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Using Self-Regulated Digital Storytelling in Primary Students' English Learning: An Exploratory Factor Analysis

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Abstract: Successful learners are cultivated by good learning habits and essential skills. Among them, self-regulated learning (SRL) is proven to be an effective learning strategy and pedagogical approach to develop independent learning, enhance learning outcomes, improve learning motivation, and finally achieve lifelong success. In language education, Digital Storytelling (DST) has been an emerging strategy for teachers to guide their students to learn a language by expressing ideas and meanings. However, little research has been done to explore the effectiveness of such integration on students' language learning. The present study designed and developed a self-regulated digital storytelling (SRDST) curriculum for teachers to teach and students to learn English writing. About 110 primary grade 4 students of 9-10 years old participated in this study. A SRDST scale with 13 items in forethought, performance, and reflection phases was developed and validated. The results of exploratory factor analysis (EFA) from the primary students (N=70) on a pre-/post-test design yielded three factors that were similar to the three phases of SRL, namely, forethought, performance and reflection stages. The paired-samples t-test results indicated a significant increase in forethought, suggesting that the students realized certain preparation needs to be done before their study, and they also preferred autonomy on managing their own learning. Further, the data demonstrated a significant result in the performance phase where the students can seek for help when encountering difficulties, and determine to keep up with the overall learning progress and complete the tasks on time. The results also revealed that the students tended to reflect on whether there were better ways to improve their final projects. Finally, the research found that young learners preferred to set learning goals during the performance stage which is different from adult learners.

Keywords: Self-regulated learning (SRL), digital storytelling, English learning, instruments, exploratory factor analysis (EFA)

1. Introduction

Self-regulated learning (SRL) is not only a learning strategy to support student learning but also a pedagogy to facilitate teacher teaching. SRL can be used as a stand-alone pedagogy or combined with other pedagogical approaches to facilitate student-centred learning (Barrett, 2006). While many researchers investigated the effectiveness of SRL in higher education and adult education both offline and online in the past years (Carter Jr et al., 2020; Jansen, 2019; Vanslambrouck et al., 2019;), more studies have been probing the impact of SRL in online or blended learning mode after the outbreak of COVID-19 pandemic when researchers and educators uphold the importance of SRL abilities. Previous studies argued that SRL can improve young learners' learning outcomes, learning strategies and motivation (McClelland & Cameron, 2011; Hung et al., 2012; Järvelä et al., 2012). Dignath et al. (2008) pointed out that primary school students can also acquire SRL and benefit from it. Researchers believe that SRL can foster sustainable lifelong learning skills as SRL can cultivate learners' generic abilities, such as problem-solving skills, digital competencies and learning autonomy (Anthonysamy et al., 2020; Lüftenegger et al., 2012). Recently, the application of SRL in

language learning is emerging, however, limited studies focused on primary EFL/ESL students' language learning guided by SRL approach.

In the last four decades, educators and researchers probed the impact of digital storytelling as a pedagogy in various subject disciplines across primary, secondary, and higher education levels (Wu & Chen, 2020). Digital Storytelling (DST) is a technology-support strategy for teachers to guide their students to learn a foreign or second language by expressing ideas and meaning through integrating the use of audio, texts, and visual artefacts to develop language ability and communication skills (Wang & Zhan, 2010; Torres et al., 2012). Besides, it is also an innovative narrative tool for promoting digital competencies and relevant skills (Del-Moral-Pérez et al., 2019). Moreover, DST can also be a learning strategy for improving learners' academic achievement, problem-solving skills, learning motivation and collaboration skills (Hung et al., 2012; Niemi & Multisilta, 2016). In the field of language learning, DST has proved to be one of the most popular and effective strategies for improving students English writing (Yang & Wu, 2012; Burke & Kafai, 2010). However, the research on innovative pedagogies or tools for facilitating primary students' DST is limited. Furthermore, aiming to equip students with digital competence in language learning, the current study aims to explore whether the SRDST enabled by technologies is effective in grooming young learners' digital competency development. Thus, for addressing the above issues, the integration of programming tools in DST, for instance, Scratch, will have great potential for engaging students in SRL learning environment.

