EXPLORING THE RELATIONSHIPS BETWEEN STUDENTS' ABILITY OF COMPUTER-BASED CHINESE INPUT AND OTHER VARIABLES ASSOCIATED TO THEIR PERFORMANCES IN COMPOSITION WRITING

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ABSTRACT
Computer-based writing is already a norm to a large extent in social communication for any major language around the world. From this perspective, it would be pedagogically sound for students to master the Chinese input system as early as possible. This poses some challenges to students in Singapore, most of which are learning Chinese as a second language, as inputting the non-alphabetic Chinese characters is not as direct as keyboard-based input. In this regard, an exploratory study that involved 419 students from three secondary schools was conducted. The aims of the study were three-folded, (1) To investigate if there is any differences between their performances in computer- and paper-based writing; (2) To determine the relationships between their Chinese input skills and their motivation in learning Chinese and using computers for Chinese assignments; (3) To recommend a cut-off level of pinyin input skill that students need to possess. The target students were first surveyed and then sat in two essay writing tests in the two different mediums. The collected data were quantitatively analyzed. The findings of this study will help to inform various strategies necessary to enhance students' ability to carry out computer-based writing, and provide additional ground for the adoption of Chinese input system in formal curriculum and assessments.
Keywords: Chinese Language learning; Composition writing; Computer-based Chinese input

INTRODUCTION

Computer-based word editing is already a norm in the workplace and to a large extent in social communication for any major language around the world. More and more, to be regarded as a proficient user of the Chinese language, one must master the skill of inputting Chinese characters on computers. From this perspective, it would be pedagogically sound for students to master the Chinese input system as early as possible. This poses some challenges to students in Singapore as inputting Chinese characters is not as direct as keyboard-based input. The students would need to choose among various input methods such as through special hand writing software or through the Hanyu pinyin system (see below).

In August 2008, the Minister for Education (MOE) of Singapore launched the third MasterPlan for ICT in Education (MP3), working towards the grand vision of "Harnessing ICT for Future Learning". The key focus of MP3 is on students' use of ICT for self-directed learning and collaborative learning with ICT (Teo & Ting, 2010). It is believed that engaging students' in self-directed learning (SDL) and collaborative learning (CoL) with ICT could better prepare Singaporean students to meet the challenges of the 21st century. However, in the context of Chinese language teaching, the actualization of the policy also demands Singaporean students to be proficient with the computer-based Chinese input system. Thus, both for the preparation of workplace performance and for their education, students' need to master Chinese input. Such need is recognized by the MOE's Mother Tongue Language (MTL) Review Committee which has recommended in January 2011 to phase in computer-based input for selected sections, such as essay writing, for national examinations within 2013-2015.

Hanyu Pinyin (or: pinyin) is a phonetic-based scheme to transcribe Chinese characters into the Roman alphabet. Published by the Chinese government in 1958, the scheme has later been adopted as the basis of a Chinese computer input method. Known as pinyin input method, it is now widely used in Singapore schools. Nevertheless, are Singaporean secondary school students proficient with the pinyin input method? Prior research (Wong, Chai, & Gao, 2011; Wong, Gao, Chung, & Chai, 2008) conducted among primary and secondary school students in Singapore seems to suggest that the students face multiple problems with Chinese input system.

Without adequate understanding about students' ability to use the Chinese input system, it would appear difficult to implement and evaluate the use of computers for Chinese learning, let alone ICT-mediated SDL and CoL in Chinese. Therefore, it is both essential and timely to conduct studies on related issues in order to inform the policy and the research community.

This paper reports on an exploratory study that involved 419 students from three public secondary schools in Singapore. All participants were first surveyed on their demographic particulars, computer and pinyin self-efficacies, and learning motivations. They then performed a pinyin input speed test based on a textbook passage that they had been taught before. The correct numbers of words typed per minute were computed to indicate students' Chinese word processing speed on computers. Next, they sat in two essay writing tests of similar difficulty on two different days, one with pen and paper, the other one on pinyin input. Finally, the researchers performed quantitative analysis that involved structural equation modelling, which will inform educators as to how the various variables are connected to the dependable variable. This study is intended to answer the following research questions,

1. Are there any differences between students' performances in Chinese Language writing when they use pen and paper versus when they use computers?
2. What are the relationships between students' Chinese input skills and their motivation in learning Chinese and using computers for Chinese assignments?
3. What is the recommended cut-off level of pinyin input skill (in terms of minimum average number of Chinese characters inputted per minute) that students need to possess so that there will be no significant difference in their performances in Chinese Language writing when they use pen and paper versus when they use computers?

