Exploring feedback and regulation in online writing classes with keystroke logging

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Exploring Feedback and Regulation in Online Writing Classes with Keystroke Logging

Abstract

The importance of feedback in writing classes has long been recognised. However, most feedback centres on writing products (e.g., drafts, completed essays) with feedback on writing processes difficult to provide. This paper explores the potential of keystroke logging software (KSL) to provide process-oriented feedback with a secondary focus on increasing self-regulated writing capacity. Specifically, we designed a four-stage intervention using KSL to provide feedback for 34 undergraduates over a 16-week English as a foreign language online writing class. Students recorded themselves writing narrative, descriptive, expository, and opinion essays (~450 words each). Both groups were given feedback tasks designed to improve time management, revision, and source use, but Group B was given targeted and more concrete tasks (i.e., increasingly other-regulated). Results show significant improvements on first draft performance for Group B in text quality and words typed. There was no significant difference between groups on second draft scores. Moreover, both groups reported a significant increase in their use of peer learning strategies, whilst Group B reported significant increases in metacognitive strategies, particularly idea planning. Based on these findings and students' perceptions on process-oriented feedback, we make a number of recommendations for future studies and lessons that seek to incorporate process-oriented feedback.

Keywords: Writing process feedback, writing intervention, L2 writing instruction, co-regulation, other-regulation

1. Introduction

There is now a growing consensus that feedback should be targeted toward supporting the development of self-regulation (Hawe & Dixon, 2017; Pandero et al., 2018). As Hattie and Timperley (2007) note, "feedback that attends to self-regulation is powerful to the degree that it leads to further engagement with or investing further effort into the task, to enhanced self-efficacy, and to attributions that the feedback is deserved and earned" (p. 102). Zimmerman (2000) refers to self-regulation as "self-generated thoughts, feelings, and actions that are planned and cyclically adapted to the attainment of personal goals" (p. 14). As process-oriented concepts, self-regulation and its academic component, self-regulated learning, require the operationalisation of various metacognitive, motivational, and behavioural processes that teachers can intervene in to help to scaffold learners (Zimmerman, 2015). In other words, whilst feedback should be geared toward self-regulation, as argued by Nicol (2020), co/other-regulation through, "a blend of different types of information (analytical and analogical) might better generate internal feedback about standards, while at the same time generate feedback that goes beyond just informing students about standards (e.g. about alternative ways to approach their work, about their own self-regulatory ability)" (p. 19). However, teacher feedback in writing courses primarily focuses on writing products (drafts), which are often tightly tied to disciplinary or genre-specific constraints. Consequently, its potential for transferability and self-regulation is somewhat low (Walker, 2009).

Conversely, feedback on writing processes arguably lends itself more to the development of self-regulated learning strategies, which can be transferred between assignments and developmental levels (Butler & Winne, 1995; Graham & Harris, 2018). Moreover, supplementing traditional feedback with individualised process feedback could also be a means by which to increase agentive engagement (Stella & Corry, 2016). For instance, Van den Bergh et al. (2016) propose a writing model with a functional dynamic approach. They claim that with a limited set of cognitive activities taking place at specific moments during the writing process, much of the variance in text quality can be predicted. Indeed, previous studies, which have focused on the relation between writing process and writing product through the use of think-aloud protocols (Beauvais et al., 2011; van Weijen et al., 2008) and keystroke logging (Bennett et al., 2020; Sinharay et al., 2019), have shown correlations between writing process activities and the quality of a text. Moreover, recent studies on processes such as planning (Bennett et al, 2020), revision (Xu, 2018), and source use (Vandermeulen, Van Steendam, et al., 2020) confirm this. Given the impact of the process on the resulting text quality, a number of scholars have thus pointed to the instructional value of addressing specific process activities in education through digital tools (Bennett et al., 2020; Spelman Miller, 2005).

