

Self-Monitoring in Learning to Write

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Abstract. The purpose of this study was to examine the role of self-monitoring support for writing skill improvement in a reciprocal peer review of writing system called SWoRD [5]. As monitoring is found critical in self-regulated learning research [3], [7], [13], [21], students were provided with opportunities of self-monitoring their writing through self-evaluations and peer evaluations on both their own writing and peer writing. With 601 undergraduate and graduate students from 16 courses in three U.S. universities, it was found that although not all the students did develop successful monitoring skills, the students who developed good monitoring skills drastically improved their writing compared to those who did not. Finally, we discussed the results and suggested future research.

Keywords. Self-monitoring, Peer review, Writing, CSCL, SWoRD

Introduction

While writing is considered as one of the most important skills that learners are expected to master for professional as well as academic success, writing well is a fundamental skill that most students lack across any ages in the U.S. [15] and also very likely in other countries. A recent study reports that 69% of 8th graders and 77% of 12th graders have only basic or lower levels of writing skills [26]. Not surprisingly, these students are entering colleges ill-prepared to engage in written communication needed for academic success in college.

As part of the Writing-Across-the-Curriculum or Writing-In-the-Discipline movement, most U.S. universities commit considerable financial and pedagogical resources to having first-year composition courses and writing-intensive courses in disciplines. As a vicious cycle, however, lower levels of writing skills are funneling more and more resources away to provide basic level reading and writing skills. More than 50 percent of first-year undergraduates are still incapable of writing without fairly free of basic language errors [24]. Moreover, undergraduates are often found to have serious difficulty writing in their disciplines even after completing composition courses [25], which cast a blight on getting good salaried jobs upon graduation [27].

Accordingly, the U.S. National Commission on Writing consisting of more than 4,300 schools and colleges in the U.S. declares of great urgency the increased emphasis on writing at all levels of education [15]. One of the major impediments in writing instruction is that instructors show *the near total neglect of writing* due to the instructor's demanding workload of reading, commenting on, and grading student papers [15].

To address the impediment while improving writing instruction, the Scaffolded Writing and Rewriting in the Discipline (SWoRD) system (<http://www.missouri.edu/~chokw/SWoRD.html>) [5] has been developed. Based on the social-cognitive framework of writing skill acquisition [17], [20], [28], the SWoRD system implements a familiar but understudied tool, reciprocal peer reviewing of writing: Students in SWoRD play two roles, one of writer and one of reviewer.

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While it is a practical solution, reciprocal peer reviewing is challenging for writing instruction mainly because students are very likely to be novices in their disciplines and also inexperienced in writing and generating constructive feedback. Therefore, SWoRD implements peer reviewing in a new way to overcome the typical challenge with peer reviewing. Specifically, SWoRD provides more pedagogical structure to guide creation of good writing assignments through its case-based reasoning module, more accountability so that students must take writing and reviewing tasks seriously through its writing and reviewing support, and infrastructure using easy-to-use technology to make the tasks manageable. Since the fall of 2002, SWoRD has been quite successfully used in about 60 courses from 10 universities. SWoRD has supported a wide spectrum of writing instruction settings from first year composition to doctoral seminar courses, from argumentation writing to lab reports to grant proposals, and from a class of five students to that of 304 students.

As part of an ongoing SWoRD research project, this study focuses on the role of self-monitoring in writing skills. Research often argues that students should develop good self-regulation skills to become proficient writers [20], [21], [29], [30] beyond basic writing skills and knowledge encompassing word, syntax, grammar, genre, style, rhetoric, and audience. For example, experienced writers successfully set goals, monitor, and reflect their learning process through iterative writing and rewriting. Self-monitoring among various self-regulation skills is known to be critical in learning to write [7], [19]. Self-Monitoring as a skill that makes writers accurately perceive their own writing from readers' perspectives is known to develop by observing oneself compared to what others perceive [3], [14]. Thus, peers in a reciprocal peer reviewing context can be a great source of developing accurate self-monitoring which in turn may lead to self-regulation skills of writing.

