

ARE LEARNING LOGS RELATED TO PROCRASTINATION? FROM THE VIEWPOINT OF SELF-REGULATED LEARNING

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ABSTRACT

This study investigated the relationships between self-regulated learning (SRL) awareness, time-management awareness, learning behaviors (report submission), and learning performance. Psychometric data and learning logs for both in-class and out-of-class activities were collected in the lecture course, and their relationships were analyzed using Pearson's correlation analysis. The results indicated that awareness of self-efficacy, intrinsic value, and cognitive learning strategies use had significant correlations with the frequency of out-of-class activities, submission time of report, and learning performance. Regarding the relationships between SRL awareness and out-of-class activities, usual reading activities as well as additional actions, such as bookmarking, had significant correlations with SRL awareness.

KEYWORDS

Learning analytics, Self-regulated learning, Procrastination

1. INTRODUCTION

1.1 Self-regulated Learning

Self-regulated learning (SRL) is an important perspective for understanding learning behaviors. Many researchers have conducted research on SRL in experimental and practical educational settings. SRL is related to motivation, cognition, and self-control, as it is directed toward the accomplishment of learning purposes (Pintrich, 1999). SRL relates to many learning concepts such as metacognition (Schunk and Zimmerman, 1986), information processing (Winne and Hadwin, 1998), procrastination (Strunk et al., 2013; Yamada et al., 2016), and so on.

SRL seems to be useful concept for understanding learners' learning features. Schunk and Zimmerman (1998) compared the learning behaviors of novice and expert SRL learners in each SRL phase. For example, in the forethought phase, skilful learners articulate their final goal and the necessary steps for its accomplishment. Skilful learners also tend to have internal motivation and high self-efficacy. In the performance/volitional phase, skilful learners try to maximise the effects of learning by monitoring the learning process. In the self-reflection phase, they seek to evaluate their learning performance independently and tend to attribute its quality to learning strategies and practice.

Recent research has investigated the effects of learning behaviors on SRL awareness in e-learning settings. Azevedo et al. (2017) suggested a framework for visualising SRL awareness using multimodal data in e-learning settings. Yamada et al. (in press) suggested that the use of cognitive learning strategies, such as annotation, as well as appropriate reading time for learning materials play important roles in enhancing SRL awareness. Using Information and Communication Technology (ICT), learning behaviors that contribute to enhancing SRL awareness can be analyzed to support learning.

1.2 Procrastination

Time management, which is an important SRL element, plays an important role in fruitful learning outcomes in both e-learning and face-to-face learning environments. Goda et al. (2015) investigated learning patterns based on learning logs in computer-assisted language learning settings. They extracted seven learning patterns: procrastination, learning habit, random, diminished drive, early bird, chevron, and catch-up. They found that students of the learning habit type and chevron type achieved higher scores than the procrastination type. However, considering daily lives, the accomplishment of learning tasks following learning plans that learners made themselves indicated high SRL skills. In this sense, procrastination is not always a harmful behavior for high learning performance. Chu and Choi (2005) proposed an ‘active procrastination’ learning behavior that regards procrastination as a positive learning strategy with meta-cognition. Chu and Choi (2005) found that active procrastination had significant effects on learners’ perceptions of life satisfaction and self-reported performance but not on grade point average (GPA). Active procrastinators have several features that effectively and efficiently contribute to their accomplishment of learning goals. Procrastination seems to be a useful perspective for supporting successive learning for the enhancement of learning performance.

In information technology era, information technologies allow instructors to understand learner’s learning behaviors, using learning logs stored in server. Learning analytics research contributes to clarify education and learning environment improvement using various data such as log about learners and learning environment, with information processing methods (e.g., Ifenthaler, 2015; Ogata et al, 2015). Oi et al (2017) investigated the relationship between learning logs in both preview and review and learning performance, using e-book logs. The results revealed that low learning performers tried to access to e-book in preview phase, but they easily gave up. Learning analytics research allows researchers and instructors to investigate various learning behaviors. Jayaprakash et al. (2014) suggested the analytical framework to predict students’ academic risk, using various data such as logs and GPA. It seems to be possible to investigate learning behaviors that affect on awareness of procrastination. Yamada et al (2016). found that procrastination and timely engagement awareness promote the learning outcome submission time directly and indirectly, using time stamp log on Learning Management System (LMS). However, the findings of their research focused on the learning outcome phase, therefore, it did not mention about usual learning behaviors, which seem to be meaningful to understand learning habits including procrastination.