However, it is often somewhat difficult to give feedback on writing processes, as they are more difficult to observe, particularly in assignments written outside of the classroom and in online writing classes (OWC). One means by which teachers can observe student writing activity online is through keystroke logging software (KSL). KSL is computer software that records inputs made by users (e.g., key presses) and logs these activities against a time stamp (Lindgren & Sullivan, 2019). It is a useful tool for examining student writing behaviour in terms of how they revise language structures and functions (Bowen, 2019), when and where they make revisions (Bowen & Van Waes, 2020), and how they incorporate and organise new information (Bowen & Thomas, 2020). Keystroke logging as a part of the feedback process has been used in a limited number of studies on writing. Lindgren and Sullivan (2003), for instance, used a KSL replay function based as a prime for stimulated recall in peer discussion; Ranalli

et al. (2018), on the other hand, combined KSL with eye-tracking data as means to stimulate one-to-one discussions between teacher and student. These studies showed the potential of process feedback based on KSL, but were limited to a replay function, were rather time consuming, and required extensive teacher/peer intervention to support students in interpreting the data (Spelman Miller, 2005).

However, recent advancements in one KSL program, Inputlog (Leijten & Van Waes, 2013), have made it possible for students to record their own writing activities and then generate detailed feedback reports on their writing processes (e.g., Vandermeulen, Leijten, & Van Waes 2020). This opens up the potential for increased feedback on writing processes in conjunction with feedback on writing products, as well as the potential for students to develop self-regulated learning capacity through the involvement of teachers (others) and material resources (material and symbolic artefacts). We see the involvement of "others" as particularly important when using KSL data, because without it there is a very real potential that this type of feedback may suffer from what Boud and Molloy (2013) refer to as "dangling data", where feedback is merely information that remains unused. For instance, in a pilot study by (Vandermeulen (2020), students evaluated KSL feedback positively, however, they reported a high cognitive load and found it hard to process the feedback without extra support. Essentially, as Nicol (2020) argues, to unlock fully the power of feedback, teachers need to help students make comparisons between their internal understandings and multiple external information sources, effectively moving them from analytical to analogical (comparative) thinking. Hence, pedagogical actions such as feedback are likely to benefit from being initially other-regulated, as students are being asked to complete tasks that enable deep processing of complex analytical and analogical information. Once effective strategic behaviour is routinized, the goal is for the regulation of this behaviour to shift to the learners, as per Thomas and Rose's (2019) model, where other-regulation and self-regulation are positioned at two ends of a continuum. Accordingly, the present study seeks to explore the potential of KSL feedback and regulatory orientations through the following questions:

1. What are the potential benefits on writing performance, if any, of incorporating process-oriented feedback that is co-regulated (analytical tasks) and increasingly other-regulated (analogical tasks) in an OWC?
2. To what extent, if any, can process-oriented feedback that is co-regulated and increasingly other-regulated enhance self-regulated learning capacity for writing in OWCs?
3. What are students' perceptions of using process-oriented feedback in an OWC?

1.1. Feedback

Contemporary research into feedback views it as "a process through which learners make sense of information from various sources and use it to enhance their work or learning strategies" (Carless & Boud, 2018, p. 1315). For instance, Carless and Boud (2018) outline the following steps to becoming feedback literate: (a) appreciating feedback, (b) making judgements, and (c) effective management of affect. Chong (2021) builds on this foundation by drawing on two fundamental tenets of sociocultural theory—mediation and the zone of proximal development (Vygotsky, 1978)—and "reconsiders student feedback literacy as a capacity mediated by symbolic and material artefacts" (Chong, 2021, p. 100). We agree with Chong that these are two key components in any feedback loop, yet they are often overlooked in writing classes, particularly when providing process-oriented feedback.

In this paper, we define *process-oriented feedback* as that which attends to specific activities that occur before, during, and after writing; specifically, the benefits of attending to activities such as goal

setting (Graham & Harris, 2018), planning (Bennet et al., 2020), time-management (Rosário et al., 2017), revising (Xu, 2018), and use of resources (Vandermeulen, Van Steendam, et al., 2020). As noted by Vandermeulen, Leijten, & Van Waes (2020), there are a number of reasons to include process-oriented feedback in writing classrooms. Notably, it has been shown to positively influence students' performance on more complex tasks, such as problem-solving (Hattie & Timperley, 2007), and lends itself to transferable skills that are not necessarily found in the task-specific nature of much product feedback (Butler & Winne, 1995).

