computing technologies has prompted researchers and educators to look into ways to leverage learners' enthusiasms in the use of technologies to extend their learning beyond the four walls of the classroom. Furthermore, the ready-to-hand access of mobile devices, which could function as a personal 'learning hub' (Looi, et al., 2009), creates the potential for a new wave of evolution of technology-enhanced learning (TEL) that is characterized by 'seamless learning spaces' (Chan, et al., 2006; Wong & Looi, 2011; Wong, in-press). Such spaces are marked by continuity of the learning

experience across different environments. Individual learner who has 24x7 ubiquitous access to *at least* one mobile device (1:1) would have plenty opportunities to traverse the formal and informal contexts, physical world and cyberspace, as well as personal and social learning spaces.

In a related note, paralleling to the paradigm shift in language learning theories from behaviorism to a communicative and authentic learning approach, the focus of Mobile-Assisted Language Learning (MALL) is swinging from content-based delivery of relatively static learning content through mobile devices to design-oriented authentic or social mobile learning activities (Kukulska-Hulme & Shield, 2007). Such a trend can make MALL a viable solution to blending learners' language learning environment into their daily life (Wong & Looi, 2010).

In this paper, we propose perspectives and approaches to address the need of establishing *seamless language learning* (SLL) practice. The proposed approach is grounded in the theories pertaining to language learning and TEL. Building on existing research work on MALL, the emerging approach highlight a socio-techno-pedagogical framework to address the challenges of Singapore ethnic Chinese children's (who tend to be more well-versed in English) learning of Chinese as second language (L2). We will describe how the notion of SLL informs a prospective research study entitled MyCLOUD (My Chinese Language ubiquitOUs learning Days). The proposed framework could contribute to current research by exploring ways in closing the loops in both the seamless learning perspective and the language learning perspective through the on-going learning process mediated by the ubiquitous technology. Matching the affordances of ubiquitous technology to these perspectives would enhance the development of 21st century knowledge and skills and nurture holistic language competencies among learners.

THE RATIONALE OF SEAMLESS LANGUAGE LEARNING

One of the critical problems in traditional L2 classroom practices is the excessive amount of decontextualized information, indirect and abstract language knowledge, and 'secondhand' experiences confined in classroom context (e.g., Jiang, 2000). Therefore, language learning theorists have been advocating the integration of formal and informal language learning (e.g., Titone, 1969). The integration implies greater learner autonomy in language learning, which is again a notable trend in both modern language learning research and practice.

Personalized mobile devices can become a learner's 'learning hub' that facilitates and supports learner involvement, learner reflection and target language use across different learning spaces. Such 1:1 TEL model has great potential in facilitating a significant reform in language learning. Nevertheless, the potential has yet to be thoroughly explored or exploited by MALL researchers. Almost all the MALL studies to date have been heavily focusing on either formal learning (Wong, Boticki, Sun, & Looi, 2011; Zurita & Nussbaum, 2004) or informal learning (Fallahkhair, Pemberton, & Griffith, 2007; Song & Fox, 2008). The integration of both seems rare.

We envisage an ongoing SLL model to address the research gap. With proper learning design, the mobile and ubiquitous technologies could facilitate the transformation of classroom learning activities into a more personalized and social learning process. Learners engaged in such a learning experience need to process and associate their experiences or the situated information received (informal contexts) with the knowledge that they have acquired or constructed in the classroom, and apply the knowledge in daily life. In the context of language learning, it is to apply their language knowledge for communication, articulation of thoughts, or production of linguistic artifacts such as essays, tweets on social networks or

blog entries. Eventually, it is desirable to feed the learners' situated learning gains back to the formal class for generalization, thus completing a seamless learning cycle.

THE FOCUS ON VOCABULARY LEARNING – THE STUDY OF "MOVE, IDIOMS!"

Vocabulary acquisition has a central role in learning a L2 (Sokmen, 1997). One important claim is that a good knowledge of how the system of language works (grammar), may not necessarily enable one to communicate; however, it is usually possible to communicate if one has sufficient vocabulary (Wallace, 1988). Ellis (2002) posits that early L2 learning should be focused on vocabulary, and that grammatical instruction comes after learners are able to engage in message-focused tasks using whatever language they have regardless of grammatical correctness.