The review of previous research mentioned above focused on the relationships among learning logs in in-class and out-of-class settings, learning behaviors, and learning awareness, especially self-regulated learning and procrastination. This study aimed to investigate the relationships between learning behaviors and SRL awareness, especially procrastination. Therefore, we set two research questions, in order to investigate these relationships.

RQ1: From the viewpoint of self-regulated learning and procrastination, what are the relationships between learning behaviors and awareness in both in-class and out-of-class settings?

RQ2: What are the learning behaviors that contribute to the improvement of SRL awareness and procrastination?

2. METHODS

2.1 Subjects and Course

Ninety-one university students participated in this research. One was a fourth-year student, and the others were first-year students taking an introductory education class. The course consisted of fifteen classes. The main learning object was to understand educational theories, principles, and history. There were three criteria for the grade: submitting a one-minute paper after every class, a regular report, and a final report. Students had to submit the one-minute paper within a day for a normal grade, but the teacher would accept it one day late (the score would be cut by half). The one-minute paper had to contain the class abstract and discussion. Regarding the regular and last reports, the teacher explained the report themes three weeks before the submission deadlines. Students were required to submit the one-minute papers and reports on LMS.

2.2 Data Collection

Students were asked to fill out two types of questionnaires: the motivational strategies for learning questionnaire (MSLQ) (Pintrich and DeGroot, 1990) and a 2 x 2 time-related academic behavior scale (Strunk et al., 2013). The MSLQ, which consists of five factors (self-efficacy (SE), internal value (IV), cognitive strategies (CS), self-regulation (SR), and test anxiety (TA); 44 items in all, rated on a seven-point Likert scale), was used for the subjective evaluation of learners' SRL skills. The 2 x 2 model of time-related academic behavior scale consisted of 22 items: seven for procrastination approach (PAP), four for procrastination avoidance (PAV), six for timely engagement approach (TAP), and five for timely engagement avoidance (TAV). Students were asked to rate each item on a seven-point Likert scale (see Appendix). Students were asked to complete the MSLQ and 2 x 2 model of time-related academic behavior scale at the first class and again at the last class. The second method of data collection was a log that recorded learning behaviors using e-books, the submission times of the one-minute papers relative to the deadlines, and the submission times of the two reports. Submission time was converted for analysis. Submission time increased the earlier a student submitted the assignment. For example, if a student submitted the one-minute paper one hour before the deadline, submission time was 1; if a student submitted the regular report 100 hours before deadline, submission time was 100.

3. RESULTS

Seventy-three out of the ninety first-year students answered the two questionnaires in class. The fourth-year student did not answer the questionnaire. We conducted Pearson's correlation analysis to investigate the relationship between SRL, procrastination, and learning behavior. In section 3.1 below, we show the descriptive data; the results of the correlation analysis are shown in section 3.2.

3.1 Descriptive Data and *t*-test

Table 1 shows the average for each item. The score for each factor was calculated by the sum of each item in each factor. The average scores for each factor are shown in Tables 1 and 2. The average times of submission are shown in Tables 3 and 4. These results show that there were large differences between individual students in the items for self-efficacy in MSLQ, procrastination approach, and all learning behaviors due to large standard deviations.

3.2 Correlation Analysis

The *t*-test results revealed that learners were aware and not aware of SRL and time management overall. However, what kinds of learning behaviors were affected pre- and post-class in terms of SRL and time management? Is awareness of SRL and procrastination related to learning behaviors and learning performance? To investigate the relationships between psychological perspectives, learning behaviors, and learning performance, Pearson's correlation analysis was conducted. The differences between post- and pre-rating data for SRL and procrastination questionnaires were calculated. Regarding learning behaviors, we summed the learning logs for both in-class and out-of-class settings, the one-minute paper submission times within the deadline, and the submission times (hours) of both reports. Table 5 shows the results.