In this study, we also adopt the term *product-oriented feedback*, which refers to any feedback given on completed drafts, where the goal is to improve drafts in terms of audience awareness, content, rhetorical organisation, language, etc. (Pritchard & Morrow, 2017). In other words, whereas in a process approach to writing (e.g., Graves, 1983), "product" and "process" feedback are typically combined and achieved through written or face-to-face comments, questions, and suggestions provided by teachers and/or peers on finished drafts, in this study we use process-oriented to refer to activities surrounding writing (as revealed in KSL data), and product-oriented to refer to the end result of such activities (as revealed in finished drafts). We hope that such an approach may go some way to addressing criticisms that the use of digital tools has often been absent in traditional writing classrooms at lower levels (Graham, 2019), and that some writing teachers do not devote enough time to explicitly teaching strategies that are tied to writing activities such as planning and revising (Graham & Sandmel, 2011).

1.2. Regulation and Feedback

Successful self-regulated learning often first emerges as the result of scaffolding via other-regulation and/or co-regulation (see Andrade & Evans, 2013; Elabdali & Arnold, 2020; Thomas & Rose, 2019). Other-regulation refers to when individuals other than the learner—such as parents, teachers, or peers—take charge of the learning process and make decisions about what is to be done (Winne, 2018). Co-regulation refers to when individuals shift or temporarily offload the responsibility of regulating the process "to each other or to tools and technologies" (Hadwin et al., 2018, p. 87).

In developing regulatory processes, students are likely to benefit from the help of others and technological resources in the following ways:

> (a) gathering reliable data about how they enacted learning and associating those data with effects, (b) access to tactics and strategies for learning that can be available to metacognitive control and (c) opportunity to practice newer tactics and strategies to bring them to the status of automated skills. (Winne, 2018, pp. 40–41)

In the current study, (a) from above is afforded through co-regulation, which is provided by the KSL tool, Inputlog (material artefact) and the analytical information it provides in the form of feedback reports (symbolic artefacts); (b) from above is afforded through other-regulation, which is provided by the classroom teacher via tasks that require comparisons between feedback reports and exemplars (analogical information); and (c) is achieved through the iterative nature of the intervention. However, to investigate the efficacy of (b), we assigned targeted and more concrete tasks to Group B (i.e., Group B was increasingly other-regulated). The rationale for this decision was based on previous research that indicates a gradual release model can be more effective in developing self-regulation (Graham & Harris, 2018), and that other-regulated feedback should be targeted and focused on helping students make formal and explicit comparisons (Nicol, 2020).

Hypothetically as learners become better able to deploy self-regulated strategies successfully, other-/co-regulation can feasibly decrease, as per Graham and Harris' (2018) Self-Regulated Strategy Development model (see also Teng & Zhang, 2020; Thomas & Rose, 2019). One caveat, though, is that successful self-regulated learning is a developmental process; learners who lack self-regulated learning/writing capacity are unlikely to achieve this aim by the end of a single course (Andrade & Evans, 2013). Since this is the first university-level writing course for our participants, small improvements in writing ability and self-regulated learning processes are seen as realistic, proximal goals.

1.3. Technology and Feedback

With regard to the role of technology and feedback, a number of automated writing tools have been shown to positively impact students' co- and self-regulatory processes; the most recent of which being AcaWriter (Knight et al., 2020), Computer-Supported Argumentative Writer (Benetos & Bétrancourt, 2020), and Research Writing Tutor (Cotos et al., 2020). There is, thus, a keen awareness of the role that computers can play with regard to developing self-regulatory processes in learners (Jansen et al., 2020; Van Alten et al., 2020) as well as facilitating co-regulatory and co-creationary processes (Blau & Shamir-Inbal, 2017).

Another computer based tool, KSL, which has been used extensively for research, also shows potential for automated feedback. One recent study by Vandermeulen et al. (2020) used Inputlog to record the writing processes of 33 first language Dutch students (average age 15.3). In this study, students wrote three expository texts (writing from sources) over a one-week period, and received process-oriented feedback on texts two and three. Students were also given two exemplars of writing process behaviours from students scoring one and two standard deviations higher. These exemplars consisted of annotated process graphs that detailed time allocation, production and fluency, revision, and source use. Results showed a small effect on text quality after the first feedback and a moderate effect after the second feedback, and thus demonstrated the potential for Inputlog to provide beneficial process-oriented feedback. However, although such emerging studies highlight the potential for process-oriented feedback, there remains the issue of how such data-driven reports can be converted into "actionable" information (Conde & Hernández-García, 2015).