LITERATURE REVIEW

Computer as the authentic medium for language workers

The proliferation of computers has essentially changed how we live and how we work (Lim, Chai, & Churchill, 2010). It is difficult to imagine today's worker who earn their living based on their language competencies to work without a computer. It is also obvious that any work that requires the use of language is likely to rely more on the use of word processing rather than hand-writing. Writing in the 21st century would largely mean electronic writing (Selfe, 1999). As such, the researchers would argue that basic language competencies has to be redefined as listening, speaking, reading, word processing and writing.

The emergence of social networking and Web 2.0 technology further enhances the importance of word processing skills. These technologies have altered the notion of authorship and the relations between people in a fundamental way. Literacy has to be redefined to accommodate digital literacies, which assumed user to have basic computer literacies (Lim, et al., 2010; Mills, 2008; Myers, 2006). Authoring for the purpose of connecting with people, shaping and maintaining online identities, and sharing knowledge are becoming part of a digital native's way of life and they exert subtle influences on a learner's holistic development (Greenhow, Robelia, & Hughes, 2009). For languages that cannot go online, there exists a risk of being perceived as inferior or obsolete language. In view of such threat, efforts in using Chinese Language portals, discussion forums and Web 2.0 tools to encourage students to write Chinese essays online has recently emerged with some positive learning outcomes reported (Tang & Wang, 2007; Wong, Chen, Chai, Chin, & Gao, 2011; Zhang, 2009).

Nevertheless, given the non-alphabetic nature of the Chinese script, it is found that learners who are not living in places where the Chinese language is the dominant language may face substantial problems in mastering the language (Fan, Tong, & Song, 1987; Shen, 2002; Wong, Boticki, Sun, & Looi, 2011; Wong, Gao, Chai, & Chin, 2011), especially for the purpose of reading and writing (Fu, 2005; Mori, Sato, & Shimizu, 2007). When it comes to word processing, the indirect (not alphabetic-based but phonetic-based) Chinese input method of pinyin would pose a greater challenge to the Chinese Language learners. The effort of Chinese input requires writers' additional mental processing, that is, recalling the pronunciations, mapping them into pinyin representations, recognizing the "shape" of the particular character from a potentially big list of homophones, and so on (Xie, 2001). Thus, many Singaporean students who were first trained in Chinese writing with pen and paper perceived writing with pinyin input as a significantly less intuitive and therefore unfavorable mode of writing (Wong, Chai, et al., 2011). This problem is not unique to Singapore students or any student studying Chinese as a second language. A considerable number of learners in China may be facing similar challenges due to other factors (e.g., Ding, 2002; Du & Crestani, 2005; Duan, 2004). As such, learners may devote too much effort in this aspect and neglect the other higher level writing processes such as planning and revising (Wong, Chai, et al., 2011). Therefore, it is crucial for learners to be adept in Chinese computer input skills up to a certain threshold level, before they could produce computer-based writing with compatible quality of paper-and-pen-based writing.

