The Impact of a Metacognitive Self-Regulation Inventory in Translator Self-training: A Pre-post Study with English-Chinese Translation Students

Abstract: The goal of this study was to investigate the impact of repeated use of a metacognitive self-regulation inventory (MSRI) in translator self-training. Designed by the researchers, the MSRI includes the cognitive management strategies of planning, monitoring and evaluation. A pre-post comparison study was conducted with two groups of students. The data obtained from students' responses to the inventory, think-aloud protocols (TAPs), post-task interviews, and translation products assessments were analyzed for triangulation purposes. The results show that an MSRI can be used as an effective tool for translator self-training. Specifically, repeated practice with the inventory in students' self-training processes can effectively increase their awareness of metacognitive self-regulation by diagnosing their strengths and weaknesses, assist them to transform declarative knowledge into procedural knowledge, promote top-down processing mode, and eventually influence the balance of their patterns of metacognitive self-regulation. Furthermore, the strengthening of metacognitive self-regulation encourages students to pay more attention to the communicative function of the translation, and ultimately enhances their translation quality, particularly in the aspects of clarity, vocabulary, morphosyntax, genre conventions, and translation's purpose and target audience.

Keywords: metacognitive self-regulation inventory, translator self-training, translation quality, pre-post study, English-Chinese translation

1. Introduction

In cognitive psychology, the term 'metacognition' is defined as 'cognition about cognitive phenomena', or as 'knowledge about knowing' (Flavell 1979, 906). In the last three decades, studies of metacognition have been highly influential in educational theory and practice, including reading comprehension, writing, and self-regulated learning (see Hacker, Dunlosky & Graesser 1998, 2009). In translation studies, the importance of metacognition has gained increasing attention over the past decade. Translation is composed of several almost equally complex cognitive sub-processes such as reading, text comprehension, semantic transfer, and writing in the target language (Shreve 2009), all processes where skilled performance depends on high levels of metacognition.

In the existing literature, the relationship between metacognition and translation competence (Alves & Gonçalves 2004; Angelone 2010; Angelone & Shreve 2011), as

well as the importance of metacognition in translation pedagogy (Fernández 2008; Fernández & Zabalbeascoa 2012a, 2012b; Fernández & Arumí Ribas 2014; Mellinger 2019; Pietrzak 2018) have been investigated in some depth, with metacognitive questionnaires being suggested as a useful instrument to stimulate metacognition for trainee translators. Most of the metacognitive questionnaires used in previous research have consisted of open-ended questions, with the aim of stimulating and training metacognitive activity by pushing students to examine their own metacognitive processes, and then to improve their strategic competence. However, such questionnaires may not be quite as effective for self-regulated translation and the self-evaluation of translation products. Since no guidelines are given to frame the answers to those open-ended questions, the responses are characterized by variability (Li 2018). For translation students particularly, a questionnaire consisting of closed-ended questions, or that uses rating scales, would be more helpful in focusing their attention on the purposes of the training, meanwhile keeping their answers within our designated scope for conducting comparative analysis. As a level-placement tool, the options provided for each question could on the one hand measure the extent of students' metacognitive activity, and on the other hand guide this activity. The effect of a closed-ended questionnaire is similar to that of self-assessment which is not only an instructional and assessment task, but a learning objective related to the domain of translator competence (Li 2018).

Some previous research (Fernández 2008; Fernández & Zabalbeascoa 2012a) has focused more on the function of metacognitive questionnaires in helping students become aware of their translation strategies, with little attention being paid to the quality of students' translations, one of the ultimate goals of developing translation competence. Fernández and Zabalbeascoa (2012b) are among the very few researchers who have investigated the relationship between the use of a metacognitive questionnaire and translation quality; they found that the 'best-performing students were more strategically and translationally aware in self-evaluating their own translating' (463). They also suggested that translators could employ questionnaires frequently and independently in their self-training processes. It is therefore both relevant and meaningful to explore whether metacognitive questionnaires consisting of closed-ended questions focusing on relevant translation problems could be designed to facilitate translators' self-training and to improve the quality of their translations.

For the purposes of this research, a pre-post study was conducted with two groups of students using data collected from a metacognitive self-regulation inventory (MSRI, or the inventory) designed by the researchers, together with think-aloud protocols (TAPs), post-task interviews, and the assessments of translation products. The following questions are addressed in this paper:

(1) How does the inventory, as a stimulus, help in raising the awareness of metacognitive self-regulation in translation?

(2) What is the impact of the inventory on translator self-training as determined by holistic and analytical quality assessments?

2. Background

2.1 Metacognitive self-regulation and translation

Metacognitive regulation, a set of self-regulatory skills and strategies used by students actively to control and coordinate their learning (Efklides 2008), is regarded as the core and essence of metacognition (Reder & Schunn 1996). According to Shreve (2009, 256), 'consciousness and volition are not sufficient conditions for cognitive activity to be metacognitive; there must also be active, strategic use of cognitive resources to control the progress of the task toward successful completion'. The four dimensions of orientation, planning, monitoring and evaluation are identified as key regulative strategies (De Backer *et al.* 2015). Orientation focuses on the task content, and leads a student to hypothesize about the content or to activate prior knowledge; planning includes selecting and sequencing problem-solving strategies, allocating resources and formulating action plans; monitoring facilitates the control of comprehension and progress, with the aim of identifying inconsistencies and modifying problem solving techniques if necessary; and evaluation involves appraisals of both the process and the product of a problem-solving activity (Meijer, Veenman & Van Hout-Wolters 2006).