We take up this challenge by using Inputlog to provide process-oriented feedback to two groups of English as a foreign language (EFL) writers. Specifically, to explore the potential of KSL in providing process-oriented feedback, we designed an intervention around a 16-week OWC. We had the following pedagogical aims in carrying out this intervention: (a) improve students' awareness of how they write; (b) enhance students' knowledge about writing processes; (c) improve the quality of students' writing; and (d) to explore whether such an intervention would impact students' reported use of self-regulated learning/writing strategies.

Our belief is that process-oriented feedback reports are able to give students insights into what they are doing and can be used as a starting point for reflection as they provide specific and objective information on students' writing—an important principle in feedback (see Nicol & Macfarlane-Dick, 2006). Furthermore, following the recommendations of Graham and Harris (2014), we seek to add to the literature on writing interventions by exploring feedback in an increasingly common context. Namely, that of online teaching as our participants completed a full semester of writing instruction online.

2. Method

2.1. Participants

Participants were second year Thai undergraduates (n = 34; 19–21 years old) enrolled on a mandatory 16-week online English essay writing course (three contact hours per week) at a large university in Bangkok. Participants came from various majors, and this was their first full English writing course. No participants were English language majors. All reported that their previous feedback on English writing assignments focused on grammar and spelling. None of them had used any kind of feedback software before, nor did they regularly write in English.

To enrol on the course, participants were required to be at or above B2 level of the Common European Framework of Reference (CEFR). Participants were randomly placed in two cohorts by the university's registrar system: Group A (control group) = 18 students and Group B (increased other-regulation group) = 16 students. There was no significant difference in pre-semester GPA scores between Group A (M = 3.16, SD = 0.20) and Group B (M = 3.31, SD = 0.26), $t(34) = -1.94$, $p = .061$. There was also no significant difference between groups on their mean scores and word counts on a timed, pre-test narrative task (see Section *2.5. Measures*).

2.2. Technological Tool: Inputlog

Inputlog is KSL software that records inputs made by users and logs these activities against a time stamp, resulting in detailed XML data files (called IDFX-files). These files contain a linear representation of the user's computer activity in terms of events such as keystrokes, mouse movements, and focus events (e.g., websites visited, programs used, etc.). These detailed files allow for various analyses to be made and for the user to generate a detailed feedback report of their recorded activity. This default feedback report includes information on: (a) *time characteristics* (time spent typing and pausing); (b) *process description* (final word count, total words typed, and words per minute); (c) *pausing behaviour* (frequency of pauses above 200ms, average pause length, and information on pauses within and between words, and between sentences); (d) *revision behaviour* (total number of revisions made, average number of revisions per 100 words, and mean length of revision burst); (e) *source use* (time spent in Microsoft Word, Internet Explorer, etc.); and (f) *process and fluency graphs*.

Inputlog also provides the option to modify the default feedback report and to create a template, where the teacher can write instructions for the student and filter out individual variables. For this project, we chose to simplify the report for the students by removing the sections on pause behaviour and pausing levels, and minimised the revision section so that it showed only the revision ratio. Furthermore, when generating the process reports, we set the pause threshold to 2000ms, number of intervals to three (beginning, middle, and end), and filtered out the representation of pausing activity on the process graphs. We did not include the fluency graph. Again, this was to make the report more student friendly and to focus on data that we believed had more pedagogical value.

2.3. Intervention Tasks

Our intervention tasks consisted of three items: a set of guided questions (Appendix A); individual process reports generated by Inputlog (Appendix B); and two annotated example reports from high-scoring first drafts (see Appendix C for one example).