However, Schmitt (2008) observes that many L2 teachers (as well as many vocabulary-focused MALL studies, e.g., Chen & Chung, 2007; Levy & Kennedy, 2005) have been emphasizing rote learning of large quantity of vocabularies, and consider a word 'learnt' if the form and meaning are known. Contrarily, Nation (2001) highlights the necessity of the inclusion of contextualized components of vocabulary knowledge, such as grammatical functions, collocations and constraints on use. Therefore, while the form-meaning link is crucial for vocabulary acquisition, learners ought to advance to contextualized exposures (listening and reading) and productive use (speaking and writing) of vocabulary, perhaps in authentic situations, which is what another smaller set of MALL studies had investigated (e.g., Fallahkhair, et al., 2007; Ogata, et al., 2008). Nevertheless, to close the loop, the learners need to proceed for decontextualization (generalization) of vocabulary knowledge (Schmitt, 2008) through personal reflections or social meaning negotiation. Hence, a seamless cycle of language learning should involve both contextualized understanding and contextualized use of the vocabulary, supported with the effort to generalize the word meanings, perhaps across both formal and informal settings. The mobile and Web 2.0 technologies offer many affordances to support the cycle of learning.

We conducted an intervention study on SLL entitled "Move, Idioms!" from February to November 2010. In learning Chinese idioms and conjunctions (two special forms of vocabulary), students were provided with smart-phones on a 1:1, 24x7 basis. They were encouraged to make sense of what they learn in class by capturing photos of the real-life contexts pertaining to the idioms/conjunctions, and to construct sentences with them. Subsequently, in-class or online (wiki) sharing and discussions on the contexts took place to enhance the students' understanding of the proper usage of the vocabulary. The multiple sentences constructed by the students then form a basis for the inductive reasoning that allowed students to construct generalizable meanings of the vocabulary. We co-constructed a cyclic learning process for "Move, Idioms!" with the teachers involved to guide the on-going learning experience design and refinement (see Figure 1).

The processes of the four activities are described below:

Activity 1 – In-class or on-campus contextual vocabulary learning (formal setting; physical and social learning space): The activity is aimed for motivating and preparing students to engage in subsequent after-school activities. During each lesson, multimedia presentations of a few vocabularies are shown in the class to assist the students in establishing the initial form-meaning link. The teacher then conducts contextualized collaborative learning activities such as facilitating student groups to take photos and make sentences on campus to illustrate the idioms/conjunctions.

Activity 2 – Out-of-class, contextual, independent sentence making (informal setting; physical, individual and productive learning space): Students carry their smart-phones 24x7. They identify or

discover contexts in their daily life that are associated with the idioms/conjunctions. They then take photos, make sentences by using the vocabulary as photo captions, and post them onto a class wiki. In the wiki, we create one page for each vocabulary for students to post their work. This allows comparison of student-identified contexts and their sentences pertaining to the same vocabulary.

Activity 3 – Out-of-class, online peer learning (informal setting; cyber- and social learning space): Students learn from and perform peer reviews on the wiki by commenting on (with the wiki comment tool), correcting or improving their peers' sentences (by modifying the sentences posted on the wiki pages). They may use PC's or laptops in school or at home to access to the wiki space.