2. Literature Review

2.1 Self-regulated Learning

Zimmerman (2002) concluded that self-regulation is neither a mental ability nor an academic performance skill. Instead, it is a process that learners self-direct themselves to transform their mental capabilities into academic skills and achievements. Self-regulated learners can apply multiple strategies including cognitive strategies (e.g. organization and elaboration), metacognitive strategies (e.g. planning and monitoring), resource management strategies (e.g. time management), and collaborative learning to improve their learning (Bai et al., 2021). Self-regulated learning can also develop positive thinking by guiding students to have an optimistic future planning which can guide them to overcome obstacles and succeed academically (Zimmerman, 2002). Therefore, SRL is essential for grooming lifelong learning skills in a digital world (Anthonysamy et al., 2020). Further, Loyens et al. (2008) found that the "self" aspect is important in the developmental processes of SRL. Therefore, emphasizing student-centred learning also aligns with the gist of SRL.

Riding on Bandura's social cognitive theory (1986) interplaying person, behavior and environment, researchers developed and entailed various notions into SRL. Pintrich (2004) added metacognition and social context to the SRL framework and expanded the regulating behaviors to the forethought phase. Forethought includes task analysis and self-motivation belief, performance includes self-control and self-observation, and self-reflection includes self-judgement and self-reaction (Zimmerman, 2008). Meanwhile, Schunk (1990) pointed out that students shall be taught to set realistic upper and lower goals to enter learning activities for goal attainment with self-efficacy. In the SRDST process, the students have little idea about the activities in the forethought period, therefore, the current research attempted to put goal setting under the early performance stage so that the students can set and adjust the upper goals or main goals, and lower goals or sub-goals throughout the performance stages. There have been various SRL models working on Zimmerman's three phases, namely, forethought, performance, and self-reflection (Panadero, 2017). In our study, we adopted an adapted Zimmerman's phases (Zimmerman & Moylan, 2009) entailing different self-regulated behaviours aiming to propose one framework that fits the primary school level. In the framework for the primary level, the forethought phase entails environment, learner autonomy and strategic planning, performance phase entails goal-setting, time management, self-efficacy, help-seeking and progress monitoring, and the reflection phase entails self-reflection

with or without peer assessment, learner engagement, improvement and well-being (Figure 1).

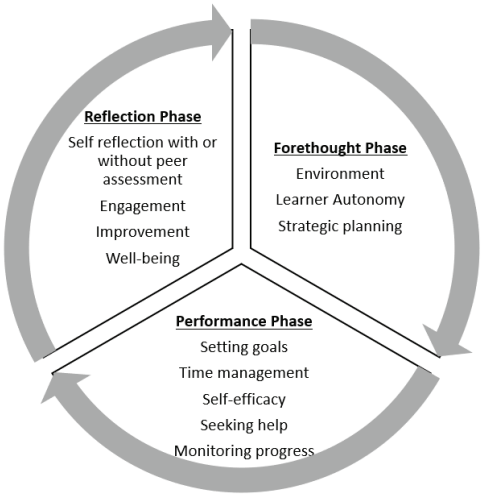

Figure 1. SRL framework proposed by the current study for primary levels based on Zimmerman and Moylan's framework (2009)

2.2 Self-regulated Digital Storytelling

DST facilitates a series of student-centred learning strategies, namely, student engagement, reflection for deep learning, project-based learning and effective integration of technology with learning and teaching by using technologies in a meaningful way in classroom settings (Barrett, 2006; Stale & Freeman, 2017). Wu and Chen (2020)'s systematic review on DST for educational purposes revealed that DST had been applied in various levels of educations ranging from primary, secondary to higher education levels as either a stand-alone pedagogy or in combination with other pedagogies, usually in culture, gender, language, social psychology, and social studies and 21st century skills among which language learning is the main subject where DST is employed. Lim et al. (2022) observed that little research offered detailed definitions of related research topics, concepts and methods of digital storytelling for language learning. Therefore, the current study proposes an SRDST framework and model to guide the research activities aiming to fill in the research gaps and probe the impacts of SRDST on EFL/ESL primary students' learning in English writing (Ma et al., 2022). In gist, SRDST is a digital storytelling approach steered by SRL for enhancing learning outcomes and improving learning motivation.