Using computers for language examination

Increasingly, computers are also employed as a medium of test and examinations (Liao & Kuo, 2011; Wolfe & Manalo, 2004). Important examinations such as TOFEL and GRE have computerized versions for years. There were also some studies that investigated the use of computers for the purpose of examination. The strength of employing computers for examination is that standardized items involving multiple-choice can be marked accurately and efficiently. Word processing can also help in terms of the presentation of the essay examination. Nevertheless, teachers often cite traditional paper-based examination medium as one reason for their reluctance to be engaged their students in using ICT (Somekh, 2008; Tan, et al., 2010). Changing the medium of examination would necessarily require teachers to change their instructional medium. However, there are multiple concerns in computer-based examination. The main concern is with regards to the potential threat to the validity of the assessment. Variables such as gender, ethnic groups, access to computers, experiences of and proficiency in using computers have all been identified as possible variables that could impact on the examinees' examination performances (Tan, et al., 2010). Students' motivation in learning the language and their general language competency are likely to influence their computer self-efficacy and their ability to input Chinese characters. Clearly, students do not have identical keyboard skills or feel equally comfortable using a computer, and it will be necessary to ensure that no systematic bias is introduced as a consequence of any move towards using computers in the examination process (Mogey, et al., 2008). However, the influences of these variables have been speculated by researchers to be diminishing as computers becomes more available, especially for standardized questions. For essay writing, word processing has been described as affecting the quality of writing as it eliminates the problems associated with illegible hand writing, results in better organized essay with neater appearance and a more formal tone (Goldberg, Russell, & Cook, 2003; Wolfe & Manalo, 2004).

Whether or not, and how the identified variables affect students' performances in using Chinese word processing for Chinese essay writing remains a knowledge gap to date. While some researchers have started to examine how word processing influence students' essay writing, such as the number of wrong characters being selected (e.g., Kang, 2011), formal investigation on students' writing performances cannot be located. Our search employing professional databases (Academic Search Premier, Education research complete, PsyInfo, Computer Source, ERIC) with Keywords "Chinese AND Writing AND Computers" yielded a return of 102 articles. Closer examination of the titles and then the abstract reveals that there is not any published research that answers to the research question directly.

RESEARCH METHOD

Sampling Strategy

This study involved three public secondary schools in Singapore with academic achievements that are average or above average. This sampling strategy is purposive in nature so that a fair representation of the typical students studying Chinese Language in secondary schools could be obtained. The participants were 419 Secondary 3 (15-year-old) students (57.8% male and 42.2 female, School X: 151 students; School Y: 104 students; School Z: 164 students). Among the participants, 94.3% were Singaporean, the rest were from other Asian countries (e.g., Malaysia and China). Most of the participants (83.8%) had access to a computer at home. Regarding the first language used, 60.9% of the participants preferred English, 36.3% favored Chinese, and the rest used Chinese dialects.

Data Collection

The study took place during September, 2010. The following three-step process was executed to collect the necessary data for subsequent analysis, (1) questionnaire; (2) pinyin input speed tests; (3) writing tests.

First of all, all participants were requested to fill in a questionnaire that comprised three parts: the demographic data, computer self-efficacy, and motivation questionnaire. The questionnaire mainly consisted of 14 statements on students' intrinsic motivation (IM) (4 items), Chinese self-efficacy (CSE) (5 items), and Pin-Yin self-efficacy (PYSE) (5 items). Participants were required to express their opinions to each statement on a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree). The above three constructs and relevant items are shown in Appendix A. To validate the 14 items, a principal component analysis with varimax rotation method was conducted. Three factors with eigenvalues greater than 1.00 were identified and they explained about 69.26% of the variance. The Cronbach's α values of these factors were then calculated. As shown in Appendix B, the factor loadings of all items were larger than .50 and the Cronbach's α values of all factors were greater than .70. According to Hair, Black, Babin, Anderson and Tatham (2006), the validity of the instrument was acceptable at the item and construct level, respectively.

Besides, participants' Chinese grade in the Primary School Leaving Examination (a national examination that the participants sat in before they entered to the secondary level) was assumed to indicate their language competency

(LC). Specifically, LC was categorized into two groups namely high LC (e.g., a grade of A+, N = 284) and low LC (e.g., a grade of A, B, C, and D, N = 99). This indicator is the closet we can obtained as there isn't any other trustworthy standardised tests between grade 6 and grade 10.

Next, the participants took part in a two-minute computer-based pinyin input speed test based on a textbook passage that they have been taught before. This ensure that the students know the words they are typing. The correct Chinese character input per minute was calculated and it provides the score for participants Chinese input skills (CIS).