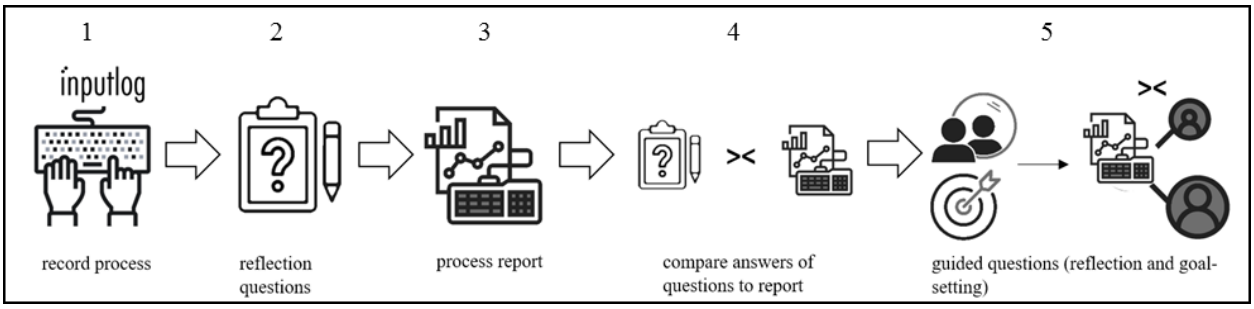
In each intervention, the questions/tasks required students to examine their writing activity—as reflected in the Inputlog reports—in terms of writing activity, text production, pausing behaviour,

fluency, revision, and source use. In other words, we covered all aspects of writing in each intervention but expanded upon the relevant section when the focal point changed. Hence, Intervention 1 (Appendix D) included questions/tasks related to time management. Intervention 2 (Appendix E) included questions/tasks related to revising strategies; and Intervention 3 (Appendix F) included questions/tasks related to source use.

Both groups processed these intervention tasks. The difference in treatment was that the tasks for Group B were more concrete and focused (i.e., increasingly other-regulated) and thus aimed to fine-tune the students' analogical thinking when interpreting and using their process-oriented feedback. Figure 1 shows the basic pedagogical flow for each intervention stage:

Figure 1

Basic pedagogical flow for self-reflection and task completion



Both groups recorded their sessions (generating XML logfiles in Step 1) and then reflected on their writing process by answering some reflective questions (Step 2). These questions were based on the focal point of each intervention (i.e., time management, revising, and source use as outlined below) and were used to engage both groups and prime them for the upcoming tasks. The teacher then used the students' XML files to generate process-oriented feedback using a customised XML report template (Step 3). Next, the teacher gave each student their individual feedback report (Appendix B) and two additional example reports for comparison (see Appendix C for one example or Figure 2 below; Step 4).

2.3.1. Intervention 1: Time Management and Planning

Intervention 1 concerned time management and planning, which are key activities in writing, particularly when writing to short deadlines. This intervention was implemented in Week 5, during the narrative essay part of the course (Condition 1: Weeks 4–6). In this intervention, students reflected on time allocation in terms of planning, revising, and searching for information. The task began with six reflective questions. Students then used the feedback reports to answer questions and complete tasks. Group B was given information on known predictors of writing quality related to planning, following recommendations from the Self-Regulated Strategy Development model on writing narratives (Graham & Harris, 2018). Accordingly, students were encouraged to reflect on POW (P = Pick my idea, O = Organise my notes, W = Write and say more) and generate notes on WWW + What = 2, How = 2 (Who? When? Where? What does the character do? What happens next? How does the story end? How do the characters feel?).

2.3.2. Intervention 2: Revision

Intervention 2 focused on revision (Appendix E), which plays a key role in writing instruction because the type of revision employed can influence text quality and disrupt the writing process leading to inefficient writing strategies. This intervention took place in Week 8, during the descriptive writing part

of the course (Condition 2: Weeks 7–9). Ten reflective questions were based on Kieft et al. (2007) and focused on revising strategies. Once again, after finishing the reflective questions, students used their feedback reports to answer questions and complete tasks. The more focused tasks for Group B were based on the recommendations of MacArthur (2012) and Hayes (2012), and had three core activities: (a) encouraging students to see revision as a continual process rather than just something you do to a final draft; (b) advising students to focus on macro-level revisions that attended to rubric items rather than surface-level revision of grammar and spelling; and (c) encouraging students to reflect on what they revise and why. We also encouraged students in both groups to set future goals in terms of time spent revising and types of revisions made.