A few studies found that digital storytelling on Scratch had a positive impact on enhancing learner's motivation and academic achievement in English learning. Digital storytelling on Scratch offers middle school learners the opportunity to better understand the process of developing a story from an idea to a digital story (Burke & Kafai, 2010; Parsazadeh et al., 2021). Smith and Burrow (2016) suggested ways to integrate DST into the classroom to support reasoning, creative thinking and problem-solving. By partnering with teachers from language arts, technology and math subjects, Wolz et al. (2011)'s study revealed that teachers can infuse computational thinking in language learning in technology-enhanced classroom settings so as to enrich the language arts curriculum. Burke and Kafai (2012) affirmed that there is a great deal of learning potential in this intersection of the formal writing practices taught during the school-day and the "informal" activities of digital creation.

2.3 Background of the SRDST Scale

Previous research attempted to develop and validate SRL scale embedded with other learning strategies in different contexts while mainly in the realm of higher education (Roth et al., 2016). Barnard et al. (2009) developed a six-dimension questionnaire to measure SRL in online or hybrid learning modes demonstrating environment structuring, goal setting, time management, help-seeking, task strategies, and self-evaluation. Although this six-dimension

questionnaire is slightly different from Zimmerman's three phases by subdividing forethought and performance phases, the current research adopted and adapted both frameworks as they match the results and findings from the previous curriculum design using a design-based research approach (Ma et al., 2023; Zimmerman, 2002).

Pintrich (2004) and Magno (2011) developed a framework to classify the phases and relevant scales based on the Motivated Strategies for Learning Questionnaire (MSLQ) (Pintrich et al., 1991) in higher education. Retnawati (2016) developed an SRL instrument consisting of a Likert scale and multiple-choice questions for college students who majored in mathematics education. Based on their self-efficacy for self-regulated learning scale for elementary to high school learners, Usher and Pajares (2008) found that elementary students attained higher self-efficacy for self-regulated learning than those in higher levels. Roth and her colleagues (2016) also reported that since 1980s there had been an emerging development and deployment of subject-specific questionnaires over the past decades. Besides, they also claimed that MSLQ seemed to be the most verified instrument in SRL research, however, the MSLQ may not be able to assess post-performance behaviours such as self-reflection and regulation. Riding on the literature review and findings, the present research developed a SRDST scale to evaluate students' performance and improvement in learning English writing guided by SRDST strategies.

2.4 Research Purposes and Research Questions

The current research, on the one hand, aims to develop and evaluation an innovative pedagogy, i.e. SRDST, for facilitating primary students' DST in English learning, on the other hand, it aims to equip students with digital competence in language learning by deploying the SRDST strategy. To achieve these research objectives, the current study attempts to address the following research questions (RQs):

(1) What are the factors related to SRDST as perceived by the primary 4 students? Are they similar to the factors identified in the literature?

(2) Do the students perceive an improvement in the factors after attending the SRDST for English learning curriculum?

3. Method

3.1 Participants

About 110 EFL/ ESL Chinese students of 9 – 10 years old from a Hong Kong local primary school participated in this study. The Human Research Ethics Committee of The Education University of Hong Kong considered and approved this study by reviewing the research methods, procedures and instruments prior to the start of the research activities. The participating students provided approved written consent from their parents. The students were divided into one experimental group and one control group. The experimental group were instructed based on SRDST approach while the control group were instructed based on paper-formed worksheets and presentations slides.

3.2 The Self-Regulated Digital Storytelling Curriculum

Figure 2 demonstrates the rationales of the lesson design and the cycling process of the SRDST approach. The SRDST emphasizes the three phases of SRL: forethought, performance I and II and reflection to guide students to acquire the vocabulary, grammar and writing skills. Guided by SRDST approach, Table 1 presents a lesson plan for a primary grade 4 English Language unit "We Love Festivals" where SRDST strategies were embedded throughout the curriculum and teaching and learning resources. The experiment was conducted in four weeks in the first semester of 2022/23 academic year.The development of

the curriculum followed a design-based research approach and was guided by the SRDST innovative pedagogy proposed by this research (Ma et al., 2023).

