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Implications of AES System of Pigai for Self-regulated Learning

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***Abstract*—Recent preoccupation with Chinese English-as-the-foreign-language (EFL) learners' unsatisfying writing performance leads to a growing interest in the use of automatic essay scoring system (AES) in EFL writing in China. Pigai (www.pigai.org), being an online AES system specialised for Chinese EFL learners, has been popularised. Yet, research into Pigai is underdeveloped and constrained by simply evaluating its linguistic effectiveness; while this research innovates in investigating the efficacy of Pigai as a self-regulated learning (SRL) instrument to judge whether it should be promoted to benefit Chinese EFL learners' writing. This study analysed and compared the changes in the quality of texts after revising via Pigai and contrasted learners' tendency to English writing before and after the use of Pigai, ultimately examining its qualification as a SRL instrument along the sociological, pedagogical and psychological dimensions. Data for this study was collected via an experiment and follow-up interviews with undergraduate Chinese EFL learners. Results suggest that Pigai users achieved improvements in the quality of the texts and showed greater passion and persistence, as well as confidence, oriented to EFL writing. It is thus inferred that Pigai is qualified enough as a SRL instrument and could be applied into Chinese learners' English writing.**

***Index Terms*—Pigai, self-regulated learning, EFL writing**

I. Introduction

Automated essay scoring (AES) system refers to the computer technology assessing the written texts based on artificial intelligence, computational linguistics and cognitive science foundations (Burstein, Chodorow, & Leacock, 2004). Despite its prosperity for a long time, it was not until the past decade that AES systems aiming at Chinese EFL students appeared. "Pigai" (www.pigai.org), being most widely-adopted among them, is designed to help Chinese EFL learners evaluate their own writings by providing scores and feedback oriented to the target text. An overall score (see Fig. 1.1), along with feedback, is promptly on the screen after the submission of the work, according to which users could be aware of the quality of their writings. In terms of feedback, a general one (see Fig. 1.1) is offered regarding the holistic linguistic usage and structure of the text; and specific feedback (see Fig. 1.2) is provided per sentence, facilitating learners to locate the mistakes.

Figure 1.1 The overall score and general comment of "www.pigai.org**"**

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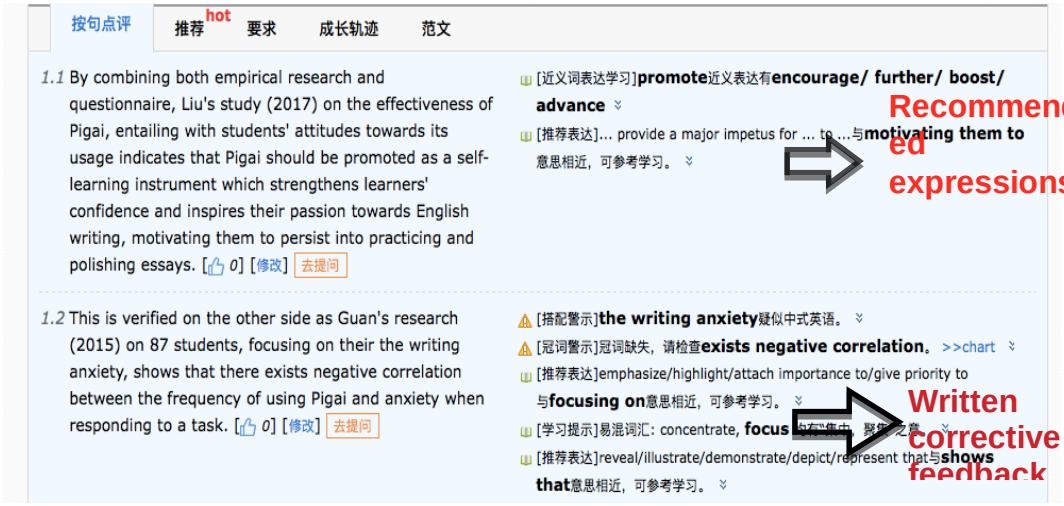

Figure 1.2 Written corrective feedback and learning suggestions of "www.pigai.org"

Owing to its strong feature set and the simplicity of assessing process, Pigai makes judging writings of Chinese EFL students automatically with just a few human-scored benchmark essays exist on-the-fly. Its allowance of multiple submissions might boost the virtuous writing circle of practice, revision and improvement, therefore promoting it as an instrument fostering learner autonomy that is indispensable in the second language (L2) learning. While due to its deviation from traditional artificial evaluation, people remain skeptical towards its usefulness. Thus, the aim of this study is to investigate the effectiveness of Pigai as a self-regulated learning (SRL) instrument from three dimensions of sociological, pedagogical and psychological.