Despite the theoretical importance of self-monitoring in writing [7], there is little research that investigated the role of self-monitoring in writing performance. Therefore, this study examines the role of self-monitoring support in improving writing skills in the SWoRD system. To serve the goal, specifically, we investigate two research questions in SWoRD: 1) How students self-monitoring changes over time and 2) how the self-monitoring changes are related to writing quality improvement.

1. Self-Monitoring

Existing research agrees upon the critical role of monitoring in writing [4], [11], [18]. While expert writers have good monitoring skills, learning writers do not have. For example, before writing, experienced writers monitor various components in texts for better communication with readers. Experienced writers are found to be aware of their writing limitations, necessary processes, and how audience would respond to their writing [20]. By contrast, learning writers have severe difficulties of monitoring their writing process. For example, learning writers are often unsuccessful in detecting problems in texts and also unsuccessful in fixing problems even if learning writers identify the same problems as experienced writers [2]. Learning writers tend to monitor local problems such as words, grammatical errors, unlike experienced writers who monitor global or structural levels [8], [16]. In addition, not surprisingly, learning writers are rarely aware of readers' perspectives [9]. Therefore, learning writers need monitoring support to complement the cognitive deficit of learning writers. Because self-monitoring skills develop by observing what one perceives compared to what others perceive [3], [14], it is expected that self- and peer-evaluation experiences may help writers strategically function while working on writing.

Although participating in both self- and peer-evaluation would improve self-monitoring skills, a reasonable concern is that students may not develop accurate monitoring skills. When student writers overestimate or underestimate their writing quality, their inaccurate monitoring may hinder the students from setting realistic goals and from using appropriate learning strategies. Indeed, it was found that inaccurate monitoring may undermine its positive role in writing improvement [12]. Hence, in their coregulation model, McCaslin and Hickey emphasize the importance of consistency of self-monitoring results between self- and others [14]. If students over- or under-estimate their learning processes, inaccurate monitoring may cause less skillful self-regulation. Thus, inaccurate self-monitoring might result in inappropriate use of learning strategies, which may have students deviate from an established route to writing improvement.

1.1. Self-Monitoring Support in SWoRD

While self-monitoring must be a valuable source for learning to write [7], [9], [10], [19], the intervention of self-monitoring support seems not straightforward in the reciprocal peer reviewing of writing situation. Based on the theoretical review, first, students in SWoRD were asked to participate in evaluating their own writing (self-evaluation) as well as peer writing (peer evaluation). Therefore, students might compare self- and peer-evaluation in their memories. Then, a newer SWoRD version provides students with monitoring interfaces that allowed students to make explicit comparisons between self- and peer evaluations on both self-writing and peer writing. As shown in Figure 1, SWoRD [5] is equipped with two types of self-monitoring supports through evaluations: One is for their own writing and the other is for others' writing.

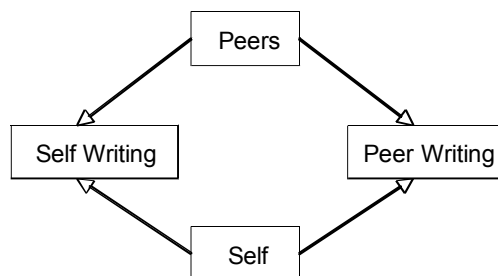


Figure 1. Self-monitoring support in SWoRD

1.1.1. Comparing self-evaluation and peer-evaluations on their own writing

With reciprocal peer reviewing, student reviewers are often asked to review multiple peer drafts (typically 4-5 in SWoRD) unlike traditional classrooms where instructors are the most typical source of evaluation [5], [6]. Therefore, reciprocal peer reviewing allows students to receive diverse evaluations. In addition, students as authors self-evaluate their own writing when they submit the writing. Self-evaluation may help authors develop more explicit awareness of their writing quality or problems on the same scale that their reviewers use.