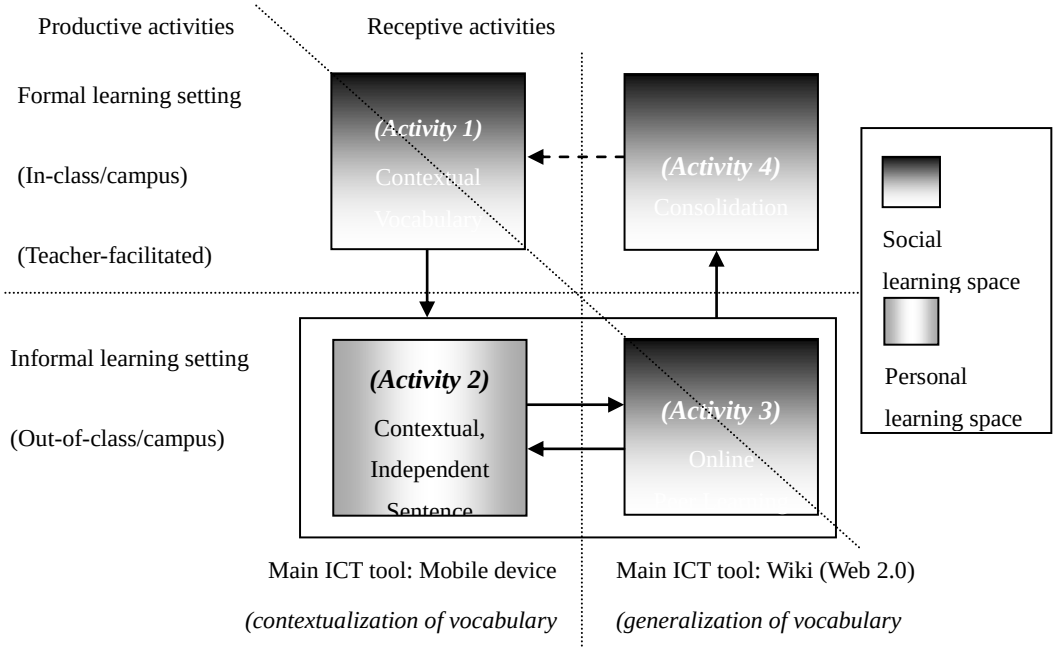

Figure 1. The mobile-assisted idiom learning process.

Activity 4 – In-class consolidation (formal setting; social and receptive learning space): The teacher facilitates class-wide or small group discussions on selected sentences made by the students on debatable contextual use of specific idioms/conjunctions.

We conducted a nine-month intervention study in 2010 with 34 Chinese Singaporean students with diverse proficiencies of the Chinese Language from a Primary 5 (11-year-old) class. Each of them was assigned a Samsung Omnia II smartphone running MS Windows Mobile™ 6.5 and with functions such as built-in digital camera, Wi-Fi access, Internet browser and English/Chinese text input.Furthermore, we used xwiki (www.xwiki.org) to create the wiki space for photo/sentence sharing and peer reviews. The teacher conducted numerous cycles of "Move, Idioms!" learning process.

The study yielded promising results. Due to the space constraint, we will only provide summarised findings in subsequent text. More details are given in Wong, Chin, Tan & Liu (2010) and Wong, Chen & Jan (in-press).

During the study, the students contributed a total of 920 photo/sentence sets. We found the students' photo/sentence production and commentary activities analogous to photo-blogging in general sense and

yet strongly linking to the SLL process facilitated by the teacher. We categorized the student artifacts and their self-reported creation processes into three dimensions, namely, 'types of physical setting', 'types of meaning making', and 'types of cognitive process in artifact creation'. With that, we observed a similar pattern, across most of the students, of language improvement and their more eager interactions with the physical environment in their daily life. This can be attributed to the process of personal meaning making. Table 1 depicts the categorizations of the student artifacts with an example given under each category. The original idioms are underlined in the students' Chinese sentences. To benefit international readers, we translated the sentences into English with the translations of the idioms underlined.

In addition, the students' online and in-class peer reviews have further enhanced both their understandings in individual idioms/conjunctions and their socio-cognitive skills. Through the student interviews, we have also found out that the learning activities have stimulated more family member interactions and intergenerational/sibling learning– some students worked with their family members to create the digital artifacts, such as brainstorming for photo ideas, or enlisting family members as photo models. All these are indicators of social meaning making.

FROM "MOVE, IDIOMS!" TO MYCLOUD – TOWARDS A SCALABLE SLL ENVIRONMENT

Despite the encouraging outcomes, there are challenges in terms of the scalability and sustainability of the project. The learning design may be seen as an add-on in relation to the formal Chinese Language curriculum, i.e., it is nice-to-have but too resource-consuming to implement in an on-going basis. Furthermore, in terms of language learning, idioms and conjunctions constitute a limited and highly context-specific aspect of language learning. A good contextual knowledge of the relatively small set of idioms (48 idioms were covered in the study) may enrich the students' oral and written expressions. However, the effects on the students' overall language proficiency are restricted.

Studies in psycholinguistics may shed light on the limitation of "Move, Idioms!" (and almost all other prior MALL studies) in this aspect. Psycholinguists believe that an individual stores vocabulary of a language in the form of mental lexicon. However, the mental lexicon differs radically from a dictionary as it does not store lexical items in an alphabetical order (Müller, 2008).