II. Self-regulated Learning and Second Language Writing

The idea of fostering learners' own responsibility has long been deemed as the ultimate end of education. Either cognitive or behavioural activities where learners engage in to accomplish their educational goals have been referred to as self-regulation (Zimmerman, Bonner & Kovach, 1996). Self-regulated learning requires learners' ability to take control of their learning that is dynamic and affected by various factors (Holec, 1981). Given that learning a language is far more than superficially acquiring its grammatical rules, the position of SRL is thus of paramount importance. While as Wiggins (1999) notes, it is not teaching that causes learning, rather "it is attempts by the learner to learn, to make meaning, to internalise" (p. 8). SRL as a double process not simply entails learning a foreign language, but also learning how to learn. This is congruent with Long (1989) who conceptualises SRL along the sociological dimension, the pedagogical dimension and the psychological dimension, as elaborated below.

Social-cultural theory defines SRL as an interactive, social process that engages "learners' capacity and willingness to act independently and in cooperation with others" (Dam, 1990, p. 231). Najeeb (2013), based on his empirical study on learning tools, demonstrates their importance for developing learner autonomy and independence; as they assist learners to understand real goals and to develop necessary skills that help them succeed in reaching these goals. Therefore, according to Thanasoulas' study (2000), autonomous learners are characterised as those who show insights into their own learning strategies, take an active approach to the learning task, be willing to take risks, complete homework whether or not it is assessed and place importance on accuracy as well as appropriacy; besides, more efficient SRL is never to learn on one's own, but to interact with outside and adopt any possible learning tool and strategy.

According to Najeeb (2013), three basic pedagogical principles should underline autonomy in language learning including learners' sharing of responsibility, learners' reflection of critical thinking and learners' appropriate use of target language. In other words, learners are required to bear their responsibility to think the target language as the principal medium. Notedly, the regular review of learning and ongoing evaluation of the learning process could never be dismissed, as the improvement in the use of target language has been valued as the most important criterion of successful SRL along the pedagogic dimension (Najeeb, 2013).

Though encompassing both the sociological and pedagogical constructs, Long (1998) asserts that only "the psychological conceptualisation is sufficient to explain SRL" (p. 10). Manifestations representing the psychological undergirding include conative factors of initiative, resourcefulness and persistence that are intrinsically interrelated (Confessore, 1991). Frese, Kring, & Soose (1996) conclude a person displaying initiative should be both goal-directed and action-oriented. The former one refers to the conation of establishing learning goals and working towards their accomplish-

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ments; the latter refers to the rapidity of transforming one's intention on learning into the actual activity. It is concluded that the self-starting behaviour is influenced by the expected outcomes, the anticipated self-satisfaction and also the perceived presence of obstacles (Confessore, 1991). Resourcefulness is conceptually used to describe whether a person is capable of dealing with problematic situations that induce stress (Confessore, 1991). Learning activities cause stress not only from learners' obligation to extend capability, but also from their decisions concerning which activities to pursue among all that vie for the learner's time and energy (Rosenbaum, 1980). Therefore, learner resourcefulness generally consists of the activation of prioritising learning over other activities, delaying immediate gratification and also solving problems in one's own learning. According to Zimmerman et al. (1996), the volitional process important to persistence in SRL usually involves self-evaluation and monitoring, strategy implementation and monitoring, and strategic outcome monitoring. Self-evaluation and monitoring occurs when learners compare their current levels and desired levels of achievement. To reduce the discrepancy between both requires the strategic implementation and monitoring. It further involves the process of strategic outcome monitoring in which learners judge whether adopted goals and plans lead to desired outcomes (Carr, 1999).

III. Pigai--An Automated Essay Scoring System

Despite the prosper development of Pigai, due to its new emergence and its target group of Chinese EFL learners, scholarly literature to date on Pigai is rather confined to its validity, the system design and its effectiveness on users' texts.