Therefore, students are allowed to compare their self-evaluations and peer evaluations on their own writing. The discrepancy between the two evaluations may play a role of triggering authors to act upon the gap to improve their writing. However, it should be noted that SWoRD did not provide students to make explicit comparisons between self-evaluation and peer evaluation on their own writing when we collected the data for this study.

1.1.2. Comparing self- and peer-evaluation on peer writing

The other type of the monitoring support was designed to allow each reviewer to compare their own evaluations with other evaluations on peer papers. It was expected that reviewing peer writing may help students better understand writing assignment, evaluation rubrics, what to do, and what not to do in writing [3], [5]. This active review experiences may enable student as reviewers to view writing from various reader perspectives. Figure 2 and Figure 3 show partial interfaces supporting self-monitoring for a reviewer. The interface visualizes the extent to which a reviewer's evaluation is consistent with that of others who reviewed the same papers. The pattern in Figure 2 shows that the reviewer's grades are consistent with those of others, while there is a visually significant difference with 400lb Gorilla. Pseudo names such as 400lb Gorilla or River are used to keep students from identifying reviewers. Also, if a reviewer clicks on the author name, then the reviewer can read both her own review and others' reviews on the same writing. Figure 3 is another SM interface that allows reviewers to compare written comments and ratings between reviewers

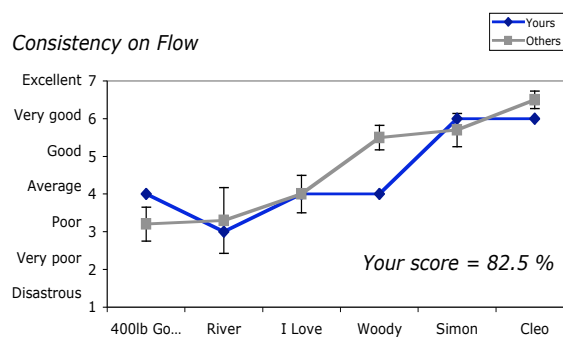


Figure 2. An example SM interface in SWoRD. The X-axis shows authors' pseudonyms

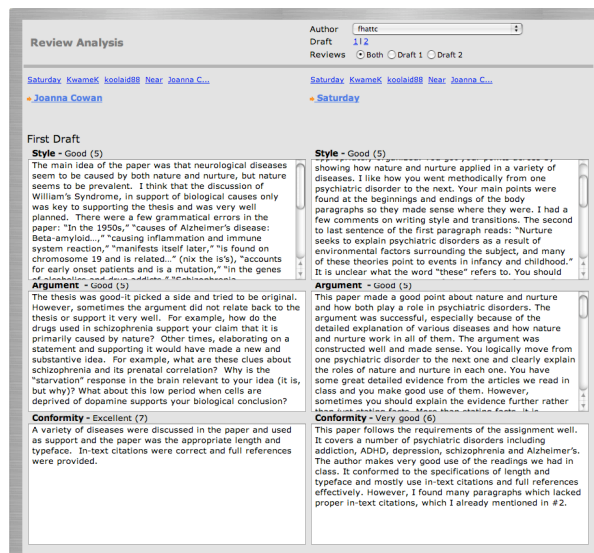


Figure 3. An example SM interface for comparing written comments and ratings between reviewers

In sum, the goal of this study was to examine the role of the self-monitoring support in improving writing skills. More specifically, we investigated how self-monitoring would change

over time, and also how self-monitoring is related to writing improvement. We examined the questions with a large number of participants in three U.S. universities, unlike the past self-regulation research conducted generally with a small number of elementary or adolescent students [10], [14], [17].

2. Method

2.1. Participants

601 students participated in this study over a 2-year span from three research universities in the U.S. across 16 courses including various writing genres and disciplines (i.e., physics, cognitive psychology, cognitive science, and health psychology) (see Table 1). Three of the courses were graduate courses, 13 were undergraduate courses, and four among the 13 undergraduate courses were for non-majors. The courses used the SWORD system to support their writing assignments and used the default evaluation rubric consisting of prose flow, argumentation, and insight that will be described later. The students participated in this research as their regular course activities. Typically writing and reviewing assignments together accounted for approximately 40% of the final course grade in each course. However the actual grade proportion could vary depending upon courses.