Table 1. Average sum scores and *t*-test results for each factor in MSLQ

Item	Average score (SD)		<i>t</i>	sig
	Pre	Post		
Self-efficacy (min: 9, max: 63)	32.438 (6.110)	33.068 (8.772)	0.654	
Internal value (min: 9, max: 63)	50.616 (5.413)	49.370 (9.001)	-1.461	p < 0.1
Cognitive strategy use (min: 13, max: 91)	60.082 (7.176)	61.671 (9.651)	1.536	p < 0.1
Self-regulation (min: 9, max: 63)	39.438 (5.624)	38.288 (5.832)	-1.812	p < 0.05
Test anxiety (min: 4, max 20)	14.150 (4.569)	14.384 (5.358)	0.606	

Table 2. Average sum score for each factor in 2 x 2 model of time-related academic behavior scale

Item	Average score (SD)		<i>t</i>	sig
	Pre	Post		
Procrastination approach (min: 7, max: 49)	19.986 (6.657)	21.671 (7.830)	2.115	p < 0.05
Procrastination avoidance (min: 4, max: 28)	11.233 (4.514)	13.342 (5.463)	3.431	p < 0.001
Timely engagement approach (min: 6, max: 42)	24.726 (6.900)	22.726 (7.683)	-2.553	p < 0.01
Timely engagement avoidance (min: 5, max: 35)	22.384 (5.301)	19.178 (6.842)	-4.403	p < 0.001

Table 3. Average sum of learning log

Log	In class (SD)	Out of class (SD)
Add bookmark	0.110 (0.427)	0.137 (0.561)
Add marker	0.411 (1.451)	0.493 (1.376)
Add memo	3.110 (8.547)	4.931 (10.483)
Change marker	0.055 (0.369)	0.164 (0.986)
Change memo	2.726 (8.856)	7.603 (22.815)
Close	14.315 (14.273)	106.178 (83.915)
Delete bookmark	0.082 (0.340)	0.041 (0.200)
Delete marker	0.123 (0.439)	0.068 (0.254)
Delete memo	0.151 (0.462)	0.219 (0.507)
Page jump	2.151 (4.348)	8.684 (10.197)
Landscape (changing display in horizontal way)	0.274 (0.672)	1.068 (1.636)
Next	60.260 (44.812)	306.205 (180.832)
Open	14.548 (12.849)	116.274 (86.064)
Portrait (changing display in vertical way)	1.342 (1.618)	6.247 (4.684)
Prev (flipping previous page)	29.123 (28.479)	180.945 (143.949)
Search	0.027 (0.234)	0.027 (0.164)
Select bookmark	0.000 (0.000)	0.000 (0.000)
Select chapterlist	0.000 (0.000)	0.000 (0.000)
Select marker	0.014 (0.117)	0.027 (0.234)
Select memo	0.068 (0.419)	0.123 (0.551)
Select thumbnail	0.000 (0.000)	0.000 (0.000)
Zoom	6.000 (7.627)	25.589 (34.895)
Average sum of all activities	134.890 (103.732)	765.027 (481.294)

These results indicated that self-efficacy, internal value, and cognitive learning strategies had significant correlations with learning activities in out-of-class settings, one-minute paper submissions, and the final score. However, awareness of procrastination did not have a significant correlation with learning activities in either in-class or out-of-class settings. Several factors in the awareness of procrastination had significant correlations with task-management behaviors. Procrastination avoidance had negative correlations with last-report submission and the final score. It also had a weakly significant correlation with one-minute paper submission. The timely engagement approach had a significant positive relationship with submission time for the last report. Timely engagement avoidance had a significant positive relationship with the submission of the first report. However, the procrastination approach had no relationship with any SRL awareness, learning behaviors, or learning performance.