By analysing writing samples from college students' essays, Shi (2012), being the pioneering researcher of Pigai, suggests that its prompt feedback succeeded in enhancing essays' accuracy of vocabulary and grammar. This has been verified by Ma & Zhen (2016) through their replicated study. All support that Pigai feedback is useful in motivating learners to focus more on their linguistic errors. Targeting at high school students, Li (2016) concludes that Pigai benefitted learners by developing their explicit knowledge; thus gains could be manifested through increasing accuracy and complexity. While based on findings from Huang & Zhang (2015), no progress was observed in the quality of writings, since feedback of Pigai was too general to be valid for enhancing their works. Other scholars (i.e., Zhong, 2015; Chen, 2013; Yuan, 2015) embrace more negative attitudes towards Pigai's effectiveness by stating that revision is limited to very superficial linguistic problems, leading to inconspicuous composition optimisation by using Pigai as a revising tool.

By synthesising research findings to address the relationship between multiple motivation constructs and writing outcomes in academic settings, Pajares' (2010) demonstrates that learners' writing motivation influences writing outcomes. The effects of Pigai on learners' writing enjoyment have also interested Pigai researchers. Wu (2017) investigates the effects of Pigai on college students' English writing self-efficacy, whose result implies that Pigai significantly increased learners' English writing self-efficacy and passion. Chen's study (2015) is congruent with Wu while he additionally compared the writing anxiety before and after users' adoption of Pigai, also demonstrating its positive effects on increasing students' writing willingness. By combining both experiment and questionnaire, Liu (2017) indicates that Pigai could be promoted as a SRL instrument that strengthened learners' confidence and inspired their passion towards English writing, spurring them to persist in polishing essays. This is verified on the other side by Guan's writing anxiety research (2015) showing that there exists a negative correlation between the frequency of using Pigai and anxiety when responding to a task. Data sourced from interviews of Zhang's analysis (2017) presents that, in spite of some complaints, users holistically were in favour of its application into L2 learning, since it enabled them to fill up the blank area and bolstered their confidence. By comparing the quantifying motivation of those using Pigai to revise their writings and those getting feedback from teachers, Jiang, Jin, & Wang (2018) concludes that the use of Pigai promoted students' achievement motivation to develop their English language skills.

As indicated above, there is a fierce debate over the effectiveness of Pigai both as a revising tool and as an impetus for writing. Pigai researchers claim its varied efficacy on linguistic aspects of the texts; while it should be noted that some studies might be out-of-date due to Pigai's constantly-improving accurateness and enlarging corpus, therefore requiring further research to re-evaluate. When it comes to the psychological part, few literatures on Pigai has centred on more motivation constructs than the simple writing self-efficacy. It is thus necessary to study the possible improvements in learners' multiple affective constructs with the adoption of Pigai. Deeper investigations into the effectiveness of Pigai might, to a great extent, evaluate whether this AES system could be promoted as a SRL instrument beneficial for Chinese EFL learners' English writing and lifelong language acquisition.

IV. Methodology

This study aims to investigate the efficacy of Pigai on L2 users' SRL in the EFL writing domain. To this end, its pedagogical, psychological and sociological effectiveness as a SRL instrument should be assessed, thus generating the research questions as follows:

1). How do the quality of the texts change after users' adoption of Pigai?
2). How do ELF users' tendency towards English writing change with using Pigai?
3). To what extent does Pigai facilitate L2 learners' SRL in EFL writing?

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A. Participants

Six subjects volunteered to participate: four are female (Irene, Ivy, Iris and Effie) and two are male (Jack and Tony) (all names used are pseudonyms chosen by the participants). All of them has been rigorously evaluated as band six based on the IELTS point system within one week of the implementation of this study to ensure that their L2 writing levels were fairly uniform. All subjects are Mandarin-as-the-first-language undergraduate students ranging from 20 to 22 years old.

Three professional raters were recruited from a qualified IELTS training agency. Two are NSs of English and one is a Chinese EFL speaker. All of them hold the certificate in Teaching English as a Foreign Language (TEFL) and have taught the writing part of IELTS in the IELTS training agencies for more than eight years, owning full experience of judging the writing part of IELTS test.

