Surveying and Modeling Students' Motivation and Learning Strategies for Mobile-Assisted Seamless Chinese Language Learning

Ching Sing Chai[1], Lung-Hsiang Wong[1*] and Ronnel B. King[2]
[1]National Institute of Education, Nanyang Technological University, Singapore // [2]The Hong Kong Institute of Education, Hong Kong // chingsing.chai@nie.edu.sg // lhwong.acad@gmail.com // ronnel@ied.edu.hk
[*]Corresponding author

(Submitted June 12, 2014; Revised November 24, 2014; Accepted March 4, 2016)

ABSTRACT

Seamless language learning promises to be an effective learning approach that addresses the limitations of classroom-only language learning. It leverages mobile technologies to facilitate holistic and perpetual learning experiences that bridge different locations, times, technologies or social settings. Despite the emergence of studies on seamless language learning, there is a lack of instruments specifically designed to measure students' motivation and learning strategies in such technology-enhanced learning environments. This study aimed to develop and validate an instrument, namely, the Mobile-Assisted Seamless Chinese Learning Questionnaire (MSCLQ), to measure students' motivation and the learning strategies they use in a seamless learning environment. Confirmatory factor analyses (CFA) were conducted to validate the psychometric properties of the instrument. Subsequently, structural equation modeling (SEM) was conducted to examine how students' intrinsic value and self-efficacy for learning Chinese language predicts their perception of the various dimensions of meaningful seamless learning. The findings indicated that the MSCLQ is a valid and reliable questionnaire. Moreover, it was also found that students' motivation predicted the learning strategies they used in a seamless learning environment. Implications are discussed.

Keywords

Mobile-assisted, Seamless learning, Mobile-assisted language learning, Motivation, Learning perceptions and strategies

Introduction

In recent years, language learning scholars (e.g., Little, 2007; Tedick & Walker, 1995) have become cognizant of the limitations of classroom-only language learning. Salient criticisms of classroom-only language learning include de-contextualization of the learning material and processes, and the lack of autonomous learning and authentic social interactions. These issues typically undermine learners' holistic language development, especially for real-life interactions. In turn, there is an emerging consensus that the language learning process could be extended beyond the classroom, and that learners could be provided with opportunities to use the target language meaningfully and extensively in their daily life (Benson, 2013; Canagarajah & Wurr, 2011).

The advancement of mobile technologies could potentially address the aforementioned problems that bedevil classroom-only language learning. Mobile technologies offer pedagogical affordances that educators can leverage to promote meaningful learning among learners, both inside and out of the classroom. The most salient pedagogical affordance of mobile devices is that they allow learning to happen in the real world, which contributes to the authenticity of the learning and situated meaning making (Pachler, 2010).

Armed with their mobile devices, learners can actively construct digital artifacts whenever and wherever they have the intention to learn. Subsequently, they can upload the constructed artifacts for sharing, peer critiquing and co-construction, thereby making learning more collaborative. Researchers have characterized this form of learning wherein there is 24/7 access to at least one mobile device (1:1) as seamless learning (Chan et al., 2006). Since 2006, emerging designs of seamless learning that aim to create holistic and perpetual learning experiences have been reported. Formal and informal learning, individual and social, and physical and digital spaces are thus woven together with the mediation of mobile technologies (Wong & Looi, 2011; Wong, Milrad, & Specht, 2015). Among the 40 seamless learning projects identified in a recent review (Wong, Chai, & Aw, 2015), ten projects were dedicated to the design of language learning tasks in multiple settings.

Despite the emergence of studies on seamless language learning (SLL), few researchers have explicitly examined the role of motivation and learning strategies in SLL. This is an important gap given that the likelihood of success in any learning activity is largely determined by students' motivation and learning strategies (Weinstein, Husman, & Dierking, 2000). This lack of research is partly due to the lack of appropriate measures of motivation in technology-enhanced learning environments, as well as the lack of instruments to measure the relevant learning strategies that students use when they are engaged in seamless learning. Furthermore, most SLL studies reported to date have been limited by small sample sizes (e.g., Ogata et al., 2008; Wei, 2012).

Students' perceptions of and strategies for SLL offer valuable data that can allow researchers to assess the efficacy of their designed activities, and that can be used for further refinement of the learning designs. In addition, how students' motivation contributes to SLL activities is also a crucial issue to consider, especially in second language acquisition (SLA) settings. Student-centered learning design is associated with learners' motivation and autonomy (self-directedness) to learn. This research therefore aims to address the stated gap by developing and validating an instrument, namely, the Mobile-Assisted Seamless Chinese Language learning Questionnaire (MSCLQ), to measure students' motivation and perceptions of strategies for seamless Chinese language learning through confirmatory factor analyses. Although the current questionnaire was focused on Chinese language learning, we believe that the instrument can easily be adapted for use with other languages.

Subsequently, structural equation modeling was conducted to test the hypotheses that students' intrinsic motivation and self-efficacy in learning Chinese language contributes to the various dimensions of meaningful seamless learning.

In the following section, we first reviewed the current issues related to second language education. This was followed by a review of seamless learning and meaningful learning. Based on the review, the four dimensions of seamless Chinese learning were formulated. Finally, a review of motivation to learn, specifically intrinsic goal orientation and self-efficacy, was presented. Hypotheses regarding the relationships among these dimensions were then formulated based on the literature review.