The process of translation involves complex problem-solving tasks under the control of metacognition, a scenario not essentially distinguishable from learning processes in other fields. However, in translation practice, orientation and planning cannot be clearly separated as translators sometimes plan their work during the stage of orientation. Moreover, orientation normally occurs at the very beginning of translation, which is not included in Shreve's (2009) definition of translation metacognitive regulation. In order to define clear-cut metacognitive self-regulation strategies in translation, this paper applies a three-strategy categorization of planning, monitoring and evaluation, using Shreve's (2009) definitions. The first strategy, planning, is a predominantly top-down translation process, and sets the schedule for selecting strategies, allocating resources and making modifications in allocation and strategy to achieve a goal. The second, monitoring, is an on-line, bottom-up translation process, and focuses on identifying and modifying any inconsistencies occurring in the translation process from comprehension to production, with error-detection being a good example. The third, evaluation, is predominantly top-down, and is concerned with judging the results of problem solving and translation quality.

2.2 Metacognitive questionnaire for metacognition training

There are four types of metacognition training modes commonly used in Chinese classes, namely, the direct instruction mode, the interactive teaching mode, the cooperative learning mode and the concept map teaching mode (Chen & Zeng 2007, 47). Metacognition training can also be assisted through metacognitive questionnaires, which serve as mediation instruments, breaking down the learning process into more easily manageable chunks (Fernández & Zabalbeascoa 2012a). The method of using questionnaires for training can be classified as a type of direct instruction, in that it transforms declarative knowledge into conditional knowledge, and finally into procedural knowledge. The underlying rationale behind using questionnaires frequently for training is the mere exposure effect, a psychological phenomenon by which people tend to develop a preference for things simply because they are familiar with them

(Zajonc 2001, 224). This principle implied four main points for the design and implementation of the inventory used in this research: first, the inventory should be user-friendly in nature so that trainees are able to follow it and know what to do; second, the inventory should include a list of closed-ended optional questions so that trainees are able to perceive the level of metacognitive awareness they have reached; third, the inventory should be answered repeatedly during the whole training process so that trainees become familiar with each question on it; and finally, it should be possible to use the inventory as both an evaluation instrument and a data collection instrument, tracing the learning process of each student trainee.

3. Developing a Metacognitive Self-Regulation Inventory
3.1 Design of the inventory
Fernández and his colleagues (Fernández & Zabalbeascoa 2012a; Fernández & Arumí Ribas 2014) have designed several open-ended metacognitive questionnaires for translation studies, including, for example, questions on the intention of the sender, the expectation of the receiver, background information of the source text (ST), the coherence of the translation, or stylistic questions involved in the translation. Using these questionnaires as a starting point, together with metacognitive self-regulation dimensions, we designed a new closed-ended MSRI focusing particularly on regulative strategies in English-Chinese translation. The initial inventory included 20 questions, with eight questions on planning, six on monitoring, and six on evaluation. It was presented to three professors in linguistics in a seminar to "avoid a completely subjective writing and item categorization" (Angelelli 2004: 53). Their constructive feedback on the accuracy, clarity, relevance and readability was integrated into the final version of the inventory. The participants' responses to each question were measured using a 5-point Likert scale (ranging from '1 for not consistent' to '5 for completely consistent'). The result of each question provided a measure of the extent to which trainees had activated their metacognitive self-regulation in translation.

3.2 Pilot test with the inventory
Copies of the MSRI were distributed in class to 96 first-year MA students specializing in English from a Chinese university. Among the 96 copies of the inventory we collected, 23 were eliminated from the study owing to missing responses, resulting in an effective response rate of 76.04%.

First, KMO and Bartlett's test were used to verify the structural validity of the inventory. Then the principal axis factoring extraction method was adopted for factor analysis, and the maximum variance method was used for rotation. Items with loading factor coefficient above 0.6 are regarded as acceptable for educational research (e.g., Widodo *et al*. 2020; Yang & Mindrila 2020). Therefore, five questions that contributed less than 0.6 to the factors were eliminated as they could not satisfactorily reveal or reflect any dimension of metacognitive self-regulation, and thus could play no effective role in stimulating participants.

The finalized inventory included 15 questions (see Appendix 1), with Cronbach's Alpha of overall reliability being 0.80, and Cronbach's Alpha for translation planning,

monitoring and evaluation being 0.89, 0.82 and 0.85 respectively, indicating that the inventory had a high level of reliability. Both of the KMO test (KMO=.74) and the Bartlett's spherical test (χ^2=574.29, df=105, p<.001) indicate that the inventory had a high level of construct validity. Thus, using principal axis factoring, another round of exploratory factor analysis was performed on the finalized inventory to determine the best factor structure for representing metacognitive self-regulation in translation.

Table 1. Rotated Factor Matrix[a]

	Factor 1	Factor 2	Factor 3
Q1	*.851*	.034	.094
Q2	*.814*	.085	.052
Q3	*.787*	.191	-.073
Q5	*.751*	.149	.085
Q4	*.650*	.030	-.077
Q6	*.638*	.036	-.021
Q13	.181	**.765**	.011
Q12	.108	**.763**	-.056
Q15	.067	**.747**	.149
Q11	.118	**.706**	.045
Q14	-.026	**.686**	.076
Q8	-.040	-.029	*.851*
Q7	-.027	-.001	*.741*
Q9	.024	.118	*.715*
Q10	.055	.091	*.631*

Extraction Method: Principal Axis Factoring.

Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 5 iterations.

Table 2. Relation between factor analysis and pre-determined dimensions

Result of factor analysis	Questions	Pre-determined dimensions
Factor 1	Q1, Q2, Q3, Q4, Q5, Q6	Translation planning
Factor 2	Q5, Q6, Q9, Q10	Translation monitoring
Factor 3	Q11, Q12, Q13, Q14, Q15	Translation evaluation

As can be seen in Table 1, the factor loadings were between 0.63 and 0.85, indicating that the above three factors could be employed to summarize the application of metacognitive self-regulation in the translation process.