Finally, all participants were required to write two essays of different topics provided on two different days. One essay was written by using paper and pen, while the other using computers. An experienced Chinese teacher who was appointed national examination marker for more than a decade, was invited to score the two essays in terms of content and structure of the essay. The full mark of each essay was 50 points, with 25 points for both content and structure. The two essay scores were used to indicate pen-and-paper-based writing performance (PBWP) and computer-based writing performance (CBWP), respectively. One hundred essays (50 pens and paper and 50 typewritten) were randomly selected and marked by another qualified markers. A total of 71% of the essays were awarded marks with 0-5 marks differences. Disagreed cases were reviewed by one of the authors who was also a qualified marker. This is deemed acceptable for the local marking practices for Chinese essay writing. Furthermore, the numbers of errors in choosing the correct Chinese characters of the individual essays were also counted for additional analysis. Among the above seven variables, IM and CSE were perceived as exogenous variables, CBWP as endogenous variable, and the rest (e.g., PYSE, CIS, and PBWP) as intervening variables.

Data Analysis

To address the first research question, a paired samples t-test was conducted to examine any difference between PBWP and CBWP. The remaining stages aimed to answer the second research question. To answer the second question, the proposed path model was tested through assessing the path coefficients and their significance. To answer the third question, the cut-off value of the variable Chinese input skills (CIS) was investigated again through paired samples t-test to examine the difference between PBWP and CBWP based on the median of CIS.

RESULTS

In this section, the results of the statistical analysis are presented to answer the three research questions of the study.

1. Are there any differences between students' performances in Chinese Language writing when they use pen and paper versus when they use computers?

A paired samples t-test was performed to investigate the difference between students' paper-based writing performance (PBWP) and computer-based writing performance (CBWP). No significant difference was recognized between PBWP (M = 27.72, SD = 6.70) and CBWP (M = 26.99, SD = 8.54), t(405) = 1.90, p = .058.

2. What are the relationships between students' Chinese input skills and their motivation in learning Chinese and using computers for Chinese assignments?

Structural equation modeling (SEM) was employed to test the fit between the proposed model and the data collected (see Figure 1). This approach was selected for its ability to examine sets of dependence relationships concurrently, especially when there are both direct and indirect effects among the variables within the model (e.g., Kline, 2005). In this study, AMOS 7.0 (Arbuckle, 2006) was used and the SEM estimation procedure was maximum likelihood estimation. Following Hair et al.'s (2006) suggestion, multiple indices were used to assess the model-fit, such as $\chi 2$, Comparative Fit Index (CFI), Tucker Lewis Index (TLI), Normed Fit Index (NFI), and Root Mean Square Error of Approximation (RMSEA). Table 1 presents the recommended level of acceptable fit (e.g., Hair et al., 2006) and the fit indices for the proposed path model. All values of indices exceed the threshold, indicating a satisfactory model-fit.

Table 1: Fit indices of the proposed path model

Fit indices	Recommended level of acceptable fit	Proposed path model
χ^2	$\chi^2/df < 3$, $p > .05$	$\chi^2/df = 1.79$, $p = .056$
CFI	>.95	.98
TLI	>.95	.96
NFI	>.95	.97
RMSEA	<.08	.04

Figure 1 demonstrates the path coefficients of the proposed model. Except for the "LC→CBWP" path, nine out of the 10 paths were significant at the .05 level. As shown in Table 2 (in bold), PBWP was found to exert the largest standardized total effects (β = .48, p < .001) on CBWP. PYSE (β = .09, p < .05), CIS (β = .16, p < .001) and LC (β = .24, p < .001) all have significant total effects on CBWP. Besides, CBWP was also found to be significantly influenced by IM (β = .07, p < .05) and CSE (β = .07, p < .05). Overall, CBWP was found to be significantly determined by the two exogenous variables (IM and CSE) and four other intervening variables (e.g., LC, PYSE, CIS, and PBWP), resulting in an R2 of .30. These results can suggest at least two interpretations. Firstly, students' intrinsic motivation and Chinese self-efficacy influence their computer-based writing performance indirectly. Such an influence was mediated by other variables such as students' language competency, pinyin self-efficacy, Chinese input skills, and their pen-and-paper-based writing performance. Secondly, students' language competency does not have a direct effect on CBWP, but mediated by their Chinese input skills. Third, compared to other variables, students' PBWP seems to influence their CBWP the most. Fourth, about 30% of the variance in CBWP can be explained by the exogenous and intervening variables. This indicates a "moderate" effect size according to Cohen's (1988) suggestion.