Literature review

Current issues in second language education

A number of empirical studies (e.g., Liao & Yang, 2012; Liu, Goh, & Zhang, 2006; Plank & Condliffe, 2011) have found that many K-12 second language classroom practices typically fall short in the following aspects: (1) Incorporating an excessive amount of decontextualized materials; (2) Unbalanced instructional emphases, i.e., predominantly teacher-centric, and emphasizing language input over language output activities; (3) Disintegrated instructions of language knowledge/skills, i.e., listening, speaking, reading and writing skills are taught and practiced separately; (4) Exercising the presentation, practice, production (PPP) procedure in a linear fashion; and (5) Lack of autonomous learning and authentic social interactions. Such classroom practices are not conducive to developing learners' communicative skills and elevating/sustaining their learning motivation.

The growing dissatisfaction with such pedagogical approaches undergirded by behaviorist and cognitivist models of language instruction has prompted scholars to investigate alternative approaches to language learning. The current theorizing which adopts sociocultural approaches to understand SLA views language production and thinking as tightly interwoven, i.e., language production mediates thinking (Lightbown & Spada, 2013). Social interaction, rather than isolated input or output, is foregrounded as the context in which language use and language learning co-occur (Min, 2006). Participation in social activities is emphasized as the primary goal, and the learning of language occurs naturally to fulfil this goal. Effective language learning is characterized by active and constructive production of thoughtful linguistic artifacts in authentic social settings (Ellis, 2000).

In addition, motivation to learn a second language has long been a perennial concern that SLA educators face (Masgoret & Gardner, 2003). In Singapore, the practice of bilingualism has promoted learning English as the first language while the ethnic mother tongues are treated as second languages. Consequently, the mother tongue language teachers, including Chinese language teachers, are facing challenges in motivating students whose proficiency levels in their mother tongues are declining (Wong, Chai, Chen, & Chin, 2013; Wong, Gao, Chai, &

Chin, 2011). Finding pedagogically engaging ways to foster students' motivation is thus an important issue. Technology-enhanced learning that helps students connect their language learning endeavours to their daily life has been explored as one possible avenue for improving students' learning motivation.

Synthesis of meaningful learning, seamless learning and second language learning

Technology-enhanced learning emphasizes students' agency in meaning making. It is student-centric and constructivist/social constructivist oriented (Voogt, 2010). It encourages students to take charge of their own learning, especially after formal instruction has ended. However, most SLL studies have been conducted from learning technologists' perspectives that typically foreground mobile affordances. Some SLL studies have facilitated learning through repetitive language learning activities in both formal and informal settings, across time and locations (e.g., Redd, 2011; Wei, 2012). In addition, the learning efforts in different learning spaces are disconnected from each other. Explicit efforts to bridge the activities will help to foster intentional learning across the spaces rather than the current compartmentalized practices. Another salient observation is that seven out of the ten SLL projects identified were in essence one-off studies. A more pervasive and immersive process of learning is crucial as the appropriation of language knowledge and skills is cumulative, and it has to be genuinely integrated into learners' daily life. Furthermore, some studies (e.g., Koh, Loh, & Hong, 2013; Ogata et al., 2011; Wei, 2012) lack language learning theoretical support. In sum, it seems clear that SLL needs more theorizing and model building supported by current language learning theories.

To improve the design of SLL, with consideration of the evolution of SLA and the review of current SLL studies, the following key design principles are proposed:

- Create opportunities for authentic learning activities;
- Facilitate learners' collaborative construction of linguistic knowledge through social interaction;
- Integrate language input with output activities for integrated skills development;
- Encourage autonomous learning among learners.

These principles of language learning can be easily synthesized with the dimensions of meaningful learning (Howland et al., 2012) to be supported by mobile technologies. These dimensions are supported by previous research (Wong, 2013; Wong, Chin, Tan, & Liu, 2010) that was only applied to a specialized domain of seamless idiom learning.

First, mobile technologies can enhance authentic learning as they enable students to go beyond the classroom into the real world to learn (Kukulska-Hulme & Traxler, 2013). Vocabulary, which includes mainly verbs, nouns, and adjectives, can be more readily found in the real world than within the classroom confines (Pavlenko, 2009). Taking photos or video clips of what is happening in the real world and using these digital resources to help students to deepen their understanding of vocabulary learned in class helps to bridge formal learning with everyday living experiences (e.g., Koh et al., 2013; Ogata et al., 2011) .

Second, active and constructive learning can be actualized through students' active construction of linguistic artifacts. Technologies afford efficient means for students to construct and mix different forms of media to represent their understanding, thus encouraging active learning mediated through the creation of artifacts (Sadik, 2008). In particular, Wong (2013) reported a study that illustrated how language inputs (i.e., vocabulary learned in the classroom) were integrated with the output activities of creating artifacts. Students in Wong's study actively enacted scenarios for vocabulary they wanted to learn, took photos or video clips, and constructed sentences or paragraphs about the recorded enactment.