The final inventory involves six questions on planning, four on monitoring, and five on evaluation (see Table 2), with different questions falling into corresponding pre-determined dimensions. The results of the factor analysis suggested that the inventory had reliability and validity, and effectively reflected the three dimensions of metacognitive self-regulation.

4. Research Design

4.1 Participants

One hundred and forty first-year MA students specializing in English from two Chinese universities expressed their willingness to participate in the research. They were not the same group of students who participated in the inventory pilot testing. After screening, 30 students with an average age of 23.13 years (range 22-24, SD=.57) who shared a similar but weak awareness of metacognitive self-regulation in translation (mean MSRI=37, range 31-40, SD=2.18) were recruited as participants. They were all native Mandarin Chinese speakers who had English as their second language (L2) with an average age of acquisition (AoA) being 9.8 years (range 9-10, SD=.41). None of them had been brought up in a bilingual context, or had had experience of conducting professional translation. They had all passed the TEM8[1] test, and could be ranked as 'very good users' of English. They were further tested for English-to-Chinese translation proficiency, and all were at passable level, with a mean score of 58% (range 50-60%, SD=.31). Among the 30 participants, 12 came from Hunan University, and 18 came from Changsha University of Science and Technology. They were randomly and evenly assigned to the control and the self-training groups using Excel formulas. Although there was an imbalance in the number in each group at each university, the two groups had no significant differences in their ages (p=.53), L2 AoA (p=1.00), scores in the translation test (p=.25), or MSRI scores (p=.70). All participants were assured that anonymity and confidentiality would be respected. They signed consent forms, and received 100RMB book vouchers as a reward for their work. The research was approved by the research ethics committee of a Chinese university.

4.2 Materials

We employed an online readability test[2] to make a holistic assessment of the readability of the STs, which include ten authentic English texts. Their average readability scores, based on all five US reading grade levels (Automated Readability Index, Flesch-Kincaid Index, Coleman-Liau Index, Gunning-Fog Index and SMOG Index), indicated that to successfully comprehend the texts, a reader would have had to have completed 13 years of schooling. Four students with language and education backgrounds similar to the selected participants were invited to evaluate the translation difficulty of the texts based on the NASA-TLX scales (Sun & Shreve 2014; Liu, Zheng & Zhou 2019). Following these evaluations of readability and ease of translation, two texts of comparable difficulty were chosen as the pre-intervention (Text A) and post-intervention (Text B) texts (see Appendix 2). The other eight texts were used as intermediate translation tasks for metacognitive self-regulation training. Translation tasks were chosen to be short enough to be completed in about 50 minutes to avoid possible fatigue effects on the participants.

4.3 Research Settings

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[1]TEM8 is a higher level national test for fourth year college students majoring in English in China. It mainly tests students' integrative ability to use English as a foreign language, including components of listening, reading, writing and translating.

[2]https://www.webfx.com/tools/read-able/

The intervention consisted of ten translation tasks, with the tasks carried out at 3-day intervals. Each participant was asked to think aloud when conducting translation tasks with online resources accessible. All translating activities were recorded by BB FlashBack Pro5 (a screen recording programme), running synchronously with voice recording. Immediately after the completion of a translation task, the 15 participants from the self-training group were asked to fill in the MSRI, and the other 15 participants from the control group were asked to fill in another questionnaire with questions including whether they had seriously completed the translation task and whether they were satisfied with their translation. The questionnaire for the control group was used as a sham stimulation; the goal was to exclude the interference caused by the very act of doing a questionnaire which reminded students that their translation behavior was being monitored. After the completion of the first (Text A) and the last task (Text B), all 30 participants were asked to attend post-task individual interviews with one of the researchers. All students completed the tasks in the same order.

4.4 Data collection
The data were collected in a library study room where each participant conducted his/her translation task, completed the MSRI, and did the post-task interview individually in order to avoid any social interaction. All group members were able to choose their own convenient time-slot within the given dates.

TAPs and post-task interviews were employed to monitor the role of the MSRI during translation. The TAPs allowed us access to the participants' metacognitive behavior. Although scholarly concerns have been expressed about their reliability in providing representative data for the change of task paradigm (Bernardini 2001), TAPs have the advantage of reporting real-time behaviors and internal thoughts, which is recognized as a useful method for documenting metacognitive activity (Angelone 2010; Bannert & Mengelkamp 2008). Both the TAPs and MSRI data were used to determine whether there were real changes in the participants' metacognitive self-regulation while translating. Post-task interviews are useful in investigating metacognitive activities in that they allow interviewers to probe participants' answers to the interview questions (Akturk & Sahin 2011). Thus this method was used to collect the self-training participants' comments on the three dimensions covered by the MSRI and the two groups' reflections on their 'problem solving bundles' (Angelone 2010), including problem identification, solution proposal and solution evaluation. Four raters with over five years' translation teaching experience were invited to assess all the translations of Texts A and B. The raters were given all the translations of Text A and B in a random order when all the intervention tasks had been completed. Raters were blind to students' membership of the training or control groups. They used the holistic assessment criteria prepared for the TEM8 (Appendix 3), and the analytical assessment rubric proposed in Hurtado Albir (2015), and each of them scored a total of 60 translations independently of the other three.

5. Quantitative Results and Discussion
5.1 Metacognitive self-regulation in translation

5.1.1 Overall development

We conducted a paired sample t-test on the MSRI scores produced by the self-training group for Texts A and B, with the effect sizes being measured for all tests of difference (Mellinger and Hanson 2017). The results show that there was an overall increase in the metacognitive self-regulation awareness of the self-training group, with the mean value increasing from 39.60 (Text A) to 66.27 (Text B). The MSRI scores were significantly different before and after the intervention with large effect size[3] (p<.05, d>.8) (see Table 3). The statistical power of the sample size is good with Power (1-β) = 1.00. The MSRI therefore effectively improved awareness of metacognitive self-regulation among participants of the self-training group.