Figure 2. Using SRDST approach to learn and teach the P4 English Language unit "We Love Festivals"

Table 1. A lesson plan of the P4 English Language unit "We Love Festivals"

Lesson	Duration*	Activities	Remark
Pre-test (30 mins)			
Lesson 0	25 mins	Vocabulary	Flipped Learning
Lesson 1	45 mins	Grammar 1	English Class
Homework	Lesson 1 Take-home Assignment		Homework
Lesson 2	45 mins	Grammar 2	English Class
Homework	Lesson 2 Take-home Assignment		Homework
Lesson 3	45 mins	Writing: To create your own story	English Class
Homework	Lesson 3 Take-home Assignment		Homework
Lesson 4	45 mins	Writing: To create your own story	English Class
Homework	Lesson 4 Take-home Assignment		Homework
Lesson 5	45 mins	To create the story on Scratch	Computer Class
Lesson 6	45 mins	To create the story on Scratch	Computer Class
Lesson 7	45 mins	Presentation	English Class
Post-test (30 mins)			
Total	**340 mins**		

3.3 Instruments and Procedure

Riding on the literature review, the current study developed and employed an SRDST scale with 13 items of forethought, performance and reflection to evaluate students' performance and improvement in learning English writing guided by SRDST strategies. In this study, the samples would be considered as two equivalent groups because (1) the distribution of gender, age, and class size were similar, (2) the teachers, textbooks, and time spent on the English classes for both groups were all the same, and (3) other important confounding variables, including students' DST experience, years of learning English, coding experience on Scratch were not significantly different based on the results of a chi-square test for homogeneity.

4. Results

4.1 Descriptive Statistics

Among the 110 participants, 70 completed both the pre- and post-tests and regarded as the data sample. The sample students consisted of 38 females and 32 males from primary grade 4 whose ages ranged from 9-10 years old (M = 9.21; SD = .41). The English language learning

experience of the students ranged from 6 to 7 years. About half of the students have some coding experience on Scratch and the other half has no coding experience at all (M = .51; SD = .50). It is assumed that there is no significant difference between the two groups of students. The descriptive statistics of the two groups are presented in Table 2. The chi-square test of independence showed that there was no significant difference between the two groups in terms of gender, X^2 (1, N = 70) = 1.490, p = .22, age, X^2 (1, N = 70) = 1.775, p = .18, and experience of coding, X^2 (1, N = 70) = .525, p = .47. Besides, the English teachers' year of experience were also similar. Therefore, any differences between the experimental group and the control group could be regarded as independent variables in the current research.

Table 2. *Descriptive Statistics of the Two Groups*

N = 70	Gender		Age		Coding Experience	
	Mean	SD	Mean	SD	Mean	SD
All Students (N = 70)	.46	.50	9.2	.41	.51	.50
Control (n = 34)	.38	.49	9.1	.35	.56	.50
Experimental (n = 36)	.53	.50	9.3	.45	.47	.50

Note. N = Gender (1 = male; 0 = female); Coding Experience (1 = Yes; 0 = No)

4.2 Reliability Test and Factor Analysis

A Cronbach's alpha reliability test was conducted to measure the reliability of the SRDST scale with the pre-test data. According to the test results presented in Table 3, the reliability of the questionnaire was robust (Cronbach's α = .858). Its 13-item scale examined three phases of SRDST in an English writing class: a) forethought (three items); b) performance (six items); and c) reflection (four items). It was measured using a 5-point Likert scale, ranging from 1, 'Strongly disagree' to 5, 'Strongly agree'. In this study, the reliability of the scale was satisfactory (forethought: Cronbach's α = .610; performance: Cronbach's α = .822; reflection: Cronbach's α = .822) as presented in Table 4.

To explore the factor structure of the SRDST instrument, a factor analysis was conducted on the pre-test data collected from the students (N = 70) of the 13 items using SPSS, with Principal Component Analysis and Varimax with Kaiser Normalization as the extraction and rotation methods, respectively, which yielded three factors that were similar to the three phases of self-regulated learning, namely, forethought, performance and reflection stages, as shown in Table 4. The sample size met the minimum requirement of delivering an EFA (Bryant & Yarnold, 1995; Winter et al., 2009). The Kaiser–Meyer–Olkin value was 0.83, and the chi-square value for Bartlett's test of sphericity was 375.11 (df = 78, p < .001), indicating that the three factors had good explanatory power. The total variance accounted for by these three factors was 62.79%. The factor loadings of the items are presented in Table 4.