Third, the notion of intentional learning is akin to self-directed or self-regulated learning. Intentional learning is supported through students' goal-directed and self-regulated use of the technologies to seek information related to the learning goals, organize and keep track of the information identified, and work on the information gathered (Howland, Jonassen, & Marra, 2012). Technologies provide students with ample choices of learning resources that can help them use different ways to represent what they have learned. Deliberating on various choices is likely to foster self-directedness that is essential for lifelong learning.

Fourth, online platforms are widely recognized as facilitating social interactions for collaborative learning (Kreijns, Kirschner, & Vermeulen, 2013). This is especially apt for language learning since the ultimate aim of language learning is to communicate. When students are exposed to a range of possible usage of vocabulary accompanied by illustrative photos shared by their peers, they are likely to acquire many more examples and thus become more fluent in using the vocabulary. Current evaluations conducted by Aw, Wong, Zhang, Li and Quek (2016) and Wong, Chai, King, and Liu (2015) indicate that students are able to use the vocabulary learned through SLL much better than those learned through the traditional method.

Taken together, successful seamless learners are those who engage in authentic learning, create different linguistic artifacts, are self-regulating, and are collaborative. Students who use these strategies are able to fully harness the power of the seamless learning environment.

Research on motivation

Motivation has been found to support student engagement and enhance the attainment of learning outcomes (Pintrich, 2003). Motivated students devote efforts to performing learning tasks, persist when they encounter problems, and regulate their learning (Masgoret & Gardner, 2003). Most importantly, studies from the past two decades have established a strong positive association between student motivation and performance (Pintrich, 2004). While there is general consensus that motivation is manifested in "the process whereby goal-directed activity is instigated and sustained" (Pintrich & Schunk, 2002, p. 5), motivation in learning is a multidimensional phenomenon (King & McInerney, 2014).

Pintrich, Smith, Garcia, and McKeachie (1991) measured six aspects of motivation from the sociocognitive framework that includes intrinsic goal orientation, extrinsic goal orientation, task value, control of learning belief, self-efficacy and test anxiety. They created a self-report instrument entitled the Motivated Strategies for Learning Questionnaire (MSLQ). This instrument consists of two parts, the first measuring the six aspects of motivation mentioned above, and the second measuring nine types of learning strategies (e.g., rehearsal, organization, elaboration, peer learning). It is one of the most widely used instruments for measuring students' academic motivation and learning strategies (Duncan & McKeachie, 2005).

While the MSLQ was originally developed for college students, it has also been adapted for elementary students (Ocak & Yamac, 2013). In particular, Ocak and Yamac's (2013) research was conducted in the context of a Turkish primary school for fifth graders learning mathematics. They reported that intrinsic goal orientation, task value and self-efficacy predicted students' cognitive and metacognitive learning strategies. In Singapore, the MSLQ was adapted to study Singapore secondary school students' motivation in learning Chinese language, known as MALLI (Motivation and Attitudes for Language Learning Inventory) (Wong et al., 2013).

The MSLQ was created in the early 1990s, and dimensions related to technology-enhanced learning were not included as part of the learning strategies subscale. In developing the MSCLQ, we replaced the learning strategies portion of the MSLQ with key seamless language learning strategies drawn from the literature review articulated above, that is, authentic learning, construction of language learning artifacts, self-regulated learning, and collaborative learning. The reason we did not use the original learning strategies question in the MSLQ was that the original subscales are more relevant for learning in traditional classroom settings that are not mediated by technology. In technology-enhanced seamless learning environments, a different set of learning strategies becomes crucial. Thus, we measure these key constructs in this paper.

Method

Background and participants

The participants in this study were 259 Primary 3 students (127 girls and 132 boys) whose ages ranged from 9-10 years from one primary school in Singapore. In general, the students' first language is English and they possess mixed abilities in Chinese as a second language. In terms of their experience of the use of Information and Communication Technology (ICT) in learning, the students were quite well-experienced in using different software

(e.g., Microsoft Word and PowerPoint) and several e-learning portals since Primary 1, as they are part of the school structured ICT training and ICT integrated lessons. However, they had no prior experience of using smartphones for learning purposes. The school has equipped all Primary 3 students with smartphones and data connection plans. In addition, a cloud-based platform named MyCLOUD was specifically designed to facilitate language learning with the mobile devices. The intervention took place during February-November 2013. The students constitute the entire Primary 3 level of the school and were taught by six different teachers. To implement SLL, the six teachers co-designed the lesson plans with the researchers and implemented the lessons in their respective classes.

The lesson usually began with classroom teaching of a prescribed text to be read and vocabulary to be learned. Subsequently, the students used their smartphones to participate in a range of learning activities including (a) intentional selections of unfamiliar vocabulary and the checking of their meanings and examples of usage from the web as a means to promote self-directed learning, (b) taking pictures and making sentences associated with the vocabulary items learned for authentic, active and constructive learning, and (c) posting the artifacts online and writing comments for their peers' artifacts on the platform for collaborative learning. These activities were initially modeled in the classroom. Subsequently, students were assigned vocabulary that they should use to construct sentences after class. The students were encouraged to go beyond the assigned tasks by creating more artifacts in a self-directed manner. The teachers periodically reviewed the students' online posts and discussed their digital artifacts during class time. Around eight thousand digital artifacts (sentences, comments, or sentences with photos) were constructed during four months of engaging in the seamless Chinese learning, averaging about two digital artifacts created per student per week. These outcomes indicate that the students were familiar with the use of smartphones for seamless Chinese language learning.