Table 1. Participant Information

Course ID	Discipline	School Year	University	No. of students
G01	Health Psychology	2005	A	30
G02	Instructional Technology	2004	C	12
G03	Biomedical Informatics	2005	B	14
U01	Cognitive Science	2004	B	20
U02	Cognitive Science	2005	B	17
U03	Cognitive Psychology*	2005	B	67
U04	Cognitive Psychology*	2005	B	78
U05	Cognitive Psychology*	2004	B	70
U06	Cognitive Psychology*	2005	B	25
U07	Physics	2005	B	81
U08	Physics	2005	B	26
U09	Writing	2005	B	10
U10	Writing	2005	B	19
U11	History	2005	B	97
U12	Leisure	2005	C	19
U13	Leisure	2005	C	16

Note. G = graduate; U = undergraduate, * Courses for non-majors.

2.2. Writing Task

The exact writing task assigned to students varied across the courses, as one would expect across courses from many different disciplines. The required length of the assigned papers varied from shorter (5-to-8 pages) to longer papers (10-to-15 pages). Writing genres included 1) a research paper, 2) an application to real life of research findings, 3) technical writing, and 4) a research proposal.

2.3. Self- and Peer Evaluation

Students in this study used same evaluation criteria for their self-evaluation and peer evaluation. Also the evaluation rubrics were always available for students to access. The default evaluation dimensions were prose flow, argumentation, and insight on a 7-point rating scale.

- Prose flow concerned how easily the main points of the argument could be followed, including aspects of sequencing and transitions.
- Argument concerned the quality of the claims and support, including relevance and consideration of counter-arguments.
- Insight concerned the new ideas, information, and inferences that the paper contributed to the class, beyond assigned course texts and materials.

2.4. Self-Monitoring (SM)

SM is defined as an absolute difference between an average of self-evaluation (SE) and that of other evaluation (OE) on their own writing. If the difference is closer to zero, a learner is assumed to have better self-monitoring. Students had SE and OE on the first writing and also on their revised writing.

$$SM = |SE - OE| \quad (1)$$

2.5. Self-Monitoring Development (SMD)

SMD is defined as a unidirectional change from the first self-monitoring (SM_{t_1}) to the second self-monitoring (SM_{t_2}). If SMD is positive, SMD was defined as *developed* because positive values means SM_{t_2} is smaller than SM_{t_1} . This means the gap between self- and peer-evaluation is reduced over time. By contrast, if SMD is equal to or less than zero, SMD was defined as *not-yet-developed*. This means the gap between self- and peer-evaluation is either the same or is not reduced over time.

$$SA = SM_{t_1} - SM_{t_2} \quad (2)$$

2.6. Procedure

The experiment followed the built-in processes in SWoRD. Specifically, in step one, students create an account in the system and specify a pseudonym. Papers are later distributed to authors under this pseudonym to reduce any status biases that may occur in peer review. Reviewers are only identified to authors by number (e.g., reviewer #1, reviewer #2, etc) to ensure there is no retribution between particular authors and reviewers. At this time, instructors set writing and reviewing assignments by using its case-based reasoning module (see Figure 4), due dates, and assignment policies.

In step two which was optional, students practice the review criteria with three sample papers and receive feedback from SWoRD based on past expert review and peer reviews on the same papers.

In step three, student authors upload their draft paper before the first draft deadline. When submitting their draft, students also self-evaluate their writing quality based on the three dimensions. The self-evaluation opportunity helps students self-monitor their writing. Once the submission deadline has passed, each author's draft is assigned to n peers, where n is prespecified by the instructor (usually 5 or 6). We use a moving window algorithm so that no two drafts are assigned to the same set of n peers. Also, student reviewers are selected based on the probability of each student completing reviews and that of being a fair reviewer to maximize the chance of writers' receiving constructive peer reviews.