Types of physical settings *(photo context)*			
Natural setting	Object manipulation	Human enacted scenario	Previously published materials (e.g., Internet images, book illustrations; TV snapshots)
			
同学们三五成群的坐着听老师讲体育课的游戏规则。 The students are sitting in groups of three and four and listening to the briefing of the game rules	成群结队的动物们正在无忧无虑的吃草。 The animals come in droves and eat the grass in a carefree manner.	他们争先恐后地挤出门。 They are racing out the door.	看到这个情景，我们惊得目瞪口呆。 We are dumbstruck seeing this.

in the PE class.			
Types of meaning making *(relationship between photo and sentence contents)*			
Literal meaning making (The sentence is a direct description or interpretation of the photo context.)	Extended meaning making (The sentence is a logically deductive interpretation on the photo context.)	Creative meaning making (The sentence is a twisted, perhaps creative or metaphorical re-interpretation on the photo context.)	
 移民厅最近人山人海，因为学校假期要到了，很多人都忙着准备护照出国。 The immigration department is crowded as the school holiday is around the corner and many people are busy preparing (applying) passports to go abroad.	 我表弟非常喜欢海绵宝宝，因为它眉开眼笑时，很可爱。 My cousin is very fond of SpongeBob as he looks so cute when smiling ear to ear.	 大家都异口同声地认为牛奶含有钙致对我们的骨骼有帮助。 We all unanimously agree that milk contains calcium and is good for our bones.	
Types of cognitive process in artifact creation			
With an idiom/conjunction in mind → object finding/manipulation or scenario enactment → photo taking	Object/human/scenario encountering → associating with an idiom/conjunction (immediate retrieval) → photo taking	Object encountering/manipulation or scenario encountering/enactment →photo taking → associating with an idiom/conjunction (delayed retrieval)	
 香蕉也会眉开眼笑！哈哈哈！ Even banana grins ear to ear! Ha Ha Ha!	 这些表演者不能说话，只可以做指手画脚的动作。 The performers can't talk but can only gesticulate.	 游客们都千里迢迢来观赏新加坡的摩观景轮。他们一边观赏一望无际的美景，一边对新加坡的美景赞不绝口。 Tourists come from far off distances to visit Singapore Flyer. They were watching and raving about the vast stretch of beautiful scenery.	

Table 1. Categorizations and examples of student artifacts in "Move, Idioms!"

To understand how L2 mental lexicon is represented as a whole, it is important to make a distinction between episodic and semantic memory (Tulving, 1983). Episodic memory receives and stores information about episodes or events. Semantic memory, conversely, functions like a mental thesaurus. It organizes knowledge one possesses about verbal symbols, their meaning and referents, and the relations among them. In word recognition studies, a similar distinction has been made between the lexical system (mental lexicon), and the non-lexical, episodic system (Forster, 1985). Within the mental lexicon, words coexist in a semantic network. In general, there exist two general lexical relations in the lexicon: the syntagmatic (collocation) relation and the paradigmatic (hyponymy, hierarchies, antonymy and synonymy) relation (Aitchison, 2003). The mental lexicon of a person is dynamic – new words acquired should be integrated to the network, which is analogous to the constructivist view of linking prior and new knowledge. If a learner encounters or rote-learns a word without a deep understanding of both its meaning and contextual usage, it may become a word in the episodic system (Jiang, 2000). In turn, we argue that a truly holistic L2 vocabulary learning process should involve the interplay of contextualized learning of individual L2 words and the construction of personal L2 mental lexicon. There had been studies in language instructions where a variety of mental lexicon-related approaches were developed, such as semantic mapping, word associations, finding substitutes, etc. (Sokmen, 1997), but other researchers argued the inadequacy of such strategies for skipping the contextualization stage (e.g., Gu & Johnson, 1996).

To address the limitations of the "Move idiom" project and to combat Singapore students' problems in Chinese Language learning (Wong, Chai & Gao, 2011; Wong, Chen, Chai, Chin & Gao, in-press), we explore a new vocabulary learning model, namely, MyCLOUD, by mobilizing the formal Chinese Language curriculum across three levels (Primary 3 to 5, or 3rd-5th grade). MyCLOUD supports cross-context seamless learning process (arose from "Move, Idioms!") and other practices informed by language acquisition theories (e.g., mental lexicon). Through the "Move, Idioms!" study, we gained a good understanding in how to facilitate SLL experiences and what is the potential of such a learning model. Our next move is to build on this learning model to address the research gap in interventions that are genuinely informed by language learning theories, an aspect that is often ignored by prior MALL studies (Wong & Looi, 2010).