Table 3. T-test on mean scores of MSRI and its three dimensions between Texts A and B (self-training group)

	Mean scores		MD	SD	95% Confidence Interval		t	df	p (2-tailed)	d
	Text A (%)	Text B (%)			Lower	Upper				
MSRI	39.60	66.27	26.67	2.16	25.47	27.86	47.81	14	.00	7.22
Planning (full score=30)	11.20 (37.33)	26.47 (88.23)	15.27	.80	14.82	15.71	74.02	14	.00	9.13
Monitoring (full score=20)	14.87 (74.35)	17.47 (87.35)	2.60	.83	2.14	3.06	12.16	14	.00	2.13
Evaluation (full score=25)	13.53 (54.12)	22.33 (89.32)	8.80	1.15	8.17	9.43	29.73	14	.00	5.77

5.1.2 Dimensional development

By calculating the means of the percentages of the self-training group's scores for each dimension[4], we found that before the intervention, the participants' highest scores were for monitoring (74.35%), followed by evaluation (54.12%), and planning (37.33%), while after the intervention, each of the dimensions had risen to a higher level (all over 85%). This suggests that before the intervention, the participants were more aware of monitoring than of the other dimensions, while after the intervention, all three dimensions of metacognitive self-regulation had developed to a higher level and use of them was more balanced.

We conducted another paired sample t-test on the scores for the three dimensions of translation in the MSRI produced by the self-training group for Texts A and B, with effect sizes measured. As displayed in Table 3, a rising tendency from Text A to Text B is evident in all three dimensions, with the mean for 'planning' increasing from 11.20 to 26.47, for 'monitoring' from 14.87 to 17.47, and for 'evaluation' from 13.53 to 22.33. The change in scores for the three dimensions of translation between Text A and Text B is significant (p<.05, d>.8). It can therefore also be said that the MSRI effectively

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[3]Cohen (1988) suggests that d=0.2 be considered a 'small' effect size, 0.5 represents a 'medium' effect size and 0.8 a 'large' effect size.

[4] The full scores for planning, monitoring and evaluation were 6(questions)*5=30, 4*5=20 and 5*5=25 respectively, based on a 0-5 Likert scale.

improved the self-training group's awareness of all three translation dimensions.

5.1.3 Think-aloud data

Supported by the screen recording tool, a set of TAPs was established for all participants and analyzed for all three dimensions of metacognitive self-regulation. An example of TAPs analysis is provided below, with Table 4 presenting the percentage of metacognitive activity for each dimension.

Example 1. (P1 from self-training group, Text B)

    ST: It can seem like common sense that if one is healthy, then why buy health insurance?

    TT: 如果一个人身体健康，那么为什么要购买医疗保险呢？这种想法看起来合乎情理。

    Gloss for TT: If a man is healthy, why would he want to buy health insurance? This idea seems reasonable.

[TAPs]: **通篇读完之后，可以看出原文作者是想告诉读者为什么要购买健康保险，**<u>不对，</u>（鼠标在原文中的 health insurance 上划了一下）<u>是医疗保险吧？</u> **一会儿查一下百度，看看保险的类型。作者还介绍了购买保险的好处。**这似乎是一个常识，如果一个人身体健康，那么为什么要购买医疗保险？（敲击键盘边翻译边打字）

    我百度一下健康保险和医疗保险的区别吧。（百度搜索）健康保险包含医疗保险，还包含收入保障险。医疗保险就专门是针对医疗费用的保险。<u>根据源语文本后面的内容，这里应该翻译成医疗保险，因为作者主要说的就是医疗费用什么的。</u>

    <u>这句中文句式有点问题，源语文本的句式不适合中文，</u>**可以把这句话拆开分成两句，把"这似乎是一个常识"放到后面。**〰中文简短清晰一些，可接受性好点。〰

[English Gloss for TAPs]: **After reading the whole article, it could be seen that the author wants to tell readers why we need buy health insurance.** <u>It's wrong.</u> (The mouse clicked on the phrase of health insurance in the ST.) <u>Is it medical insurance?</u> **I will check the type of insurance on Baidu later. And the author also introduces the benefits of buying insurance.** This seems to be common sense if a person is healthy, then why buy health insurance? (translating while typing on the keyboard)

I use Baidu to check the difference between health insurance and medical insurance. (Baidu search) Health insurance includes medical insurance, and also includes income security insurance. Medical insurance is specifically for insurance against medical expenses. <u>According to the later part of the ST, it should be translated into medical insurance, because the author mainly talks about medical expenses or something.</u>

〰The translated version is a bit problematic. The sentence pattern of the ST is not suitable for the TT.〰 **I could split this sentence into two sentences, move 'This seems to be common sense' to the end.** 〰The shorter and clearer the Chinese is, the better the acceptability.〰

(Note for transcription: 'planning' is indicated by bold text, 'monitoring' by underlining, and 'evaluation' by wavy lines.)

In example 1, during the planning stage, P1 analyzes the author's intention from a macro level to set a translation goal, indicates his intention to use online resources to distinguish between two terms in order to gain a better understanding of the ST, and plans to adjust the word order to improve the composition of the TT. The whole metacognitive activity is characterized by a top-down processing mode. These

behaviors are counted as two planning strategies, as they are planning for two different translation problems. During the monitoring stage, P1 discovers term inconsistency against the context and makes detailed changes to the translation, which is a typical bottom-up mode. This is counted as one monitoring strategy. Finally, during the evaluation stage, he makes a choice between possible translations of a sentence in the ST, and comments on the acceptability of the TT, which is a typical top-down mode. This is counted as one evaluation strategy. The total number of metacognitive self-regulation strategies was calculated by adding the sub-totals for the three strategies.