Instrument

To explore the students' motivation and perceptions of the seamless Chinese language learning practices, a questionnaire entitled Motivation for Seamless Chinese Learning Questionnaire (MSCLQ) was constructed. This questionnaire contains six subscales: intrinsic value (IV), self-efficacy (SE), artifact creation (AC), authentic learning (AL), self-directed learning with technology (SDT) and collaborative learning with technology (CLT).

Items for intrinsic value and self-efficacy for Chinese learning were adapted from a previous study which aimed to explore Singaporean secondary students' motivation to learn Chinese language (Wong et al., 2013). Items for the self-directed and collaborative learning with technology were adapted from another study among Singaporean secondary students in the context of promoting self-directed and collaborative learning with technology, which is the current focus of the local Masterplan for ICT (Tan et al., 2011). Both studies validated the instruments through factor analysis. The items adopted were reviewed, contextualized and simplified with input from the teachers.

Authentic learning and artifact creation were created by the authors for this study based on the literature review. Minor changes involved adding qualifiers such as "in learning Chinese" and specifying "smart phones and computers" as the devices. Authentic learning is understood to involve connecting what is learnt to one's daily life or to the real world (Howland et al., 2012). Artifact creation represents students' active and constructive learning (Sadik, 2008; Wong, 2013) whereby students create digital artifacts to illustrate their understanding of the linguistic knowledge acquired. The authors brainstormed a list of possible behavior indicators that represent the two constructs with reference to the lesson activities that they co-designed with the teachers. After drafting the initial set of items, the 30-item MSCLQ was reviewed by two professors in education. The professors were asked to check if the items corresponded to the constructs we wanted to measure. Both professors, who are experienced in quantitative research, provided their feedback. The items were revised before we gave the questionnaire to the teachers to review again to check if the language and content were appropriate for Primary 3 students.

Data collection and analysis

To validate the instrument, the participants should have prolonged experience of SLL. Since the students did have such experience, the sampling strategy for this study is purposive sampling. All Primary 3 classes in the researched school were invited to participate. The data were collected four months after the intervention commenced. After

cleaning the raw data, 259 valid responses (97.4 % of the P3 students) were keyed into the SPSS. Some students were absent, while some responses were incomplete. These cases were excluded from further analysis.

An analysis of skewness and kurtosis was first conducted to check if the data could be considered as normally distributed. The results indicate that all items were within the acceptable range of |2|, indicating that the data could be treated as normally distributed. The data were then subjected to CFA to test the construct validity of the responses to the questionnaire. After removing items with insufficient factor loadings or items that exhibited multicollinearity, the means, average variance extracted (AVE) and the composite reliability for each factor were computed. The correlations between the factors were then computed. Finally, structural equation modelling was used to test the hypotheses. The data analysis procedures were in accordance with the recommendations of Hair, Black, Babin, and Anderson (2010).

Results

Validation of the MSCLQ with CFA

The first aim of this study was to test the factor structure of the MSCLQ, which was developed to study students' motivation and perceptions of seamless learning. The MSCLQ is comprised of six factors. The final version of the questionnaire with the factor loadings of each item is presented in Appendix 1. Four items were removed due to low factor loadings. When CFA was conducted on the remaining 26 items, a satisfactory model fit was obtained (χ^2 = 432.01, χ^2/df = 1.54, p < 0.001, RMSEA = 0.046, SRMR = 0.045, CFI = 0.96, GFI = 0.88). Based on the recommended value for instruments with 12 to 30 items for a sample of more than 250 participants (χ^2/df < 3, CFI > 0.92, RMSEA < 0.07, SRMR < 0.08) (Hair et al., 2010), the model fit obtained supported the construct validity of the MSCLQ. Table 1 reports the means, *SD*s and the AVE and composite reliability (CR) values. The AVE values are all above the recommended value of 0.5, and the CR values are all above 0.7. These indicators attest that the MSCLQ is a reliable instrument.

Table 1. Means, standard deviations, average variance extracted and composite reliability of the MSCLQ

Variables	Mean	*SD*	AVE	CR
Intrinsic Value (IV)	3.79	0.97	0.51	0.75
Self-efficacy (SE)	3.66	0.98	0.53	0.85
Authentic learning (AL)	3.75	1.03	0.56	0.84
Self-directed learning with technology (SDT)	3.50	1.03	0.56	0.83
Artifact creation (AC)	3.65	1.12	0.56	0.82
Collaborative learning with ICT (CLT)	3.44	1.09	0.51	0.84

Note. *SD* = standard deviation; AVE = average variance extracted; CR = composite reliability.

Correlations among perceptions of learning practices and motivation

Table 2 shows the correlations among the six factors in the students' perceptions of seamless Chinese learning practices with the motivation factors. The six factors were significantly correlated with each other (r = 0.47 to r = 0.76).