Table 3. *Reliability and factor loading of the SRDST scale*

	Self-regulated Digital Storytelling Scale (N = 70)	Mean	SD	Factor loading	Cronbach's α
SRDST Scale					**.858**
Forethought					**.610**
1.	I know where and when I can learn English most efficiently.	2.81	1.572	.697	.876
2.	I consult or discuss with someone when I need help in my learning.	3.17	1.296	.756	.861
3.	I have the autonomy to achieve my learning goals in my own way.	3.01	1.367	.633	.840
Performance					**.822**
4.	I proactively seek for relevant information to understand the self-regulated digital storytelling activities on Scratch if I have difficulties.	3.14	1.289	.646	.848
5.	I am clear about the main learning goals of self-regulated digital storytelling on Scratch.	3.39	1.376	.694	.850
6.	I have set sub-goals (e.g. read the digital stories on Scratch on time and complete the worksheets) leading to the main learning goals.	3.24	1.408	.767	.842
7.	I have enough time to learn English.	3.07	1.220	.576	.847
8.	I make sure I can keep up with the overall progress of self-regulated digital stories on Scratch for learning English (e.g. read the digital stories on Scratch on time and complete the worksheets).	3.16	1.519	.664	.839

9.	I can schedule a suitable time to read the digital stories on Scratch for learning English.	3.20	1.336	.762	.846
Reflection					**.822**
10.	I receive guidance on how to achieve the goals in stages.	3.20	1.336	.850	.855
11.	I enjoy the parts of Scratch digital stories and worksheets that lead me to reflect on my English learning.	2.97	1.251	.640	.842
12.	I will reflect on what I have learned after I finish the self-regulated digital storytelling activities.	3.14	1.311	.758	.840
13.	After I finish the self-regulated digital storytelling activities, I will reflect on whether there are better ways of creating my digital stories.	3.11	1.368	.734	.839

Note. A 5-point Likert scale is used, where 5 = "strongly agree", and 1 = "strongly disagree". *p ≤ .05; **p ≤ .01; ***p ≤ .001

4.3 Paired-samples T-test

Among the participants, 52 of them completed the whole experiment process by attending all the learning activities and finished the pre-/post-test surveys. The others who were absent from one or some classes were excluded from the paired-samples T-test analysis. The means, standard deviations and t-values are presented in Table 4.

Table 4. *Means, standard deviations and t-values of the Paired-samples T-Test*

Self-regulated Digital Storytelling Scale (N = 52)		**Pre-test**		**Post-test**		**t-value**
		Mean	**SD**	**Mean**	**SD**	
Forethought						
1.	I know where and when I can learn English most efficiently.	2.670	1.642	3.620	1.207	-3.424**
2.	I consult or discuss with someone when I need help in my learning.	3.080	1.296	3.830	1.115	-2.819**
3.	I have the autonomy to achieve my learning goals in my own way.	2.920	1.326	3.710	1.126	-3.308**
Performance						
4.	I proactively seek for relevant information to understand the self-regulated digital storytelling activities on Scratch if I have difficulties.	3.060	1.211	3.790	1.304	-2.919**
5.	I am clear about the main learning goals of self-regulated digital storytelling on Scratch.	3.330	1.396	3.460	1.335	-0.555
6.	I have set sub-goals (e.g. read the digital stories on Scratch on time and complete the worksheets) leading to the main learning goals.	3.170	1.410	3.270	1.315	-0.467
7.	I have enough time to learn English.	3.060	1.243	3.440	1.145	-1.853
8.	I make sure I can keep up with the overall progress of self-regulated digital stories on Scratch for learning English (e.g. read the digital stories on Scratch on time and complete the worksheets).	2.960	1.533	3.420	1.194	-2.299*
9.	I can schedule a suitable time to read the digital stories on Scratch for learning English.	3.100	1.347	3.190	1.253	-0.437
Reflection						
10.	I receive guidance on how to achieve the goals in stages.	3.130	1.329	3.290	1.242	-0.704
11.	I enjoy the parts of Scratch digital stories and worksheets that lead me to reflect on my English learning.	2.790	1.160	3.120	1.215	-1.761
12.	I will reflect on what I have learned after I finish the self-regulated digital storytelling activities.	3.080	1.296	3.270	1.254	-0.919
13.	After I finish the self-regulated digital storytelling activities, I will reflect on whether there are better ways of creating my digital stories.	3.100	1.376	3.630	1.189	-2.442*

Note. A 5-point Likert scale is used, where 5 = "strongly agree", and 1 = "strongly disagree". *p ≤ .05; **p ≤ .01; ***p ≤ .001