Table 4. Mean number and percentage of each metacognitive self-regulation strategy based on TAPs

	Text	Total metacognitive self-regulation strategies	Planning (%)	Monitoring (%)	Evaluation (%)
Self-training Group	A	22.85	3.69 (16.15)	11.38 (49.80)	7.78 (34.05)
	B	38.39	11.56 (30.11)	12.46 (32.46)	14.37 (37.43)
Control Group	A	22.46	3.93 (17.50)	10.74 (47.82)	7.79 (34.68)
	B	27.00	4.56 (16.89)	13.01 (48.19)	9.43 (34.93)

Table 4 displays three findings. First, after the intervention of the MSRI practice, the total number of metacognitive self-regulation strategies adopted by the self-training group (38.39) was higher than that used by the control group (27.00), indicating that MSRI practice improves students' awareness of metacognitive self-regulation. This is shown by the statistical results of overall development of metacognitive self-regulation (Table 3). Second, before the intervention of the MSRI practice both groups favoured use of monitoring strategies in translating Text A (>45%) above use of the other two strategies. The finding of more frequent use of monitoring strategies is supported by the statistical results of monitoring strategies obtained from the MSRI (Table 3). Third, after the intervention of using the MSRI practice, the metacognitive activity of the self-training group exhibited a more balanced distribution (in percentages) over the three strategies in translating Text B, indicating the use of the MSRI changed their metacognitive self-regulation pattern. This finding confirms the dimensional development revealed by the MSRI (Table 3): after the intervention of MSRI practice, students' employment of all the metacognitive self-regulation strategies was more balanced than before. In contrast, for the control group, the distributions (in percentages) over the three strategies remain almost the same in translating Text B, as compared to their Text A translation.

5.2 Translation quality assessment
5.2.1 Holistic assessment

As stated in Section 4.4, all 60 translations were holistically scored by four professional raters based on the TEM8 translation marking criteria. The original scores were transformed into a 5-grade scale, ranging from '0-2 for grade 1' to '9-10 for grade 5'. Kendall's coefficient of concordance test was conducted on the translation grades of Texts A and B to assess the inter-rater reliability. As presented in Table 5, the statistical results indicate a substantial agreement with Kendall's W=.64 (p<.05) for Text A, and Kendall's W=.79 (p<.05) for Text B[5].

Table 5. Statistical results for the holistic assessment of TTs

	N	Kendall's W	Chi-Square	df	p
Text A	4	.64	74.02	29	.00
Text B	4	.79	91.74	29	.00

Table 6. T-test results for the holistic assessment results before and after the intervention

	Mean		MD	SD	95% Confidence Interval		t	df	p (2-tailed)	d
	Text A	Text B			Lower	Upper				
Self-training Group	5.75	7.23	1.48	.24	1.35	1.62	23.91	14	.00	3.65
Control Group	5.73	5.97	.23	.44	.01	.48	2.02	14	.06	.58

As illustrated in Table 6, after the intervention, the self-training group had a significantly higher mean score for their translations of Text B than for Text A with large effect size (MD=1.48, p<.05, d>.8). The statistical power of the sample size is good with Power (1-β) = 1.00. Although the control group also had a higher mean score for their Text B translations, the difference was not statistically significant (MD=.23, p>.05, .5<d<.8). It can therefore be concluded that the intervention had a significantly positive effect on the translation competence of the self-training group, by enhancing their overall translation quality.

5.2.2 Analytical assessment

The analytical assessment was divided into 10 items with reference to Hurtado Albir's (2015, 275) rubric. The four raters were asked to use a 0-10 Likert scale (with 10 being the highest score) to rate all the 10 items for all 60 translations. The statistical results of the analytical assessment are presented as follows.

Table 7. Statistical results of the analytical assessment conducted by the four raters

	Rubric Item	N	Kendall's W	Chi-Square	df	p
Text A	1. same information	4	.47	54.25	29	.00
	2. same clarity	4	.50	57.61	29	.00

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[5]Kendall's W ranges from 0 (no agreement) to 1 (complete agreement), with 0.00-0.20 being "slight", 0.21-0.40 "fair", 0.41-0.60 "moderate", 0.61-0.80 "substantial" and 0.81-1.00 "almost perfect" agreement. (Landis and Koch 1977)

	3. same register	4	.46	53.25	29	.00
	4. conventions of written language	4	.63	73.19	29	.00
	5. vocabulary	4	.53	61.88	29	.00
	6. morphosyntax	4	.62	72.36	29	.00
	7. cohesion	4	.58	67.23	29	.00
	8. coherence	4	.49	57.10	29	.00
	9. genre conventions	4	.56	64.64	29	.00
	10. translation's purpose and target audience	4	.70	80.88	29	.00
Text B	1. same information	4	.60	69.81	29	.00
	2. same clarity	4	.77	89.18	29	.00
	3. same register	4	.51	59.38	29	.00
	4. conventions of written language	4	.76	88.66	29	.00
	5. vocabulary	4	.62	72.31	29	.00
	6. morphosyntax	4	.71	82.45	29	.00
	7. cohesion	4	.55	64.18	29	.00
	8. coherence	4	.59	68.54	29	.00
	9. genre conventions	4	.61	71.02	29	.00
	10. translation's purpose and target audience	4	.46	53.79	29	.00

The results for Kendall's coefficient of concordance on the 10 items before and after the intervention (see Table 7) show a moderate to substantial agreement among the raters in their ratings, with Kendall's W ranging from 0.46 to 0.77 ($p<.05$).