MYCLOUD – THE RESEARCH PROCESS AND PLATFORM DEVELOPMENT

In the MyCLOUD project, we intend to iteratively design, implement, evaluate and refine a ubiquitous seamless learning environment for Chinese learning that is both integrated into the formal lessons and promoting students' autonomous informal learning. As the national curriculum of Chinese Language embroils a series of textbook passages associated with various learning goals, including vocabulary learning, the vocabulary-focused learning process of MyCLOUD will take the lexical items of the passages as the starting point of each learning cycle (refer to Figure 1). However, instead of prescribing a learning model developed solely by us, we will facilitate dialogues between research and practice by proposing a high-level socio-techno-pedagogical design framework. A researcher-teacher taskforce will co-design and refine the concrete pedagogy in on-going basis, where teachers' practical experiences will be respected. We adopt this approach to ease the settling of the learning model into the school ecology (see: Wong, Gao, Chai, & Chin, 2011).

As depicted in Figure 2, our proposed high-level design framework synthesizes two theoretical perspectives, namely, the language learning perspective and the seamless learning perspective. To incorporate the language learning perspective, we examine how relevant linguistic and language learning

theories such as mental lexicon, contextualized learning, incidental vocabulary learning, inductive learning, productive learning, etc., can be integrated into the learning design. We consider how vocabulary learning can serve as a starting point that leads to learning and/or enhancement of other aspects of the linguistic skills – grammar, oral, reading, writing, etc. The iterative process starts with vocabulary contextualization through situated learning (e.g., Nation, 2001), followed by decontextualization through personal reflection and social meaning making(e.g., Long, 1980), and finally the construction of mental lexicon(e.g., Hall, 1992). In a nutshell, it is a bottom-up process in building a learner's mental lexicon.

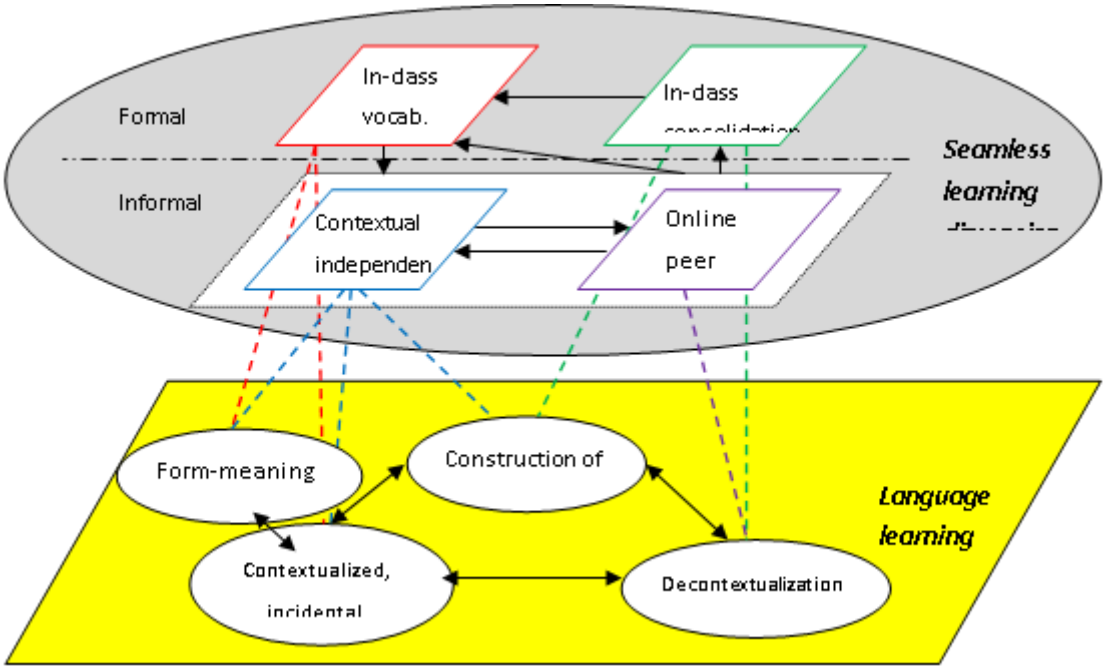

Figure 2: The socio-techno-pedagogical framework for MyCLOUD learning design

In the seamless learning dimension, we seek to refine the SLL processes that we previously developed for "Move, Idioms!" (see Figure 1). We do not prescribe the details of the process as it will be up to the taskforce to design the actual activities. For example, for the "contextual independent learning" activity, it was referred to student artifact creation in "Move, Idioms!". In MyCLOUD, we may retain this effective learning activity while incorporating additional ubiquitous learning activity types to further enhance student learning. Conversely, for "vocabulary learning" in formal setting, we might explore alternative activity models such as off-campus (perhaps context-aware) mobile learning field trips.