Table 4. Average submission time for one-minute paper, average submission time (hour) for reports, and average final score

Item	Average	SD
Submission time for one-minute paper in the deadline	9.918	1.579
Submission time (hour) for regular report 1	18.575	25.987
Submission time (hour) for last report	39.753	69.384
Final score	76.447	13.727

Table 5. Correlation analysis results between psychological factors, learning logs, and learning performance (upper: correlation coefficient; lower: significance)

	In-class logs	Out-of-class logs	One-minute paper submission	First report submission	Last report submission	Final score
SE	0.015	0.368	0.322	0.119	0.018	0.402
		p < 0.01	p < 0.01			p < 0.001
IV	-0.019	0.399	0.363	0.172	0.032	0.372
		p < 0.001	p < 0.01			p < 0.01
CS	-0.123	0.225	0.327	0.110	0.060	0.301
		p < 0.1	p < 0.01			p < 0.01
SR	0.137	0.186	0.177	0.037	0.033	0.083
TA	-0.002	0.109	0.122	0.172	0.083	0.263
						p < 0.05
PAP	-0.041	-0.046	0.083	-0.153	-0.077	0.097
PAV	-0.068	-0.076	-0.220	-0.013	-0.233	-0.272
			p < 0.1		p < 0.05	p < 0.05
TAP	0.071	0.058	0.125	0.169	0.266	0.075
					p < 0.05	
TAV	-0.007	-0.019	0.191	0.301	0.099	0.085
				p < 0.01		
Final score	-0.058	0.241	0.732	0.184	0.121	
		p < 0.05	p < 0.001			

The correlation coefficients between learning logs for out-of-class settings, psychological data (SE, IV, CS), and final scores were calculated based on the results of the correlation analysis shown in Table 5. The learning logs 'select marker', 'select chapterlist', and 'select thumbnail' were eliminated because the learners did not take these actions at all. Table 6 shows the results.

Pearson's correlation analysis showed several significant correlations between SRL and learning behaviors in out-of-class settings: self-efficacy (add bookmark, close, next, open, prev, zoom, final score), internal value (close, next, open, portrait, prev, zoom, final score), cognitive learning strategies (zoom, final score), and final score (close, landscape, next, open). Overall, learning logs about reading activity (e.g. page flipping and zoom) had significant correlations with final score and SRL awareness. However, awareness of cognitive learning strategies was not significantly related to learning logs, except for zoom. The additional action 'add bookmark' had a significant positive correlation with self-efficacy. The learning log 'landscape' had no relationship with SRL awareness but had one with final score. All types of SRL awareness were significant with final score.

Table 6. Correlation coefficients between SE, IV, CS, learning logs in out-of-class settings, and final score (upper: correlation coefficient; lower: significance level)

	SE	IV	CS	Final score
Add bookmark	0.330 p < 0.01	0.141	0.070	0.147
Add marker	0.106	0.087	0.039	0.079
Add memo	0.193	0.116	0.077	0.153
Change marker	0.028	0.110	-0.040	0.056
Change memo	0.108	0.110	0.109	0.106
Close	0.268 p < 0.05	0.298 p < 0.05	0.189	0.242 p < 0.05
Delete bookmark	0.077	0.150	0.096	0.069
Delete marker	0.032	0.092	0.087	0.101
Delete memo	0.083	-0.004	-0.035	0.057
Jump	0.066	0.084	0.048	0.169
Landscape	0.144	0.132	0.094	0.267 p < 0.05
Next	0.357 p < 0.01	0.382 p < 0.001	0.199	0.214 p < 0.1
Open	0.313 p < 0.01	0.305 p < 0.01	0.196	0.288 p < 0.05
Portrait	0.210	0.297 p < 0.1	0.170	0.111
Prev	0.325 p < 0.01	0.385 p < 0.001	0.187	0.140
Search	-0.044	-0.215	-0.126	-0.049
Select marker	0.020	0.053	0.046	-0.012
Select memo	-0.060	0.032	-0.029	-0.002
Zoom	0.279 p < 0.05	0.281 p < 0.05	0.228 p < 0.1	0.143
Final score	0.402 p < 0.001	0.372 p < 0.01	0.301 p < 0.01	