In step four, peer reviewers submit their evaluations on the papers assigned to them. They generate written comments on and rate each draft on three 7-point evaluation dimensions. SWORD requires written comments to be entered for each evaluation dimension before the evaluation rating is made. This order encourages reviewers to base ratings on substance rather than intuition. These evaluations and comments are made available to authors after the peer evaluation deadline. The system evaluates each reviewer's evaluation in terms of three measures; problems in relative ordering of paper quality, systemically high or low evaluation, and systematic problems in how broadly or narrowly evaluations are made. The goal of the grades is to force accountability on the peer-grading task and to encourage reviewers to consider a broader audience than just themselves.

In step five, when students begin revising the draft, they can see the full set of comments on their paper, the system's assessment of each reviewer's consistency (marked with stars), their overall writing grade so far in relation to the class mean, the system's assessment of their own reviewing consistency, and their overall reviewing grade so far relative to the class mean. Students upload their final draft and it is distributed to the same peer reviewers as in the first round of reviewing.

In step six, once the draft has been submitted, each author is asked to rate the helpfulness of each review they received. They use a 7-point helpfulness scale, from *Not helpful at all (1)* to *Very helpful (7)*. These ratings constitute the other half of the reviewer's reviewing grade and serve to encourage reviewers to take the written review task seriously.

In step seven, reviewers download the final drafts assigned to them and begin the final draft review process. The same rating rubric is used as for the first draft.

In step eight, students see the full set of comments on their draft paper, the system's assessment of each reviewer's consistency, their overall writing grade so far in relation to the class mean, the system's assessment of their own reviewing consistency, and their overall reviewing grade so far relative to the class mean. Students are asked to grade the helpfulness of the final draft comments. SWORD automatically places equal weight on first and final draft activities and equally weights reviewing rating consistency and comment helpfulness.



Figure 4. A partial interface of a case-based reasoning module for creating a writing evaluation rubric

3. Results

The results of the study were presented with each research question.

3.1 How did SM change over time?

We first examined if SM would change over time while students self-evaluated and received feedback from peers. 601 students' SM_t1 was 3.04 (SD = 2.6) and SM_t2 was 3.32 (SD = 3.1). Among 601 students, 287 students developed their SM skills over time and 314 students did not develop their SM skills. In general, SM significantly decreased from SM_t1 to SM_t2 , $t(600) = -2.23$, $p < .05$. Paired t-tests were conducted to investigate SM change over time in each course of the 16 courses. Among the 16 courses, significant changes appeared only in the three courses (G03: $t(29) = 2.67$, $p < .05$; U02: $t(16) = -3.47$, $p < .05$; U05: $t(69) = 2.06$, $p < .05$).

3.2 How was SM change associated with writing improvement?

To address the second question, the overall Pearson correlation was first computed to analyze a linear association between the amount of SMD and the writing quality improvement. The correlation was statistically significant, $r(600) = .66$, $p < .001$, showing that SMD and writing quality improvement are highly associated.

Then the Pearson correlations were carried out in each of the 16 courses. Figure 5 shows individual correlations between SMD and the writing improvement with 95% confidence intervals bars. Two graduate courses' Pearson correlation out of three was significant and 11 undergraduate courses' Pearson correlations out of 13 was significant, $p < .05$. Also, the ranges of correlations were diverse from $-.18$ to $.82$. The average Pearson correlation over 16 courses was $.56$, the average Pearson correlation over the three graduate courses was $.58$, and the average Pearson correlation over the 13 undergraduate courses was $.55$.