Table 8. Results of the T-test before and after intervention

	Rubric Item	Mean Difference (MD)	SD	SEM	t	df	p (2-tailed)	d
Self-training Group	1 same information	.25	.46	.12	2.09	14	.06	.73
	2 same clarity	.40	.65	.17	2.37	14	*.03*	*1.02*
	3 same register	.18	.66	.17	1.08	14	.30	.47
	4 conventions of written language	.07	.55	.14	.47	14	.65	.14
	5 vocabulary	.70	.63	.16	4.32	14	*.00*	*1.79*
	6 morphosyntax	.87	.77	.20	4.34	14	*.00*	*2.06*
	7 cohesion	.27	.58	.15	1.79	14	.10	.67
	8 coherence	.27	.53	.14	1.95	14	.07	.76
	9 genre conventions	.50	.56	.14	3.46	14	*.00*	*1.22*

			MD		SE	t	df	p	d
	10	translation's purpose and target audience	.43	.61	.16	2.76	14	*.02*	*1.10*
Control Group	1	same information	.03	.59	.15	.22	14	.83	.08
	2	same clarity	.02	.55	.14	.12	14	.91	.04
	3	same register conventions of	.10	.48	.12	.81	14	.43	.26
	4	written language	.02	.92	.24	.07	14	.95	.02
	5	vocabulary	.13	.41	.11	1.26	14	.23	.45
	6	morphosyntax	.15	.48	.12	1.21	14	.25	.40
	7	cohesion	.12	.63	.16	.71	14	.49	.31
	8	coherence	.12	.39	.10	1.16	14	.26	.30
	9	genre conventions translation's	.13	.23	.06	2.26	14	*.04*	.54
	10	purpose and target audience	.13	.54	.12	.95	14	.36	.31

The results of the paired sample t-test (see Table 8) reveal that the translation quality of the self-training group had improved most significantly in Item 6: morphosyntax (MD=.87, p<.05, d>.8), followed by Item 5: vocabulary (MD=.70, p<.05, d>.8), Item 9: genre conventions (MD=.50, p<.05, d>.8), Item 10: purpose and target audience of the translation (MD=.43, p<.05, d>.8), and Item 2: same clarity (MD=.40, p<.05, d>.8); while even though the translations of the control group show a statistically significant improvement in Item 9: genre conventions (MD=.13, p<.05), the effect size is medium (.5<d<.8).

5.3 The relationship between metacognitive self-regulation and translation quality
We had assumed that the students' self-training with the MSRI would improve the quality of their translations if their metacognitive awareness could be effectively stimulated. Furthermore, it was assumed that use of the MSRI would be positively correlated with the results for translation quality. To this end, we conducted a correlation test between the increased scores of MSRI and the improved scores of translation quality. Both holistic and analytical scores are included in this section. Note that we used only the analytical scores for the five items which indicated significant improvements in the translation quality of the self-training group, i.e., clarity, vocabulary, morpho-syntax, genre conventions, and purpose and audience.

We ran Kendall's tau correlation coefficient test to measure the relationship between the MSRI scores and translation quality scores. The values of Kendall's tau, ranging from 0.30 to 0.88 were all positive and statistically significant (p<.05; see Table 9). In summary, the use of the MSRI had a very strong positive correlation with improvements in holistic assessment, followed by morphosyntax, vocabulary,

translation purpose & target audience, genre conventions, and clarity.

Table 9. Nonparametric correlations test between MSRI and translation quality

	MSRI	
Subscale	Kendall's tau-b	p (2-tailed)
Holistic	.88**	.00
Clarity	.30*	.03
Vocabulary	.49**	.00
Morphosyntax	.59**	.00
Genre conventions	.43**	.00
Translation purpose & target audience	.44**	.00

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

6. Qualitative Results and Discussion
6.1 Development of metacognitive self-regulation

The overall results and those obtained for the different dimensions of translation on the participants' awareness of metacognitive self-regulation, together with the think-aloud data, produced several significant findings. Most participants initially had greater awareness of using monitoring than of using planning and evaluation processes. The MSRI practice, however, promoted a more balanced development in the participants' awareness of metacognitive self-regulation among the dimensions of planning, monitoring and evaluation. This result, which has been supported by the statistical data of MSRI (Table 3) and TAPs (Table 4), can be further illustrated by the following qualitative interview data:

(1) Repeated practice with the MSRI improves the accuracy of metacognitive self-assessment, which aligns with previous research that the accuracy of self-assessment improves over time (Boud, Lawson & Thompson 2015; De Saint-Leger 2009; Li 2018). The improvement in the accuracy of self-assessment is indicated by self-training participants' greater command of metacognitive self-regulation strategies reported in the interview: more than two-thirds of the participants had little knowledge about how to evaluate their metacognitive activities before the intervention, while all of them could accurately evaluate their metacognitive self-regulation activities by mentioning the content of the MSRI after the intervention. They also revealed that that they had instinctively made holistic assessments, and had rarely considered specific factors such as text style, the author's intention, and readership before the intervention. Moreover, about one quarter of participants reported that the MSRI had inspired them to employ some additional regulatory skills, such as retelling the meaning of the ST in their own words before translating, evaluating the equivalence between the ST and the TT, and classifying types of translation problems. Three-fifths of participants mentioned that since using the MSRI they used better planning strategies. For example, prompted by the strategies listed in the MSRI, they now often consulted relevant monolingual parallel texts in addition to bilingual resources, and three of them had even built up their own resource databases on various topics.

(2) Repeated practice with the MSRI appears to facilitate students' transfer of their declarative knowledge into procedural knowledge. During the interviews with the self-training group about Text B, all 15 participants reported that the repeated practice of using the MSRI had been instrumental in improving their use of metacognitive self-regulation strategies. Furthermore, in most cases they reported that these activities were unconscious, as revealed when they recalled their translation process by watching their screen recording. Four-fifths of the participants said that before the intervention, they had rushed into the translation process soon after reading the ST, whereas after the intervention, their translation process had become more strategic. For example, they began their translation with plans of strategy-selection for specific translation problems, then made choices among possible solutions according to the context, and evaluated their solutions with reference to the communicative function of the text.