Table 2. The correlations among six scales of perceptions of learning practices (n = 586)

Variables	1	2	3	4	5	6
Intrinsic Value (IV)	-					
Self-efficacy (SE)	0.64**	-				
Authentic learning (AL)	0.66**	0.59**	-			
Self-directed learning with technology (SDT)	0.59**	0.55**	0.70**	-		
Artifact creation (AC)	0.51**	0.47**	0.64**	0.76**	-	
Collaborative learning with ICT (CLT)	0.48**	0.48**	0.63**	0.66**	0.57**	-

Note. **p < 0.01.

Structural equation modeling

To test the hypothesis that student motivation would positively predict students' perceptions of seamless Chinese learning practices, SEM analysis with AMOS was conducted (see Table 3). The fit indices indicated that the model had a good fit to the data ($\chi^2 = 486.89$, $\chi^2/df = 1.70$, $p < 0.001$, RMSEA = 0.052, SRMR = 0.048, CFI = 0.94, GFI = 0.87). Table 3 reports the hypotheses and the estimates. Out of the eight hypotheses, four regarding intrinsic value were supported, while the four related to self-efficacy were not supported. Interestingly, self-efficacy was a significant negative predictor of the seamless learning perceptions.

Table 3. Hypothesis testing with SEM

Hypotheses	Unstandardized estimates	*S.E.*	C.R.	*p*	Supported?
H1 IV positively predicts AC	4.21	1.32	3.21**	.001	Yes
H2 IV positively predicts AL	2.49	.77	3.25**	.001	Yes
H3 IV positively predicts SDT	4.28	1.31	3.28**	.001	Yes
H4 IV positively predicts CLT	2.74	.88	3.12**	.002	Yes
H5 SE positively predicts AC	-3.14	1.20	-2.61**	.009	No
H6 SE positively predicts AL	-1.47	.69	-2.13*	.034	No
H7 SE positively predicts SDT	-3.04	1.19	-2.55*	.011	No
H8 SE positively predicts CLT	-1.87	.80	-2.34*	.019	No

Note. $^*p < 0.05$; $^{**}p < 0.01$; *S.E.* = standard error; C.R. = critical ratio.

It was surprising to find that SE was a negative predictor in the model, while its bivariate correlation with the other outcomes was positive. This is a case of the negative suppression effect which occurs when two independent variables have a positive zero-order correlation with the dependent variable and correlate positively with each other. In such cases one of the independent variables may become a negative predictor in a regression equation or path model (Conger, 1974; Darlington, 1968). Psychometricians have identified a high correlation between the two independent variables as a possible cause of negative suppression (Pandey & Elliott, 2010).

One possible way to deal with the suppression effect is to delete one of the predictors if it is completely redundant. Another possibility is to combine the constructs into one omnibus construct (Maassen & Bakker, 2001). We found this suggestion to be more valid because the bivariate correlation between IV and SE was quite high ($r = .64$, $p < .001$), but they were not completely redundant.

We re-ran the SEM model with a higher-order construct underpinned by the first-order latent constructs of intrinsic value and self-efficacy (see Table 4). We termed this higher order construct general motivation. The results of the analysis were in line with the theoretical expectations. General motivation positively predicted AC, AL, SDT, and CLT. The model had a good fit to the data ($\chi^2 = 497.07$, $\chi^2/df = 1.71$, $p < 0.001$, RMSEA = 0.052, SRMR = 0.047, CFI = 0.94, GFI = 0.87).

Table 4. Hypothesis testing with SEM

Hypotheses		Unstandardized estimates	*S.E.*	C.R.	*p*	Supported?
H1	Motivation positively predicts AC	1.40	.194	7.21***	.001	Yes
H2	Motivation positively predicts AL	1.28	.194	7.45***	.001	Yes
H3	Motivation positively predicts SDT	1.58	.20	7.90***	.001	Yes
H4	Motivation positively predicts CLT	1.13	.17	6.80**	.001	Yes

Note. $^{**}p < 0.01$; $^{***}p < 0.001$. *S.E.* = standard error; C.R. = critical ratio.

Discussion and conclusion

Recent technological advancements in cloud computing and nanotechnology have enabled computing devices to shrink in size and to increase their functionality. Wireless technology is facilitating better connectivity between the learners and the learning resources, and among learners in learning communities (Specht et al., 2012; Wong, Milrad, & Specht, 2015). Such technological advancements are unlikely to be reversible, and they are driving changes in the

social and pedagogical milieu. Given such technological conditions, language teaching practices should involve active construction of digital artifacts that can be refined progressively supported by a face-to-face and/or online community (Wong, 2013).

This paper aimed to develop and validate the MSCLQ as a reliable and valid instrument to measure student motivation in and strategies for seamless Chinese language learning. To fulfil this aim, the relevant literature on meaningful learning (Howland et al., 2012), seamless learning (Wong, 2012; Wong, Milrad, & Specht, 2015) and SLA (Lightbown & Spada, 2013) were reviewed and synthesized. As a result, four subscales which measure students' perceptions of meaningful seamless learning were formed (AL, AC, SDT, CLT). The creation of the MSCLQ was inspired by the MSLQ (Duncan & McKeachie, 2005; Pintrich et al., 1991) and by replacing the learning strategies portion with strategies associated with meaningful seamless learning supported by technologies. This study contributes to the research on motivation and technology-enhanced learning.