2.3.3. Intervention 3: Source Use

Intervention 3 concentrated on source use (Appendix F), which is an increasingly important skill in the world of digital literacy. This intervention was implemented in Week 12, during expository writing (Condition 3: Weeks 11–13). Seventeen reflective questions were based on Wette (2018), Gebril and Plakans (2009), and Vandermeulen, De Maeyer, et al. (2020). Group B's more focused tasks centred on raising student awareness on "three sourcing dimensions [that] are critical to readers' assessment of information quality, namely: author position ("*who says what*"), author motivation ("*why the author says it*") and media quality ("*where it is published*")" (Pérez et al., 2018, p. 54, emphasis in original). Participant fidelity was measured by a knowledge application task, where students were asked to rate the reliability of six internet sources. This task was based on Anmarkrud et al. (2014) and Bråten et al. (2015). Using the feedback reports, we also challenged both groups to examine when and how often they searched for and used sources, as well as to how their source-based activity compared to that of the two example reports.

2.3.4. Intervention 4: Combined

In Intervention 4 (Appendix A), we did not focus on any one aspect of writing in detail. Instead, we broadly covered all three previous interventions by selecting tasks that students in Group B responded well to. Specifically, we analysed the students' responses to the previous tasks and used inductive content analysis to select items that students engaged more strongly with. This resulted in us selecting the following items: for time management, students used their process graphs to identify and reflect on how long it took them to start writing (i.e., their planning stage); for text production, students used their graphs to reflect on how long it took to reach the half-way point of their final word count; for fluency, students identified bursts of uninterrupted writing activity on their graphs and reflected on the distribution and length of these bursts; for revision, students were asked to annotate their graphs for macro-level revisions, reflect on forward and backward movements, and examine how far from the point of inscription they had moved; finally, for source use, we challenged students to look at how many times they switched between sources, how long they spent using each, and how this activity was distributed across the writing session.

2.4. Procedure

Students were given the opportunity to participate voluntarily in the study as part of their intact writing class. We explained that the intervention would involve receiving feedback on their writing and tracking their development over the course. This was the participants' first undergraduate writing course, and an accompanying intermediate-level textbook, *Effective Academic Writing 2: The Short Essay* (Savage & Mayer, 2012), was used to supplement teaching in both classes.

Both intact classes received the same instruction and product-oriented feedback for each of the

four essay types (conditions) they wrote over the 16-week course. The essays were narrative, descriptive, expository, and opinion. Each essay was worth 20% of their final grade—10% for the first draft (2.5-hour time limit) and 10% for the second draft (no time limit). These weightings were a requirement set by the course curriculum committee and were independent of the study. To comply with these regulations and minimise student imposition, we only recorded students' writing activity on their first drafts, which were written during online class time. This way, we could also control for time-on-task and be present (via Microsoft Teams) to address any problems. Both classes were run consecutively on the same day so that students from the first class did not have time to inform the other class about writing prompts, and thus give them time to prepare. Students also wrote pre- and post-experiment timed essays (2-hour time limit) in Weeks 1 and 16, for which they received neither feedback nor points toward their grades.

2.4.1. Recording Procedure

Students installed Inputlog on their laptops so that they could participate at home. We also installed Inputlog on computers in the faculty's computer room. This was because some students did not have Windows-based computers (Inputlog currently only works with Windows) and some did not have strong internet connections at home, so they preferred to work on campus. We provided students with a basic handout on how to install, setup, and use Inputlog. To familiarise students with the software, we had them record their pre-experiment essays in Week 1.

Students recorded themselves writing their first drafts during online class time. Recording sessions took place in Weeks 3, 7, 11, and 15, as outlined in Table 1. The table also shows essay types (conditions) and when the students wrote their second drafts (outside class time and not recorded).