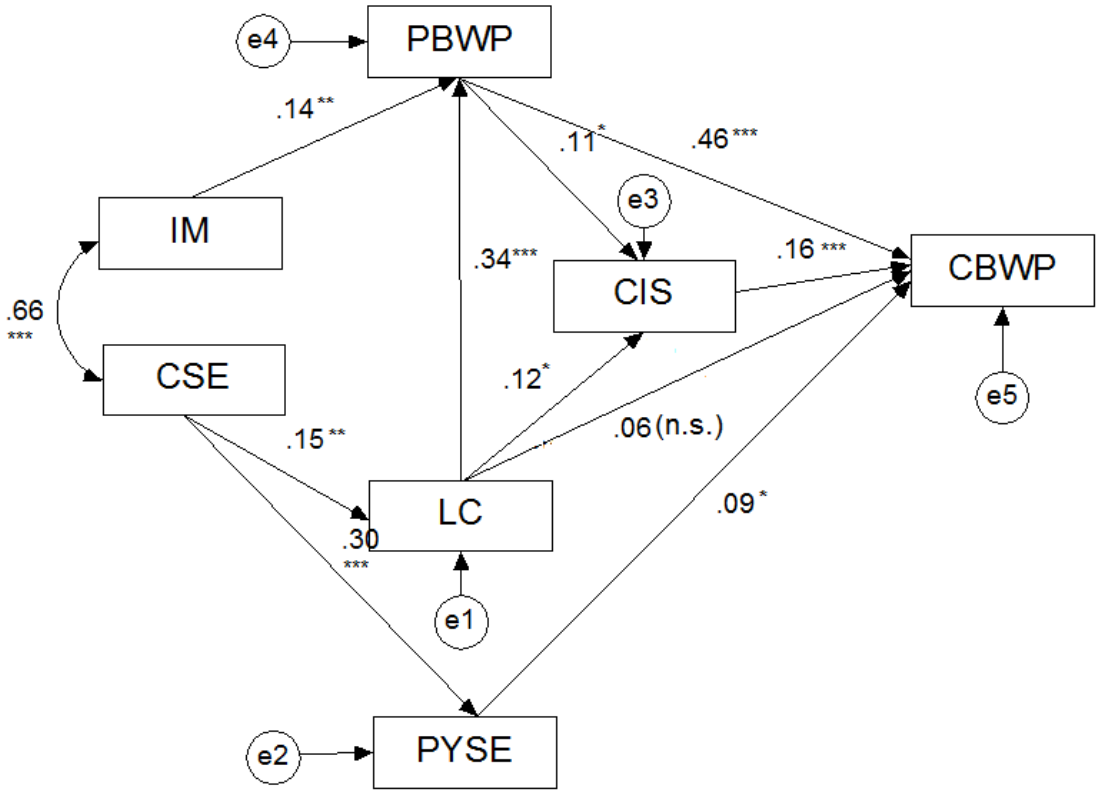

Figure 1 Model path coefficients. n.s., not significant; * p < .05; ** p < .01; *** p < .001

Table 2: Unstandardized and Standardized effects for the path model

Variable	CSE	LC	IM	PBWP	PYSE	CIS
LC						
Direct effect	.09 (.15)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Indirect effects	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Total effect	.09 (.15)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
PBWP						
Direct effect	-- (--)	5.24 (.34)	1.14 (.14)	-- (--)	-- (--)	-- (--)
Indirect effects	45 (.05)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Total effect	45 (.05)	5.24 (.34)	1.14 (.14)	-- (--)	-- (--)	-- (--)
PYSE						
Direct effect	32 (.31)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Indirect effects	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)
Total effect	.32 (.31)	-- (--)	-- (--)	-- (--)	-- (--)	-- (--)