Motivation remains an important factor to consider in any form of learning. Students who are more motivated achieve better grades and have higher quality learning (Pintrich, 2003). This has been attested by thousands of psychological studies. Researchers in technology-enhanced learning will need to draw upon motivation research to provide an additional angle to examine the influences of the technology on learning as well as to examine how motivation influences the way students learn in technology-rich settings. Too often, learning technologists have neglected the important role of motivation by exclusively focusing on the technological affordances and technical features of new learning technologies (e.g., Nehme, 2010). While these studies have certainly advanced our understanding, the examination of motivation provides an additional layer of nuance that would be left unexplored if the focus was exclusively on the technical and pedagogical features of various technologies. For example, given the same technology-enhanced learning environment, how do we know who among the students will learn better? How do we account for these individual differences in motivation to make learning maximally effective? These types of questions can only be answered if one takes the role of motivation into account.

Currently, most SLL studies reported were limited by small sample sizes (e.g., Ogata et al., 2008; Wei, 2012). However, as one-to-one computing is becoming more prevalent, the importance of SLL is likely to be raised with more schools tapping into the pedagogical affordances of mobile technology. Given the access to a sizable sample, this study was able to validate the MSCLQ. The findings of the CFA, coupled with the AVE and CR, provide sufficient evidence for the MSCLQ to be accepted for future use in assessing and comparing different designs of mobile-assisted seamless learning interventions. This study therefore has important implications for educators who might be interested in taking up the socio-technological affordances of mobile computing devices to scale up seamless learning.

In addition, we found that self-efficacy and intrinsic value were highly correlated in our current sample, which necessitated their combination into an omnibus variable. It is possible that the Singaporean Chinese students in our study did not make fine-grained distinctions between self-efficacy and task value. Cross-cultural research on motivational constructs has shown that East Asian students from collectivist societies make fewer distinctions between overlapping motivational constructs (e.g., Ho, Hau, & Salili, 2007; King, 2015; King & McInerney, 2014). Psychologists have attributed this to the possibility that academic achievement has become highly internalized among East Asian students. For these students, valuing the task (intrinsic value) and doing it well (self-efficacy) are highly overlapping as they both propel students towards greater task engagement.

This study has several important academic and practical implications. In terms of its academic implications, it advances the literature on mobile seamless learning by developing a questionnaire that could be used to study perceptions of meaningful Chinese seamless learning. The lack of a standardized questionnaire that could be used to measure seamless learning has hindered meaningful integration across different studies. While initially developed for the Chinese language context, it is possible that the questionnaire could be modified by other researchers who are interested in promoting seamless learning in other subject areas. The most obvious ones would be those related to language learning such as learning English or learning a foreign language. However, it is also possible that the questionnaire could be modified to study seamless learning in non-language domains such as science or mathematics.

In terms of practical implications, the results of the current study could be used to aid educators who are interested in enhancing the seamless learning experience of their students. For mobile seamless learning to be meaningful,

engaging students in self-directed and collaborative learning mediated through linguistic artifacts created around students' life experiences is a pedagogically viable way forward. As reflected by the mean scores of the four dimensions of learning which are all above the mid-point of three (see Table 1), the students involved in this study are reportedly engaged in various forms of learning. In particular, this study suggests the need to focus on intrinsic value. Teachers could foster a greater degree of intrinsic valuing of a subject by designing meaningful learning activities beyond the classroom walls. With their mobile computing devices in hand, students can easily engage in cross-boundary seamless learning and connect what they have learned with what they encounter daily. This will help to alleviate common problems associated with language instruction such as decontextualization and isolated language learning.

One limitation of the current study is that the validation of the instrument was confined to one level of primary three students from a single Singapore school. Future studies involving more schools and perhaps higher levels of students (e.g., secondary school) are desirable. In addition, collecting data with a larger sample size (> 500) will allow researchers to perform CFA using split-half techniques. This will subject the MSCLQ to more rigorous statistical examination to further enhance its validity, reliability and generalizability across different schools and year levels. It is also advisable to adopt a mixed methods approach. Another limitation of the current study is that it has only tested two dimensions of motivation. Motivation is a multifaceted construct, and different theoretical perspectives on motivation focus on different motivational constructs. In future research, more dimensions could be included to further unpack the relationships between mobilized seamless learning and students' motivation. Lastly, we drew exclusively on a Singapore sample in our study. It is possible that relationships among the variables might be different across cultures. Thus, future pancultural studies are needed that would shed light on the cultural similarities and differences in terms of the variables examined (King & McInerney, 2014). We would also like to encourage future researchers to conduct focus group interviews with students in order to strengthen understanding of their perceptions directly from the students' first-hand accounts. There could be other dimensions of motivation or seamless learning practices that emerge naturally from students' experience and initiatives in using technology.

Acknowledgments

The study was funded by the Office of Education Research, National Institute of Education, Nanyang Technological University, Singapore (project ID: OER 16/12 WLH).

References

Aw, G. P., Wong, L.-H., Zhang, X., Li, Y., & Quek, G. H., (2016). MyCLOUD: A Seamless Chinese vocabulary learning experience mediated by cloud and mobile technologies. In C. S. Chai, C. P. Lim & C. M. Tan (Eds.), *Future Learning in Primary Schools - A Singapore Perspective* (pp. 65-78). Singapore: Springer.