5. Discussions

According to the factor analysis results, we calculated the pre-test and post-test means of the three factors and carried out a paired-samples T-test to examine whether students have significant improvements after the completion of the course. The t-test results of the three factors, together with those of individual items, were as shown in Table 4. On the one hand, the results showed a significant increase in forethought, suggesting that the students realized certain preparation needs to be done before their study. With learning activities facilitated by technologies and internet, the students learned to find a suitable place and a good time to

attend the activities at home. SRDST approach encouraged students to seek for help when they were in need. They also appealed for autonomy in managing their own learning and achieving their goals in their own ways. SRL has a positive impact on learners' autonomy and under some conditions can support learners' autonomy (Papamitsiou & Economides, 2019; Yamauchi & Tanaka, 1998). Sierens et al. (2009) argued "when teachers want their students to evaluate themselves, to plan their study activities, and to think about themselves as learners, the teachers are encouraged to provide help, instructions, and expectations in an autonomy-supportive way." On the other hand, the data demonstrated a significant result in the performance phase where the students can seek relevant information when they encounter difficulties and determine to keep up with the overall progress for learning English and complete the tasks on time. The abilities and habits of keeping up with the learning progress are very critical to ensure learning effectiveness (Hong et al, 2021).

Although Zimmerman's framework (2002) puts goal setting in the forethought phase, in the current study, it is found that the young learners set and adjusted sub-goals during the performance phase to guide them to achieve the main learning goals. The importance of such behaviours was echoed by many studies (Huh & Reigeluth, 2017; Kizilcec et al., 2017; Schunk, 1990). Huh and Reigeluth (2017) argued that goal setting is an iterative procedure in SRL that was supported by overarching self-efficacy and self-motivation. Kizilec et al. (2017) highlighted that goal seeing and strategic planning positively predict academic achievements. Further, the results also revealed that with self-reflection, peer assessment rubrics and teachers' feedback provided, the students were willing to reflect on whether there were better ways to improve their final projects, namely their English writing, storyboard and their own digital stories. It is believed that self-reflection can be cultivated when reflection prompts and feedback from teachers and peers are provided to engage students in self-reflection (Masui & De Corte, 2005; Schunk & Zimmerman, 1998; Van den Boom et al, 2004, 2007).

6. Conclusion, Limitations and Future Studies

In the study, an innovative pedagogy, namely SRDST, was employed in primary school students' formal English learning. In order to understand its effectiveness, an instrument with a factor analysis yielding three factors 1) forethought. 2) performance 3) reflection was developed. The factors were similar to the ones identified in the literature (Zimmerman, 2002). Based on the SRL framework for guiding teaching and learning, a curriculum with teaching and learning resources were developed for implementing SRDST in English learning. The t-test results suggested a significant improvement in the forethought phase where the students believed they know where and when they can learn English most efficiently, they reckoned that they can consult others when they are in need, and they possessed the autonomy to achieve learning goals in their own ways. Besides, the students managed to monitor their own progress as long as clear guidelines and guidance were given to them. Further, after they finished the first draft of English writing and their first digital stories based on their own English writing storyboards, they would reflect on whether there were better ways for refinement according to the self-reflection rubrics as well as the feedback from teachers and peers. The positive results revealed the feasibility of using SRDST to teach and learn English language. Further, the SRDST has much potential in innovating teaching and learning. For example, this pedagogy can be used in other disciplines, e.g. science, history, for steering the development of curriculum resources. Besides, this learning strategy can be taught to young learners for cultivating good learning habits, developing digital competencies, and preparing them for becoming lifelong learners in a digital world.

Admittedly, this research may have some limitations due to the limited sample size. First, the experiment time only lasted for 3 weeks and covered only one English unit due to the school's class planning and limited curriculum space. A longer duration with more suitable topics to be covered would be ideal for further exploration and later a broader implementation. Second, the current study was conducted in one primary school and the sample size only met the minimum requirement of delivering an exploratory factor analysis (Bryant & Yarnold, 1995). To better understand the relationship between students' gender, interests and motivations, a

large sample size with participants from different schools was desired to examine the factor structure and access the effectiveness of this pedagogy and learning strategy. Third, the teachers' perspectives on the SRDST pedagogy were not clear. Further studies need to be done by organizing in-depth teacher and student interviews, class observation and content analysis on students' works.

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