Table 1

Breakdown of student drafts

	Condition 1: Narrative		Condition 2: Descriptive		Condition 3: Expository		Condition 4: Opinion	
Week(s)	3	5	7	9	11	13	15	16
Student activity	Record 1st draft	Write 2nd draft	Record 1st draft	Write 2nd draft	Record 1st draft	Write 2nd draft	Record 1st draft	Write 2nd draft

Students were free to use the internet when composing their essays. We felt that this added to the ecological validity of data collection, as this is what students would normally do with assigned work. In total, we collected 123 recordings of writing sessions, with nine recordings lost due to computer problems or student error. When this happened, we had no choice but to provide the student with a replacement feedback report. We made the choice to choose a report from a student whose first-draft score and word count were comparable. We recognise that this is not ideal, but such issues were rare, and this seemed like a reasonable compromise. Students were aware of the replacement and saw no issues with it.

2.4.2. Feedback Procedure

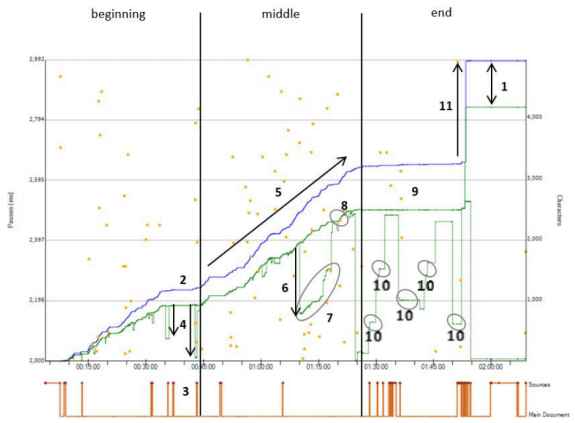
Product-oriented feedback consisted of implicit (indirect) feedback on student drafts in the form of correction symbols, organisational comments, and points on essay-specific scoring rubrics (see Bitchener & Storch, 2016). Each essay type the student wrote had two drafts, and thus students received two rounds of product-oriented feedback per essay type. Product-oriented feedback for first drafts was given to students after they completed the intervention task. Product-oriented feedback for second drafts was given to students before they started a new essay type.

Process-oriented feedback (Appendix B) was given to students three days after they completed their first draft. Both groups were given a set of questions related to their feedback reports. Group B differed in that one section of the questions were modified to give more focused and concrete guidance on each intervention as outlined in *2.3. Intervention Tasks* (see also Appendix A, D, E, and F). In other words, Group B's intervention tasks were increasingly other-regulated. Both groups received the same amount of time to reflect on their feedback and answer the questions. No extra writing was involved for either group. Both groups were also given two example reports (see Appendix C for one example). These example reports were generated using the XML files of two high-scoring students from either group. As shown in Figure 2, we added descriptive details to the example reports to guide the students' interpretations of them and to highlight important aspects related to that session's intervention focus.

Figure 2

Example report from a high scoring student focusing on revision (Intervention 2)

Example 1: Process Report from one student, focusing on their revision activity



Revision

79% of what the student wrote during the task ended up in the final text.

The blue line shows all the characters produced during the task. The green line shows all the characters in the text. So, when there is a difference between the blue and green line, it means that the student typed more characters during the task than there are in the actual essay [1]. This is normal as, when writing an essay, you make changes, edits, deletions and insertions (revisions). i.e., sometimes you make a typo or mistake, want to use a different word, or change the content of your essay.

The student in this example made revisions in all three stages of the 2 hrs: beginning, middle, and end.

Beginning of writing (0 – 40min):

In the beginning, the blue process line and the green product line gradually diverge. This means that the student typed more characters than there can be found in the MS Word document (essay). In other words, the student typed characters that they later deleted.

While typing, the student then made small revisions: revising spelling errors or changing words.

Between 35 and 45 min, there is hardly any text production [**2**]. The blue process line and the green product line run horizontal (neither lines increases). The student consults 3 sources [**3**] and spends time reading or looking at their essay in MS Word.

But the student does make two small changes during this time: the green dotted line goes down [**4**], which means this student went back to a previously written part of their essay and made a large revision.

Middle of writing (40 min – 1 hr 20 min):

In the middle of the 2 hrs, there is very fluent text production. The blue process line rapidly increases; i.e., goes up steeply [**5**].