B. Instruments

An experiment of pre-test and post-test design was devised. Pre-test and post-test were same that required all subjects to write an essay on an item related to news media (see Appendix A), considering its closeness to daily life that minimises the bias caused by subjects' varied familiarity with the topic. The pre-test was applied to determine the starting point of the subjects' writing achievement, while the post-test was given to measure changes in the quality of subjects' texts after the treatment.

The effectiveness of Pigai on driving users to write will be judged through semi-structured interviews that allow respondents' sufficient flexibility and clarification of their answers. To keep the whole process topic-oriented, guiding questions were generated concerning user' affective changes in their English writing perceptions. All interviews were on an one-to-one basis for the purposes of 1) avoiding the interference of other informants; and 2) making most questions personalised to facilitate the variety of interviewees' responses (Bailey, 1994).

C. Procedures

On the scheduled date, the experiment was carried out in a quiet study room equipped with computers, while subjects were also permitted to use their own laptops to reduce the influences of using unfamiliar computers. All subjects were asked to write an essay on their attitudes towards news media as the pre-test within 45 minutes and send their initial drafts to my e-mail address that was encrypted and only accessible to me. Then, they were provided with full time to constantly polish their texts with the assistance of Pigai until they were satisfied; the whole revising process lasted for 20 to 40 minutes up to the individual, after which their final drafts were alike sent to my personal e-mail address. Writings were then anonymised, printed on the paper and brought to the IELTS training agency, where three well-trained human raters scored every text carefully to give an overall score. It should be noted that human scores were ranging from 0 to 100 so as to be sensitive to any change and the score of each text was the average of three.

Within the four days of the experiment, three participants among six were randomly chosen to be interviewed respectively in different places. Each interview endured for approximately 10 minutes and was recorded with my personal encrypted mobile phone, during and after which I took down notes that I valued. Processes were carried out in Mandarin so that interviewees were able to fully elaborate their ideas and thoughts without linguistic obstacles.

D. Data Analysis

Statistical data obtained from the experiment was entered into SPSS version 24.0 for analysis. To see how significant improvements in the quality of the texts were after revision, paired-samples *t* tests were conducted between scores before and after revision to determine whether Pigai is effective in improving the quality of the texts.

Before analysing the qualitative data from interviews, the audio-recorded interviews were broadly transcribed with relatively little detail in the transcription convention adopted by Adger & Wright (2008) so as to not only avoid the premature editing of potentially relevant content (Dornyei 2007), but also save time when broad transcription suffices (Mackey & Gass, 2005). Process coding of the transcribed data facilitated by the tool of NVivo contributed to the natural emergence of several topics of learners' persistence in writing, learners' passion for writing and learners' confidence in writing.

V. Results

To answer the first research question concerning the pedagogical effectiveness of Pigai, differences of scores rated by human-raters prior to and post the treatment were measured to present the increase in the quality of the texts. Analyses were performed by applying paired-samples *t* tests to all scores to examine whether significant differences exist after revision.

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Table 5.1 The result of paired-samples *t*-test for overall scores rated by human raters

Measure	M	SD	p	d	t
Pre-test	65.53	3.89	0.22	0.84	-0.84
Post-test	68.47	3.04			

Scores given by raters indicate that Pigai enhanced the quality of the texts. Table 5.1 below presents the mean scores for the pre-test (M = 65.53%) and post-test (M = 68.47%) showed an increase of 2.94%. Although no statistically significant difference (p = 0.22>0.05) was found due to the small sample size, the Cohen's *d* value — an effect size to evaluate the effectiveness of the treatment — were fairly large (d = 0.84), as d = .4 is small, d = .7 is medium, and d = 1.0 is large (Oswald & Plonsky, 2010). Since *d* value, being independent from the sample size, is believed to be a much better indicator of the importance of a result than the p-value (Kline, 2004), there are therefore good reasons to think that Pigai revision are effective in improving L2 learners' texts.

Qualitative data from the interviews are categorised into L2 writing confidence, persistence and passion. Despite the interrelation between these themes, each one is explored individually in a separate sub-section. The interview extracts presented in this section typify the themes represented.

According to interviews, higher score, instant feedback and unlimited time allowance are considered as factors reinforcing learners' tendency for persisting in writing, as reflected in the Extract 1 and 2.