CIS						
Direct effect	-- (--)	4.95 (.12)	-- (--)	.31 (.12)	-- (--)	-- (--)
Indirect effects	.56 (.02)	1.64 (.04)	.36 (.02)	-- (--)	-- (--)	-- (--)
Total effect	.56 (.02)	6.59 (.16)	.36 (.02)	.31 (.12)	-- (--)	-- (--)
CBWP						
Direct effect	-- (--)	1.10 (.06)	-- (--)	.59 (.46)	.97 (.09)	.08 (.16)
Indirect effects	.71 (.07)	3.58 (.18)	.70 (.07)	.02 (.02)	-- (--)	-- (--)
Total effect	**.71 (.07)**	**4.69 (.24)**	**.70 (.07)**	**.61 (.48)**	**.97 (.09)**	**.08 (.16)**

Note: Figures in parentheses show the standardized effects

3. What is the recommended cut-off level of pinyin input skill (in terms of minimum average number of Chinese characters inputted per minute) that students need to possess so that there will be no significant difference in their performances in Chinese Language writing when they use pen and paper versus when they use computers?

The cut-off value of the variable Word Processing Speed (indicating Chinese input skills, CIS) was also investigated through paired samples t-tests. Based on the Median and Mode of CIS (both are 21.50), 22.00 was used as a potential cut-off value to check the difference between PBWP and CBWP. When word processing speed (indicating Chinese input skills, CIS) is less than 22.00, students' pen-and-paper-based writing performance (M = 27.11, SD = 6.54) was significantly higher than their computer-based writing performance (M = 25.76, SD = 8.62), t (199) = 2.42, $p < .05$, effect size d = .34. According to Cohen (1988), the effect size was regarded as "small". When word processing speed equals to and exceeds 22.00, no significant difference was recognized between students' PBWP (M = 28.68, SD = 6.58) and their CBWP (M = 28.57, SD = 7.91), t (191) = .21, p = .83.

ADDITIONAL FINDINGS

Difference in the numbers of spelling errors. A paired samples t-test was performed to examine the difference between the two writing test regarding the numbers of errors in Chinese characters input. No significant difference was observed, t (405) =.1.35, p =.18. This indicates that using computer for writing test may not result in increasing or reducing error numbers.

Difference in PBWP and CBWP between HCL and CL students. Independent samples t-tests were conducted to investigate the differences between HCL and CL students regarding their PBWP and CBWP. Results suggested that HCL students (M = 29.51, SD = 6.59) performed significantly better than CL students (M = 26.78, SD = 6.68), t (415) = 3.94, $p < .001$. However, no significant differences in CBWP were found between HCL (M = 28.04, SD = 8.82) and CL students (M = 26.37, SD = 8.49), t (406) = 1.85, p = .07.

DISCUSSION AND CONLUSION

Changing the medium of examination is a major decision for any education system. Examination drives teachers' behavior and action, as revealed in many research papers (Lim & Chai, 2008; Tan, et al., 2010). A decision to open up the alternative of allowing computer-based Chinese language examination would definitely drive teachers to use more ICT in their classrooms instead of confining students' learning to paper-and-pen based activities. This is congruent to Singapore's effort in promoting the use of ICT. In addition, as students are spending more time on computers via social networking sites (Greenhow, et al., 2009), moves toward building students' capacity in using Chinese when working on computers is also more attune to students' lifestyle. Most importantly, students' competency is using Chinese input system prepare them better for their work life. In this study, the first encouraging finding is that the medium of input does not has statistically significant effects on students' composition scores for this group of students. This provides a basis to elevate fears that changing towards computer-based input may have adverse influence on students. Previous studies indicates that word processing improves the overall presentation of the essay by removing illegible hand writing and promoting a more formal tone (Goldberg, et al., 2003; Wolfe & Manalo, 2004). This however did not result in students obtaining better scores in this study. In addition, as indicated by the findings for the second research questions, the decision of adopting computer-based input for examination has to be made based on thorough studies of a collection of associated variables.