Benson, P. (2013). *Teaching and researching: Autonomy in language learning*. Milton Park, OX: Routledge.

Canagarajah, A. S., & Wurr, A., J. (2011). Multilingual communication and language acquisition: New research directions. *The Reading Matrix, 11*(1), 1-15.

Chan, T.-W., Roschelle, J., Hsi, S., Kinshuk, Sharples, M., Brown, T., Patton, C., Cherniavsky, J., Pea, R., Norris, C., Soloway, E., Balacheff, N., Scardamalia, M., Dillenbourg, P., Looi, C. K., Milrad, M., & Hoppe, U. (2006). One-to-one technology-enhanced learning: An Opportunity for global research collaboration. *Research and Practice in Technology-Enhanced Learning, 1*(1), 3-29.

Conger, A. J. (1974). A Revised definition for suppressor variables: A Guide to their identification and interpretation. *Educational and Psychological Measurement, 34*, 35-46.

Darlington, R. B. (1968). Multiple regression in psychological research and practice. *Psychological Bulletin, 69*, 161-182.

Duncan, T. G., & McKeachie, W. J. (2005). The Making of the Motivated Strategies for Learning Questionnaire. *Educational Psychologist, 40*, 117-128.

Ellis, R. (2000). Task-based research and language pedagogy. *Language Teaching Research*, *4*(3), 193-220.

Hair, J. F. J., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). *Multivariate data analysis: A Global perspective* (7th ed.). Upper Saddle River, NJ: Pearson Education.

Howland, J. L., Jonassen, D., & Marra, R. M. (2012). *Meaningful learning with technology*. Upper Saddle River, NJ: Pearson.

Ho, I. T., Hau, K. T., & Salili, F. (2007). Expectancy and value as predictors of Chinese students' achievement goals. In F. Salili & R. Hoosain (Eds.), *Culture, motivation, and learning: A Multicultural perspective* (pp. 43-66). Charlotte, NC: Information Age.

King, R. B. (2015). Examining the dimensional structure and nomological network of achievement goals in the Philippines. *Journal of Adolescence, 44*, 214-218.

King, R. B., & McInerney, D. M. (2014). Culture's consequences on student motivation: Capturing cross-cultural universality and variability through Personal Investment Theory. *Educational Psychologist, 49*(3), 175-198.

Koh, E., Loh, J., & Hong, H. (2013). A Snapshot approach of a smartphone-enabled implementation. *Research and Practice in Technology Enhanced Learning, 8*(1), 91-115.

Kreijns, K., Kirschner, P. A., & Vermeulen, M. (2013). Social aspects of CSCL environments: A Research framework. *Educational Psychologist, 48*(4), 229-242.

Kukulska-Hulme, A., & Traxler, J. (2013). Design principles for mobile learning. In H. Beetham & R. Sharpe (Eds.), *Rethinking Pedagogy for a Digital Age: Designing for 21st Century Learning* (2nd ed., pp. 244-257). New York, NY: Routledge.

Liao, H. C., & Yang, C. C. (2012). Teaching practice and cultural difference of an English as foreign language classroom in Taiwan. *English Language Teaching, 5*(11), 151-160.

Lightbown, P. M., & Spada, N. (2013). *How languages are learned* (4th ed.). Oxford, UK: Oxford University Press.

Little, D. (2007). Language learner autonomy: Some fundamental considerations revisited. *Innovation in Language Learning and Teaching, 1*(1), 14-29.

Liu, Y., Goh, H. H., & Zhang, D. (2006). A Preliminary description of Singaporean Chinese language classrooms. *Chinese Teaching of the World, 1*, 97-105.

Maassen, G. H., & Bakker, A. B. (2001). Suppressor variables in path models: Definitions and interpretations. *Sociological Methods and Research, 30*, 241-270.

Masgoret, A. M., & Gardner, R. C. (2003). Attitudes, motivation, and second language learning: A Meta-analysis of studies conducted by Gardner and associates. *Language Learning, 53*(1), 123-163.

Min, G. (2006). Vygotsky sociocultural theory and the role of input and output in second language acquisition. *CELEA Journal, 29*(4), 87-92.

Nehme, M. (2010). E-learning and students' motivation. *Legal Education Review, 20*, 223-228.

Ocak, G., & Yamac, A. (2013). Examination of the relationships between fifth graders' self-regulated learning strategies, motivational beliefs, attitudes, and achievement. *Educational Sciences: Theory & Practice, 13*(1), 380-387.

Ogata, H., Hui, G. L., Yin, C., Ueda, T., Oishi, Y., & Yano, Y. (2008). LOCH: Supporting mobile language learning outside classrooms. *Mobile Learning and Organisation, 2*(3), 271-282.

Ogata, H., Li, M., Hou, B., Uosaki, N., El-Bishouty, M., & Yano, Y. (2011). SCROLL: Supporting to share and reuse ubiquitous learning log in the context of language learning. *Research and Practice in Technology Enhanced Learning, 6*(2), 69-82.

Pachler, N. (2010). The Socio-cultural ecological approach to mobile learning: An Overview. In B. Bachmair (Ed.), *Medienbildung in neuen Kulturräumen* (pp. 153-167). Berlin, Germany: Springer-Verlag.