Extract 1

Irene: I had pressure, like an obsessive-compulsive disorder... if I know there's still room for me to improve, I can't stop myself putting more efforts. I feel guilty when I'm perfunctory.

Extract 2

Jack: There were times when I wanted to review my texts..for example, the next day after the writing. But as I mentioned, there were always deadlines and long waiting. That's why I just give up revising and put texts with feedback aside…

Another category is related to participants' perceived improvements in their passion towards writing; all of them expressed that they felt more motivated. One respondent owed this stimulation to the instant score generated by Pigai,

Extract 3

Irene: Pigai lets me know where to improve and how to improve... I'm chasing for a higher score and meanwhile for a better performance in writing. The process of scoring, of quantifying just makes the whole thing more meaningful and worth challenging.

Respondents also stated they felt more pleasant when using Pigai, as shown in the Extract 4,

Extract 4

Jack: I could write whatever I want.. and there was no need to worry about my performance.

To sum up, Pigai is demonstrated to be effective on alleviating psychological burdens and spurring learners to write and revise more.

Responses from interviews also suggested that Pigai could, to a limited extent, boost learners' confidence in writing. And all interviewees agreed upon higher scores after revision to be the most encouraging reason, as seen in the following extracts.

Extract 5

Iris: Any increase, even one or two points, provided me with a sense of accomplishment... that's like my competence, or efforts, has been recognised...

Extract 6

Iris: I think the confidence should be credited to words, phrases and collocations Pigai provides that make the whole text seemingly...classier.

However, Pigai's feedback, on the other hand, confused learners.

Extract 7

Irene: It says there is inappropriateness between the subject and the verb, but actually there is not.

Extract 8

Jack: Pigai always warned me of Chinglish collocations while no alternative was given. I could only replace them with easier words.

Thus, Pigai did exert positive influences by reducing participants' anxiety of making errors, offering more alternative expressions and giving higher scores after revision; yet, its negative effects caused by inaccurate feedback might be a weapon to slash participants' confidence in writing.

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Through analyses of the experiment data and the interview data, the effectiveness of Pigai as a SRL instrument could be presented. The results reveal that Pigai was useful in improving the qualities of the texts and facilitated EFL learners' persistence and passion towards English writing with good reasons to support, whereas participants' confidence in English writing was influenced in two ways.

VI. Discussion

To discuss the effectiveness of Pigai as a SRL learning instrument, three dimensions of sociological, pedagogical and psychological should be considered.

From the sociological perspective, Pigai fully fulfils the requirements addressing L2 learners' isolation and social-interaction. Users were asked not only to complete but also to revise their works independently without supervision or step-by-step guidance from professionals. While notedly, working independently is never equivalent to working alone, as SRL is also defined as a matter of supported performance involving learners' ability and tendency to act in cooperation with others (Vygotsky, 1991). The vitality of learning tools for developing learner autonomy and independence has also been emphasised by researchers, as they facilitate learners to find their real goals and develop requisite skills to achieve those goals. Pigai, in this sense, is qualified enough, considering its stimulation for learners to respond actively to the task and simultaneously place importance on both accuracy and appropriateness.

In terms of the pedagogical dimension, Najeeb (2013) proposes three elementary principles underlining autonomy in language learning, including learners' involvement of sharing responsibility, learners' reflection of critical thinking and learners' appropriate use of target language. By empowering learners to exercise their autonomy, Pigai, for one thing, involves learners to participate in the process of writing, monitoring, revising and evaluating, offering learners a sense of responsibility and accomplishment, as interview going with Irene shows it is not only language knowledge she acquired, but also "a sense of writing better [she] could perceive". More vitally, Pigai provides feedback on users' shortage to help to reduce gaps between their interlanguage and the target language. The increasing quality of the polished texts best indicated that Pigai contributes much to the pedagogical improvement of users' EFL writing. Thus, it is at this juncture that Pigai's role in promoting learners' autonomy and in developing practical abilities becomes crucial along the pedagogical dimension of SRL (Benson, 2001).

With regards to the psychological dimension that is "necessary and sufficient to explain self-regulating learning" (Confessore, 1991, p. 10), conative manifestations of the exhibition of initiative, resourcefulness, and persistence (ibid) are required to be presented to show Pigai's effectiveness on improving users' SRL.