In Figure 2, the dashed lines between the two dimensions refer to the possible mappings between the seamless learning activities and the language learning activities – for example, "construction of mental lexicon" could take place during "contextual independent learning" (construction of students' personal mental lexicon) and "in-class consolidation" (group mental lexicon) respectively. These mappings are again not prescriptions but rather references for future learning co-design. Furthermore, the bi-directional arrows signify that the three-step vocabulary learning process is iterative and intertwining (i.e., not in fixed sequence). Nevertheless, we acknowledge that such a cognitively and disciplinarily demanding learning process is a tall order for average primary school kids. That is also one of the reasons that we set the intervention period to be three years in three experimental classes. Instead of overwhelming them with all the learning activities stated in Figure 2 from Day One, we intend to gradually introduce various learning activities and emphasise them at different stages, in order to progressively foster autonomous learning with ubiquitous technology among the students. In Year 1 (Primary 3), we will focus on

contextualized learning (e.g., photo taking and sentence making to describe their daily life) and simple social networking activities (see below), plus relatively 'casual' discussions on their peers' artifacts. In Year 2 (Primary 4), with the contextualized learning activities still going on (where they will start to write paragraphs containing not one but multiple "target vocabularies" to describe the photos that they take), we will foster more meaningful, inductive peer reviews among the students. They will also deepen their learning through the construction of simple personal mental lexicons. Finally, in Year 3 (Primary 5): While the contextualized learning activities are still going on, we will elevate them to construct more complex personal and group mental lexicons.

The main mobile device that we will provide to the students in the three experimental classes in 1:1, 24x7 basis will be tablets, where they can carry out most of the MyCLOUD activities across different learning contexts. In addition, they may either make use of their personal digital cameras or camera phones, or occasionally sign out smart-phones from the school. These lightweight devices will become supplementary tools for their spontaneous photo taking activities in their daily lives and perhaps having quicker and more convenient access to My Mictionary or tweeting (see below).

Informed by the prospective researcher-teacher co-designed MyCLOUD learning model, we will proceed to develop the MyCLOUD platform that leverages on ubiquitous and cloud computing technologies to mediate students' SLL activities. The entire system will consist of student module and teacher module.

The central component of the student module will be *My Mictionary* (My Mobile/Mental dictionary), a cloud-based personalized dictionary. Starting with an "empty" dictionary, My Mictionary can serve as an individual student's vocabulary learning e-portfolio for her to add vocabularies that she learn either intentionally (e.g., in-class, in the digitized passages on the platform) or incidentally (unfamiliar vocabularies encountered by the students in daily life), anytime, anywhere. When a new vocabulary is added, the system will automatically extract its definition and example sentences from an online Chinese-Chinese and Chinese-English dictionary, and incorporate the vocabulary into the "vocabulary page" (lexicon entry) in the My Mictionary. The student can then continue to build the content of each "vocabulary page" by pooling relevant Internet resources (e.g., webpages, online photos or YouTube videos) and upload her own photos with accompanied sentences/paragraphs (similar to the approach of "Move, Idioms!"). My Mictionary may also serve as the basis for the students to construct their personal or group *mental lexicon* (with additional MyCLOUD affordances for semantic map creation; with each node in the map representing a vocabulary linking to its corresponding lexical entry). Furthermore, a wiki-like *CoMictionary* (Community Mictionary) will be developed for students to share and peer-review their artifacts (similar to the wiki space in "Move, Idioms!"). We will also incorporate essay writing tools into the platform so that students can make use of My Mictionary to support their writing.

In addition, as we discovered most of the Primary 3 children's express tremendous interest in social networking with their peers (albeit almost always in English) through our pre-intervention surveys with the potential target students, we decided to incorporate some social networking functionality such as tweets and chats to the platform. When a student adds an Internet resource or uploads a photo/sentence set to her My Mictionary, the hyperlink to the new content will also be displayed on the social networking space, along with the student's other 'casual' tweets. Our intention is to give each student a highly personalized space so that the students would not perceive MyCLOUD as an extension of the formal curriculum but rather a space where they can 'seamlessly' bring together casual socialising and language learning. With such functionality, students will be encouraged to use Chinese in social networking.