This finding suggests that the intervention had increased the task awareness of the self-training group, who indicated, just as Shreve (2009, 257) put it, that they had learned to reflect on the task, recognize its processes and sequences, and incorporate changes into the task where necessary. Shreve (2009) holds that task awareness is a precondition for metacognitive activity to occur; in this study, the results suggest that metacognitive activity could in turn strengthen task awareness.

(3) Repeated practice with the MSRI promoted the students' information processing mode. Four-fifths of the participants from the self-training group reported that in the later translation tasks, they analyzed the ST as a whole before they started translating, and paid more attention to the global structure and overall semantic coherence of the translation than to detailed translation problems, which indicates that they had adopted a top-down processing mode. This finding is also confirmed by their improvement in the top-down processing of planning and evaluation indicated by the quantitative data.

According to Carrell and Eisterhold (1983), top-down processing occurs as the person makes general predictions based on higher level schemata, and then searches the input for information to fit into these partially satisfied, higher order schemata. Repeated training in both planning and evaluation processes, predominantly top-down translation processes, evokes higher level schemata, assisting students to control translation process macroscopically. This top-down processing occurs at all levels simultaneously with bottom-up processing (Rumelhart 1980).

Based on the above findings, we answer our first research question confidently: the MSRI effectively promoted the participants' awareness of metacognitive self-regulation by assisting students in diagnosing their strengths and weaknesses accurately, transforming declarative knowledge into procedural knowledge, and promoting their use of top-down processing modes. The three strategies of planning, monitoring and evaluation were employed flexibly; students' use of the three strategies became more balanced across the three elements of the macro-skill.

The results of the study indicate the positive role an MSRI can play in translator self-training, which accords with Pietrzak's (2019) argument that reflective assessment can be used by translation teachers to foster students' metacognitive skills. Being adults, translation students are all equipped with basic metacognitive skills, and it is essential

and reasonable to train them to enhance use of metacognitive self-regulation strategies that apply specifically to their area of expertise.

6.2 The impact of MSRI on translation quality

The strong positive correlation between use of the MSRI and holistic assessment suggests metacognitive self-regulation training can be used to enhance development of translation competence. The improvement in their competence enabled participants to see the value of the changes they had instituted and to transform the metacognitive experience into metacognitive knowledge and regulation; at the same time, their awareness of their metacognitive self-regulation was strengthened and promoted.

The results of the translation quality assessment and the obvious link between the use of the MSRI and translation quality suggest that increasing awareness of metacognitive self-regulation enhances translation students' skills, especially in the aspects of clarity, vocabulary, morphosyntax, genre conventions, and the purpose and target audience of the translation. This finding is in line with Fernández and Zabalbeascoa's (2012b) study which used open-ended questionnaires. Our research also explored the underlying reasons why metacognitive self-regulation can promote translation quality, and these reasons will now be discussed.

First, after the intervention of the MSRI practice, participants paid more attention to the communicative function of translation. Four-fifths of the self-training participants reported that after several rounds of practice with the MSRI, they had gradually come to recognize the importance of the communicative function of the TT, and constantly thought about how it would be received by the target readers. The participants' emphasis on communicative translation mainly depends on the information function of the ST, as proposed by Newmark (1981). Adaptations made by translators on behalf of the target reader are particularly associated with high levels of metacognitive regulation (Shreve 2009). The improvement of translation quality in the aspects of genre conventions and the purpose and target audience of the translation indicates well-trained metacognitive self-regulation.

Second, repeated practice with the MSRI trained the self-training group to have more strategic awareness of the expression of the TT. About half the participants in the control group admitted that they sometimes remained at the stage of explaining the ST in the target language, rather than translating it using equivalent terms, since they could not work out the best way of expressing it in the target language. By contrast, about two-thirds of the self-training participants stated that thanks to the inspiration of the MSRI, they would translate with the specific intention of considering stylistic features, and of making lexical and syntactical selections in line with the characteristics of popular science articles (in the case of Text B) in the target culture. As a result, the translations of the control group were sometimes crude and awkward compared with those of the self-training group, who strategically refined their renditions. This result is in line with Fernández and Zabalbeascoa's (2012b) report that more strategically aware students are able to outperform less strategically aware students in the quality of their translations. Being constantly influenced by metacognitive self-regulation strategies offered by the MSRI, students with more strategic awareness could find more

diversified ways to solve translation problems they encountered., The quality of their translation was enhanced largely in terms of vocabulary selection, morphosyntax application, etc., making their translation products more compatible with the target culture.

Third, repeated practice with the MSRI promoted more accurate understanding of the ST. Influenced by the MSRI, the self-training group tried to fulfill the communicative purpose of their translations, so they first needed to understand the ST accurately. More than two-thirds of the participants from the self-training group reported that they no longer confined themselves to an approximate or overall meaning, but would make every effort to ensure that they understood the ST accurately and clearly. In communicative translation, translators attempt to produce an effect for readers as close as possible to that experienced by the readers of the original (Newmark 1981), but the realization of this effect is inseparable from the translator's accurate understanding of the meaning of ST. Therefore, the goal of the self-training participants was to achieve this deep correspondence between the ST and the TT; this enhanced the quality of this aspect of their translation.