Initiative is displayed to be both goal-directed and action-oriented (Frese et al., 1996) elaborated before. Since "the intentionality of action implies a differentiation of ends and means...[whereby] the action is performed in order to bring about a certain goal" (Chapman & Skinner, 1985, p. 201), Pigai users were both goal-oriented with their strong desires for higher scores based on data of interview, and action-oriented reflected through their highly-enhanced passion for writing, presenting greater initiative and therefore facilitating SRL in English writing.

Concerning resourcefulness related to the capability for dealing with problematic situations, it is concluded that to prioritise learning over other activities, to delay immediate gratification and to solve problems in one's own learning should be conducted (Rosenbaum, 1980). Though minimal, the increase of confidence in writing is believed to be indicative of greater resourcefulness adopted by Pigai users, as learners of higher confidence are more likely to embrace favourable attitudes when making choices, expanding efforts and exerting persistence and perseverance (Pajares, 2003). The resourceful behaviours of positive anticipation of future rewards, the priority of learning over other activities and independent problem-solving actions (Carr, 1999) exhibited through the use of Pigai are hence good evidence of its facilitation for SRL.

Despite the great effectiveness of Pigai on helping learners persist in writing reflected through the interviews, it should be noted that persistence in writing and persistence in SRL, though overlap, are conceptually different. Volitional process important to persist SRL involves: self-evaluation and monitoring, strategy implementation and monitoring, and strategic outcome monitoring (Zimmerman et al., 1996). As driven by learners' desire of achieving higher scores, or reducing the discrepancy between their current levels and the ideal level in its essence, self-evaluation and monitoring occurs, the process of which may be accelerated by Pigai based on learners' largely increasing writing persistence after its use. Given that "the establishment of proximal goals provide the learner with immediate feedback thereby facilitating an assessment as to whether the adopt- ed learning strategies enable the learner to reach the ultimate goal" (Ponton & Carr, 2000, p. 275), the enhancing goal-directedness facilitated by Pigai might benefit either strategy implementation and monitoring, or strategic outcome monitoring — as it, from one perspective, helps to narrow the gaps between learners' interlanguage and the target language; meanwhile it also encourages users to reflect upon whether the strategy are adequate for the eventual levels of desired learning. Take together, it is unsurprising that users with developing persistence in writing and enhancing goal-directedness are more inclined to persevere in self-regulated English writing with Pigai as an auxiliary instrument.

To sum up, by reinforcing learners' writing passion, confidence and persistence, Pigai is enormously effective in enhancing the psychological undergirding of individuals' SRL. Whereas the better quality of the texts after revision is also powerful evidence demonstrating Pigai's contributions pedagogically and sociologically as a SRL instrument. It is therefore concluded that Pigai is beneficial for L2 learners' SRL in the EFL writing domain.

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VII. Conclusion

This study highlights many gaps in the literature and draws attention to important pedagogical implications and suggestions for future research. The positive influences of Pigai on users' L2 writing academically and psychologically indicate its potential value in EFL learning. Besides, this AES system is also believed to develop learners' learning autonomy that is necessary in the L2 domain. Notwithstanding its endeavour to guarantee the accuracy of the results, several limitations of the study may affect the outcome. The first issue originates from the credibility of the interview data. Considering the complicatedness of cognitive process, interviewees may be hard to perceive every slight change when responding to their perceptions of affective constructs. The second issue concerns the scope of participants. The current study did not compare the effects of Pigai on learners of varied proficiency while their different metalinguistic capacities might affect the efficacy of Pigai feedback. Thus, future research could take L2 proficiency into consideration to maximise the effectiveness of AES feedback.

In conclusion, the use of Pigai not only helps to improve the quality of the reviewed texts linguistically, but also facilities users' writing tendency, both contributing to foresting greater learner autonomy. Therefore, it is hoped that this study will encourage a wider application of Pigai into SRL so as to impact positively on Chinese EFL writing.

Appendix

WRITING TASK:
You should spend about 45 minutes on this task.
Write about the following topic:
News media has become influential to our life nowadays. Some people think that it is the negative development. To what extent do you agree or disagree?
Write at least 250 words.

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