Pandey, S., & Elliott, W. (2010). Suppressor variables in social work research: Ways to identify in multiple regression models. *Journal of the Society for Social Work and Research, 1*, 28-40.

Pavlenko, A. (2009). Conceptual representation in the bilingual lexicon and second language vocabulary learning. In A. Pavlenko (Ed.), *The bilingual mental lexicon: Interdisciplinary approaches* (pp. 125-160). Bristol, UK: Multilingual Matters.

Pintrich, P. R. (2003). A Motivational science perspective on the role of student motivation in learning and teaching contexts. *Journal of Educational Psychology, 95*, 667-686.

Pintrich, P. R. (2004). A Conceptual framework for assessing motivation and self-regulated learning in college students. *Educational Psychology Review, 16*, 385-407.

Pintrich, P. R., & Schunk, D. H. (2002). *Motivation in education: Theory, research, and applications*. Upper Saddle River, NJ: Merrill Prentice-Hall.

Pintrich, P. R., Smith, D. A. F., Garcia, T., & McKeachie, W. J. (1991). *A Manual for the use of the Motivated Strategies for Learning Questionnaire (MSLQ)*. Ann Arbor: University of Michigan, National Center for Research to Improve Postsecondary Teaching and Learning.

Plank, S. B., & Condliffe, B. (2011). *Pressures of the season: A Descriptive look at classroom quality in second and third grade classrooms*. Baltimore, MD: Baltimore Education Research Consortium.

Redd, J. (2011). *Supporting vocabulary growth of high school students: An Analysis of the potential of a mobile learning device and gaming app* (Unpublished doctoral disseration). Iowa State University, Ames, Iowa.

Sadik, A. (2008). Digital storytelling: a meaningful technology-integrated approach for engaged student learning. *Educational Technology Research and Development, 56*(4), 487-506.

Specht, M., Börner, D., Tabuenca, B., Ternier, S., De Vries, F., Kalz, M., Drachsler, H., Musaddaq, A., & Schmitz, B. (2012). *RTST trend report: Lead theme contextualisation*. Retrieved from: http://dspace.learningnetworks.org/bitstream/1820/4356/1/STELLAR_Deliverable17_designed_v4.pdf

Tan, S.-C., Chai, C.-S., Lee, C.-B., Teo, T., Chen, W., Koh, J., Lee, S. C., & Cheah, H.-M. (2011). *Evaluation of implementation of the IT Masterplan 3 and its impact on Singapore schools*. Singapore: National Institute of Education.

Tedick, D. J., & Walker, C. L. (1995). From theory to practice: How do we prepare teachers for second language classrooms? *Foreign Language Annals, 28*(4), 499-517.

Voogt, J. (2010). Teacher factors associated with innovative curriculum goals and pedagogical practices: differences between extensive and non-extensive ICT-using science teachers. *Journal of Computer Assisted Learning, 26*(6), 453-464.

Wei, L. (2012). Construction of seamless English Language learning cyberspace via interactive text messaging tool. *Theory and Practice in Language Studies, 2*(8), 1590-1596.

Weinstein, C. E., Husman, J., & Dierking, D. R. (2000). Self-regulation interventions with a focus on learning strategies. In M. Boekaerts, P. R. Pintrich & M. Zeidner (Eds.), *Handbook on Self-regulation* (pp. 727-747). New York, NY: Academic Press.

Wong, L.-H. (2013). Analysis of students' after-school mobile-assisted artifact creation processes in a seamless language learning environment. *Educational Technology & Society, 16*(2), 198-211.

Wong, L. H., Chai, C. S., & Aw, G. P. (2015). What seams do we remove in learning a language: Towards a Seamless Language Learning framework. In L.-H. Wong, M. Milrad, & M. Specht (Eds.), *Seamless Learning in the Age of Mobile Connectivity* (pp. 295-318). Singapore: Springer.

Wong, L.-H., Chai, C. S., Chen, W., & Chin, C. K. (2013). Measuring Singaporean students' motivation and strategies of bilingual learning. *The Asia-Pacific Education Researcher, 22*(3), 263-272.

Wong, L.-H., Chai, C. S., King, R. B., & Liu, M. (2015). Implications of students' vocabulary growth in a seamless language learning environment mediated by handhelds and social media. In *Proceedings of International Conference on Computers in Education 2015* (pp. 804-813). Ishikawa, Japan: Asia-Pacific Society for Computers in Education.

Wong, L.-H., Chin, C.-K., Tan, C.-L., & Liu, M. (2010). Students' personal and social meaning making in a Chinese idiom mobile learning environment. *Educational Technology & Society, 13*(4), 15-26.

Wong, L.-H., Gao, P., Chai, C.-S., & Chin, C.-K. (2011). Where research, practice and authority meet: A Collaborative inquiry for development of technology-enhanced Chinese language curricula. *The Turkish Online Journal of Educational Technology, 10*(1), 232-243.

Wong, L.-H., & Looi, C.-K. (2011). What seams do we remove in mobile assisted seamless learning? A Critical review of the literature. *Computers & Education, 57*(4), 2364-2381.

Wong, L.-H., Milrad, M., & Specht, M. (Eds.). (2015). *Seamless learning in the age of mobile connectivity*. Singapore: Springer.