7. Conclusion

The over-arching goal of this study was to contribute an exploration of effective training strategies for student translators. In particular, this study explored the relationship between the use of an MSRI and student translators' performance, with a multiple comparison of metacognitive self-regulation development (overall and dimensional) and translation quality development (holistic and analytical) being made before and after the intervention. The implications are summarized below:

First, repeated practice with using an MSRI in the process of student self-training could effectively increase a student's awareness of metacognitive self-regulation, in dimensions including planning, monitoring and evaluation. An MSRI using closed-ended questions could help students accurately diagnose their strengths and weaknesses, transform their declarative knowledge into procedural knowledge, promote a top-down processing mode, and eventually balance their patterns of metacognitive self-regulation. The results obtained from the MSRI in this study were clearly supported by the think-aloud and interview data. An MSRI can serve as a self-assessment tool for students, and guide them to translate in a more organized, planned and controlled way.

Second, the strengthening of metacognitive self-regulation could help students enhance their translation quality, especially in the aspects of clarity, vocabulary, morphosyntax, genre conventions, and the purpose and target audience of the translation. Repeatedly stimulated by the MSRI, the self-training participants reported more task awareness, and used planning, monitoring and evaluation strategies to solve translation problems with reference to the communicative function of translation more skillfully. The results of Kendall's tau correlation coefficient test suggest a significantly positive correlation between metacognitive self-regulation and translation quality, validating the effectiveness of using MSRIs for student self-training.

The results of this study contribute to the development of an inventory to stimulate awareness of metacognitive self-regulation in English-Chinese translation, and suggest

that repeated practice with using an MSRI could significantly enhance students' translation performance. However, the inventory is far from unique or standard, and requires further refinement in order to comprehensively assess students' use of diversified metacognitive strategies in translation, and to offer teachers an effective tool that provides more targeted translation training. Moreover, we are mindful of other limitations of this study, such as the moderate sample size, the limited text type and domain, and the lack of comparison of the initial and final MSRI scores of the control group, which should be considered in future studies on this topic.

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Appendices

Appendix 1. Metacognitive Self-Regulation Inventory

(The original inventory was presented to Chinese native participants in mandarin Chinese, which was translated into English by the authors.)

Please choose number 1-5 according to your translation activities for the following inventory (1=not consistent, 2=slightly consistent, 3=generally consistent, 4=very consistent, 5=completely consistent).

1. In the orientation stage, I read through the full text to grasp the main content of the source text.
2. In the orientation stage, I consider the author's intentions in the source text.
3. In the orientation stage, I consider the reader's expectations of the target text.
4. In the orientation stage, I analyze the language features of the source text.
5. In the drafting stage, I consult parallel texts and references of both source and target languages according to the content of the source text so as to deepen my understanding of it.
6. In the drafting stage, I search parallel texts and references for authentic expressions in the target language based on the text type and language characteristics of the source text.
7. In the drafting stage, I solve the specific translation problems encountered in the translation process by analyzing syntactic structures of the source text.
8. In the drafting stage, I identify mistakes in my previous understanding and expression

according to the current translation activities and modify them immediately.

9. In the drafting stage, I put problems I am not able to solve at once aside to deal with later.

10. In the drafting stage, I think of as many ways as possible to solve a translation problem.

11. In the revision stage, I re-read the translated version, without referring to the source text, with a focus on its readability.

12. In the revision stage, I examine the translated version to see whether it is consistent with the source text in style.

13. In the revision stage, I examine the translated version to see whether it clearly expresses the intentions of the source text.

14. In the revision stage, I examine the translated version to see whether it meets the expectations of readers.

15. In the revision stage, I make a preliminary assessment of the quality of the translated version.

Appendix 2. Materials

Text A: Managing Negative Emotions

The idea of "managing" negative emotions is a complex one. It doesn't mean avoiding feeling them - avoidance coping is actually a form of coping that attempts to do this, and it can often backfire. It also doesn't mean letting these negative emotions wreak havoc on your life, your relationships, and your stress levels. Unmanaged anger, for example, can compel us to destroy relationships if we allow it to.

Managing negative emotions is more about embracing the fact that we are feeling them, determining why we are feeling this way, and allowing ourselves to receive the messages that they are sending us before we release them and move forward. Managing negative emotions also means not allowing them to overrun us; we can keep them under control without denying that we are feeling them.

Text B: Health Insurance

It can seem like common sense that if one is healthy, then why buy health insurance? But, this is similar in thinking, if I am a safe driver, why buy auto insurance? First off, under the ACA, consumers must purchase health insurance or participate in a health cost sharing program, or they will face tax penalties. Secondly, having health insurance enables consumers to access preventative health care services that catch problems before they become serious health threats.

At the very least, consumers need health insurance benefits to cover them in the case of a catastrophic illness or accident which can easily bankrupt anyone with one serious surgery or hospitalization. The peace of mind and income protection are reasons enough to enroll in benefits.

The basic information of Text A and B

Text	No. of words	No. of sentences	Average words per sentence
A	133	6	22.17
B	123	6	20.50

Appendix 3. The score descriptors for TEM8 translation tasks

Score	Descriptor
10-9	EXCELLENT TRANSLATION

	The translation faithfully reflects all the original passage with only 1 or 2 minor errors in vocabulary, syntax, punctuation or spelling. The translation is elegant (appropriate choice of words, a variety in sentence patterns).
8-7	GOOD TRANSLATION WITH FEW INACCURACIES The translation reflects almost all the original passage with relatively few significant errors of vocabulary, syntax, spelling or punctuation. The translation is readable (generally clear, smooth and cohesive).
6-5	PASSABLE TRANSLATION WITH SOME INACCURACIES The translation adequately reflects most of the original passage with occasional errors of vocabulary, syntax, spelling or punctuation. The translation is, for the most part, readable.
4-3	INADEQUATE TRANSLATION WITH FREQUENT INACCURACIES The translation only reflects about half of the original passage with frequent errors of vocabulary, syntax, spelling or punctuation. The translation is, in some parts, unreadable.
2-0	POOR TRANSLATION The translation reflects less than half of the original passage. Almost all sentences contain errors of vocabulary, syntax, spelling or punctuation. The translation is, for the most part, unreadable.