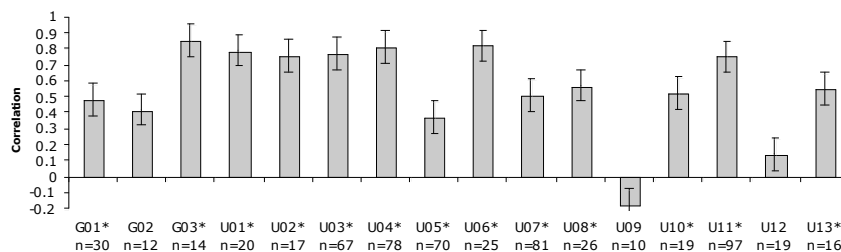


Figure 5. Pearson Correlation between SA and Non-SA and Writing Improvement

Note. G = graduate course; U = undergraduate course. * indicates significance of Pearson Correlation $p < .05$, n indicates the number of students in each course

4. Discussion

In this study, we examined the role of self-monitoring skills in learning to write in the SWoRD system that provides students with the self-monitoring support. With the large-scale field data, the results empirically found that SM is important for undergraduate students to improve writing. Consistent with self-regulated learning theories, this study empirically showed that skillful self-regulated writers tend to be correctly aware of their own learning [12], [27], [18] which also leads

to performance improvement. For example, the results are consistent with Graham and Harris's self-regulated strategy development (SRSD) model in that self-regulated writing positively influences writing performance [10]. In addition, Graham, Harris, and Mason found that students who received SRSD training significantly improved their writing in their posttest as well as outperformed those who did not receive SRSD training in terms of number of writing length, story element, persuasive elements, and quality [11].

The results also revealed that SM skills do not develop easily although about the half of the participants improved their SM skills over time. Indeed, past research showed that students in the computer environment are less likely to activate self-regulated learning strategies than those in the human-agent environment [1]. Although further research is necessary to investigate individual differences of SM skills to see why some students changed their SM skills while others did not, there are at least two possible conjectures. First, the SM interfaces might not be enough to trigger accurate self-monitoring. Although students self-evaluated their own writing, they were provided with any scheme or interface to make an explicit comparison between self- and peer-evaluations on their own writing. Thus, some students might regularly avoid comparing self- with peer-evaluations, or once started, abandon it because of the high memory demands required to effectively administrate the comparison. Therefore, it would be expected that students would develop SM skills with the explicit comparison between self- and peer-evaluations on their own writing. Second, students may better benefit from the SM support when they are aware of the positive role of SM in learning to write. Zimmerman, Bonner, and Kovach suggest that students be explicitly instructed on the benefits of using self-regulated learning strategies before and also while performing tasks [21]. However, we did not provide students with instructions on why they need develop SM skills in the SWoRD system. Therefore, it would be expected that training on the benefit of SM skills would help students develop the skills.

Further research may reveal a more detailed picture of how SM works. For example, the use analysis of the SM interfaces with student characteristics (such as age, gender, ethnicity, gender, past writing experiences) would allow researchers to look into self-monitoring behaviors at a more detailed level. This information would be also important for machine learning to categorize who would and would not develop SM skills.

Finally, feedback quality may influence self-monitoring in learning to write. An interesting hypothesis would be that students receiving quality feedback from peers are more likely to use the feedback, accept suggestions, and self-regulate to bridge the gap between self-evaluation and peer evaluation. By contrast, students receiving low quality feedback from peers are less likely to use the feedback, ignore suggestions, and keep their own self-evaluation. To address this situation, machine learning can be used to diagnose feedback quality. For example, student writing improves as a function of comments that have specific, detailed explanations on a problem of writing and a solution to the problem [23]. Therefore, a discourse tree can be used to detect the absence of explanation in feedback to diagnose feedback quality. The open source SPADE [22] could be used to produce a discourse tree for each sentence in feedback. SPADE is based on the formal model of text coherence developed for a free text and generates a tree consisting of three sets: Elementary text units or *etus*, discourse relations, some of which are indicative of explanation (such as Explanation, Elaboration, and Cause), and derived text units (internal nodes) via discourse relations applied to *etus*.

Acknowledgement

This research was supported by the grants from the Andrew Mellon Foundation to the first author. We thank Carla Bates for her comments on an earlier draft.

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