The structural equation model obtained in the study indicates that students' computer-based writing performance is related to a number of variables. The most important variable is their paper-based performances, follow by their input speed and their pinyin self-efficacy. These variables are in turn significantly associated to the general language competency, computer self-efficacy and students' learning motivation. As such, decision to change should be based on systemic studies of associated variables rather than isolated variables. This study contributes to research by exploring the relationships among the identify variables and it provides some initial picture of

which variables matter. Subsequent research can study how other variables such as students' learning strategies or conception of learning pertaining to the learning of Chinese language, students' views about the value of using computer for the learning of Chinese language; and how the teaching practices associated with Chinese language (teacher-centric versus student-centric instruction) are structurally related to students' performances. The variables investigated in this study accounted for 30% of the variances, indicating more variables need to be considered. Educational change need to be systemic rather than in a piecemeal manner (Sterling, 2001). Teachers' view about the matter has to be also carefully surveyed and considered. Without coordinated changes in especially teaching practice, and therefore the need for substantial professional development, abrupt changes is likely to be harmful and it adds difficulty to subsequent changes.

This study was able to identify the input speed of 22 words per minute as the tipping off point where computer-based composition would results in better test scores. This finding has to be replicated by more rigorous research where a larger sample of students and a more rigorous test scoring is put in place. The current research achieved inter-rater agreement of 71%. While the researchers would argue that the outcome is acceptable, ideally, it was preferred that all essays would be double-marked by qualified examiners following the exact procedures of the national examination. Funding situation prevented the researchers from being more ambitious.

The additional findings of this study inform educators that the use of computers do not result in more misspelled Chinese characters. This is important because some teachers may feel that students often choose wrong Chinese characters and that handwriting will help students to remember the correct words better. Such notion is not supported by this research but more studies on the types of misspelling that could occur for both handwritten composition and typewritten composition should be conducted for deeper understanding. Research in this area will help to inform the various strategies necessary to enhance students' ability to write in both modes. Lastly, the computer-based input does not seem to disfavor students with weaker language competency. This provides additional ground for the adoption of Chinese input system.

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APPENDIX A: THE 13-ITEM QUESTIONNAIRE

IM1 学习华文，对我来说是重要的。 (Learning Chinese is important to me.)

IM2 我对学习华文很有兴趣。 (I am interested in learning Chinese.)

IM3 我在华文课所学到的知识有用。 (The knowledge that I have learned in the Chinese lessons is useful.)

IM4 我喜欢上华文课。 (I like to study Chinese lessons.)

CSE1 我能在华文科考到好成绩。 (I can get better grades in Chinese exams.)

CSE2 我能学会华文课所教的语言技能。 (I can pick up the language skills being taught in Chinese lessons.)

CSE3 我能在华文课业和考试中，取得良好的表现。 (I can do an excellent job in Chinese lessons and exams.)

CSE4 我在华文课里会有好的表现。 (I can perform well in Chinese lessons.)

CSE5 我能掌握华文课所教导的技能。 (I can master the skills being taught in Chinese lessons.)

PYSE1 使用拼音输入法能帮助我把作文写好。 (Using pinyin input can help me in writing good essays.)

PYSE2 使用拼音输入法能帮助我在作文方面得到更好的分数。 (Using pinyin input can help me in getting better grades in essays.)

PYSE3 使用使用拼音输入法能减少我写作文的困难。 (Using pinyin input can reduce my difficulty in writing essays.)

PYSE4 使用拼音输入法时，我的作文写得更快。 (I can write essays faster when I use pinyin input.)

PYSE5 拼音输入法能减少我在作文时查字典的时间。 (Using pinyin input can cut short the time in checking the dictionary when I am writing essays.)

APPENDIX B: ROTATED FACTOR LOADINGS AND CRONBACH'S α VALUES FOR THE THREE FACTORS

Items	Factor 1	Factor 2	Factor 3
Factor 1: Chinese Self-Efficacy (CSE) (α = .90)			
CSE 3	.86		
CSE 1	.83		
CSE 4	.76		
CSE 5	.73		
CSE 2	.70		
Factor 2: Pin-Yin Self-Efficacy (PYSE) (α = .87)			
PYSE 3		.84	
PYSE 1		.83	
PYSE 4		.79	
PYSE 2		.77	
PYSE 5		.74	
Factor 3: Intrinsic Motivation (IM) (α = .87)			
IM 4			.81
IM 3			.78
IM 2			.77
IM1			.76
Eigenvalues	5.96	2.65	1.09
% variance explained	24.77	23.56	20.93