In the teacher module, the platform can also serve as a Learning Management System for the teachers to regulate and support student learning. As the MyCLOUD learning model will involve pedagogical revamp of regular Chinese classes (not just an add-on learning activity to the formal curriculum), a user interface for lesson orchestration will be made available to the teachers for planning and managing the pedagogical processes in regular lessons. A variety of features will be incorporated, ranging from locking and unlocking selected or all platform features on in-class students' devices, the classroom response system, to monitoring of MyCLOUD platform-supported small-group learning activities.

RESEARCH METHODOLOGICAL ISSUES FOR SLL

a core issue in mobile-assisted SLL research is to collect and analyze data pertaining to both the seamless learning and language learning dimensions in order to understand how the students' learning behaviors, the technology, and the theory-informed pedagogy interplay and lead to actual learning outcomes. In the seamless learning dimension, due to the perpetual and cross-context nature of students' learning process, a variety of data collection and analysis methods should be employed, such as ethnographic methods, in-situ self-reporting, on-going questionnaires and interviews, server logging, and constant comparisons of these data sources.

In the language learning dimension, we intend to trace and analyze the full, recursive trajectory of students' initial form-meaning linking (i.e., in-class vocabulary learning), individual contextualized learning process (i.e., content creation in My Mictionary, interactions within the social networking space), social decontextualized learning process (e.g., peer reviews in CoMictionary and in-class consolidation), and the construction of the mental lexicons. Students' cognitive processes in artifact (photo/sentence sets) creation and peer reviews will be captured and examined. In addition, a corpus analysis tool will be integrated into the MyCLOUD platform to track individual students' vocabulary usage in the tweets, sentences and essays that they compose within the platform. These data will be analyzed through the lens of Second Language Acquisition theories. In addition, we will study how these productive and constructivist language learning activities may become a means of on-going formative assessment on the students.

Furthermore, there are important considerations for the technological aspect of SLL. Instead of positioning this aspect as a separate dimension in our framework, we lump it into the seamless learning dimension. The rationale is that whereas our SLL process design has been surrounding the use of tablets as 'learning hubs', we would strive for pedagogy-informed, rather than technical-driven, design for learning activities and the platform. The learning and platform design is not meant to replace paper and pen or formal lessons, but rather to support the students in extending their learning to their daily life. With the concern of the rapid obsolescence of mobile device models, we will develop the MyCLOUD platform to be device-independent in order to ensure sustainability of the learning model. A mobile client will also be developed for students to access to the platform with personal smart-phones.

In view of the complex interplay between the students' learning experiences, the technology and pedagogy involved, we adopt Design-based research (DBR) methodology (Brown, 1992) to conduct our research. This method stresses upon systematic study on the interdependence of design elements, and the importance of examining emerging issues through progressive, iterative refining processes. It allows us to collect and analyze rich data to bear on the many simultaneously interacting factors that shapes the learning we envisage. This will help to improve the design and shape the development of the technology and the pedagogy (Design-Based Research Collective, 2003).

CONCLUSIONS

We have examined the trend of modern language learning theories and found them congruent with the general learning philosophy of the 21st century, such as seamless learning, that advocates the nurturing of learners who can positively direct their learning and collaborate with others. The ubiquitous and cloud computing technologies may mediate and support assimilation of learning into the learners' daily life. Nevertheless, instead of solely leveraging general, domain-independent learning notions such as situated cognition or socio-constructivism to guide our SLL design, it is equally important to incorporate subject matter-specific learning theories in developing learning models that would provide concrete methodology to ensure deep learning of relevant knowledge and skills. A common limitation of prior vocabulary-focused MALL studies is that they rarely go beyond behaviorist or contextualized learning. Our proposed SLL framework aims to address this limitation. Informed by psycholinguistics, we recognize the importance of facilitating learners in constructing their mental lexicon, especially for L2 learning. We therefore incorporate mental lexicon-related learning activities to assist the learners in synthesizing their vocabulary learning, as well as address the limitation of similar prior learning design of ignoring the contextualized stage by exploiting the affordances of ubiquitous technology. Indeed, our SLL framework emphasizes closing the loops in both the seamless learning dimension (to foster 21st century knowledge and skills) and the domain-specific language learning dimension (to nurture holistic language competencies) through the on-going learning process mediated by the ubiquitous technology.

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