4. CONCLUSION AND FUTURE WORK

This study aimed to investigate the relationships between SRL awareness, procrastination, and learning logs; the submission time of learning outcomes; and learning performance. There were four main findings. About RQ1, overall, several factors in the awareness of SRL (self-efficacy, internal value, and cognitive learning strategies) and all factors of time management showed significant differences between before and after classes. The awareness of SRL—in particular self-efficacy, internal value, and cognitive learning strategies—had significant relationships with learning logs in out-of-class settings and the final score. Time-management awareness was related to the submission of learning outcomes. SRL awareness was related to reading activities such as page flipping. Time management is one of the important skills in SRL (e.g. Wolters et al., 2003; Barnard et al., 2009; Yamada et al., 2016). The results about RQ2 also indicated that the awareness of SRL and time management had a positive relationship with learning logs in out-of-class settings. Procrastination avoidance had negative correlations with one-minute paper submission times, last-report

submission times, and final scores. The timely engagement approach had a positive relationship with last-report submission, and timely engagement avoidance had a negative relationship with first-report submission. These results differ from those of previous research (Yamada et al., 2016). Yamada et al. (2016) demonstrated the overall causal relationships between SRL, time management, and learning behaviors. That research found that procrastination avoidance had negative effects on the submission of one-minute papers, and timely engagement avoidance had positive effects on the submission of the first report. In this research, the awareness of procrastination was regarded as a positive learning strategy through the class. However, learners were less aware of both types of timely engagement as suggested by the results of the *t*-test and the correlation analysis. A possible reason is that meta-cognition seemed to have been developed through the class. Submission deadlines were important criteria for gaining credit in the class. The change in avoidance awareness in both procrastination and timely engagement seems to indicate that learners reflected on their learning behaviors and then tried to manage their learning time. However, this consideration is only one possibility. To further examine this point, more data should be collected, and causal data analysis should be conducted (e.g. multiple regression analysis).

Regarding the relationships between psychometric data and learning behaviors, previous research supports these results (Yamada et al., 2015). These findings provided more concrete results compared to Yamada et al. (2015). Not only usual reading activities, such as page flipping, but also additional actions, such as bookmark and zoom, had significant correlations with SRL and learning performance. Additional actions allow learners to read learning materials in detail and can therefore promote their comprehension. For example, adding a bookmark helps learners to access and read learning materials again. This feature supports a learner's intention to learn again. By learning through these actions, learners seemed to perceive their SRL skill awareness development.

Future research should clarify the relationship between SRL, learning behaviors, and learning performance with more data in order to investigate these relationships. Processes for changing SRL and time-management awareness should be investigated using learning log data. If changing points in the process can be detected in consideration of instructional design, it can help instructors improve their classes and learning materials.

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Appendix: 2 x 2 measure of time-related academic behavior scale (Strunk et al., 2013)

Factor	Item
Procrastination approach	I more effectively utilise my time by postponing tasks
	I delay completing tasks to increase the quality of my work
	I put off starting tasks to increase my motivation
	I feel a stronger state of flow in my tasks when working closer to a deadline
	I intentionally wait until closer to a deadline to begin work to enhance my performance
	I delay tasks because I perform better when under more time pressure
	I rarely have difficulty completing quality work when starting a task close to the deadline
Procrastination avoidance	I put off tasks for later because they are too difficult to complete
	I avoid starting and completing tasks
	I often delay starting tasks because I am afraid of failure
Timely engagement approach	I delay starting tasks because they are overwhelming
	I work further ahead of the deadline at a slower pace because it helps me perform better
	I believe I can successfully complete most tasks because I start work immediately after being assigned a task
	I do my best work well ahead of the deadline
	I start working right away on a new task so I can perform better on the task
	I complete my tasks prior to the deadline to help me be successful
Timely engagement avoidance	I begin working on difficult tasks early to achieve positive results
	I start my work early because my performance suffers when I have to rush through a task
	I do not start things at the last minute because I find it difficult to complete them on time
	I begin working on a newly assigned task right away to avoid falling behind
	When I receive a new assignment, I try to complete it ahead of the deadline to avoid feeling overwhelmed
	For extremely difficult tasks, I begin work even earlier so I can avoid the consequences of putting them off for later