At 1 hr 10 min, the student makes a large revision **[6]**: the green dotted line goes down to approximately 900 characters. The student then steadily inserts text over the next 5 min **[7]**.

At 1hr 20 min, the student moves back to the end of their essay and continues adding text [**8**].

End of writing (1 hr 20 min – 2hrs):

In the last stage of the 2 hrs, the student does not produce much text [**9**]: the blue line runs horizontal and the student does not produce many characters between 1hr 25 min and 1 hr 55 min. The green line also runs horizontal, and the word count of the essay does not increase much.

The student is probably proofreading at this stage. We see backwards movements through the essay where the students makes revisions each time [**10**]. At several moments the green dotted line goes down: this indicates that the student is working on several parts of this text. But because the blue line is not really increasing, not much text is produced. So, the student is making small changes: they are rewriting some parts.

At 1hr 55 min, the student pastes a lot of text into the main document [**11**]: both the blue and the green line go straight up. This is where the student has copied and pasted the scoring rubric to the end of their essay.

Students then compared the answers to their initial questionnaires (Step 2) with the information given in their feedback reports (Step 4). Finally, teachers introduced guided questions and tasks that required the students to make use of the feedback reports (Step 5)—at this stage, questions and tasks were different for each group. Students were given time to read all the reports and were allowed to ask questions. Upon a two-hour time limit, we collected their answers and checked for completion.

2.5. Measures

We charted text quality using students' drafts. Drafts were graded using analytical scoring rubrics that were tailored for each essay type and this demographic of students; these rubrics had evolved over the twelve years the course has been taught. The rubrics awarded points for ideas/content, organisation, word choice, sentence fluency, conventions, and references (for expository and opinion essays only). Both first and second drafts were assessed using the same rubrics, but points were deducted for the number of micro-level instances of non-standard usage made on the second drafts, such as grammatical or spelling "errors", with five errors resulting in a one-point deduction.

A random sample of four essays were taken from each condition (first and second drafts). These 32 essays were independently graded by a colleague who also taught the same writing course at the university but with another cohort of students. They used the same analytical scoring rubrics. Inter-rater reliability was calculated using Cohen's kappa. Results showed substantial agreement (as per Landis & Koch, 1977), $\kappa = 0.805$ ($p < .001$), 95% CI, (0.65, 0.96).

We also administered the Writing Strategies for Self-Regulated Learning (WSSRL) Questionnaire (Teng & Zhang, 2016) as a means to measure individual and group writing strategies pre- and post-experiment. The questionnaire includes forty Likert-scale items that are grouped into nine types of WSSRL that can be further categorised into four dimensions: cognition, metacognition, social behavior, and motivational regulation. We calculated means and standard deviations for each item within groups. Coefficients of kurtosis and skewness were used to remove any abnormally distributed items. We then compared pre- and post-measures within groups using independent samples *t*-tests (two tailed) for each of the nine types of WSSRL.

As a measure of pre- and post-experiment performance, we also administered narrative writing tasks (2-hour time limit) in Weeks 2 and 16. Tasks were comparable in terms of demands and text-type, and were designed to incorporate some writing from sources. These measures were scored using the same analytical rubric as Condition 1 (narrative). Participants did not receive any feedback on these measures.

Students' perceptions on the use of process-oriented feedback were measured via their responses to a post-experiment group interview, one for each group (Week 16). The lead researcher asked a series of questions pertaining to the students' expectations when they discovered they would be using KSL software, difficulties they may have experienced, perceived benefits, and their opinions about product-oriented and process-oriented feedback, respectively, after the experiment. Questions were initially posed to the group, and then to individual students, with most participants responding directly to the researcher (as per Rose et al., 2020). To avoid social-desirability bias (Edwards, 1953), the students were informed that the purpose of experimenting with process-oriented feedback was to explore its effectiveness and that the researcher was genuinely curious about the students' perceptions as they could be helpful in designing future courses. To ensure further that all students' honest views were accounted for, they were sent a link to a shared Google document where they could add additional, anonymous responses. The interviews lasted approximately one hour. They were recorded, transcribed, and analysed using (inductive) qualitative content analysis; this involved coding and categorizing responses given to each pre-determined question (see Selvi, 2020).

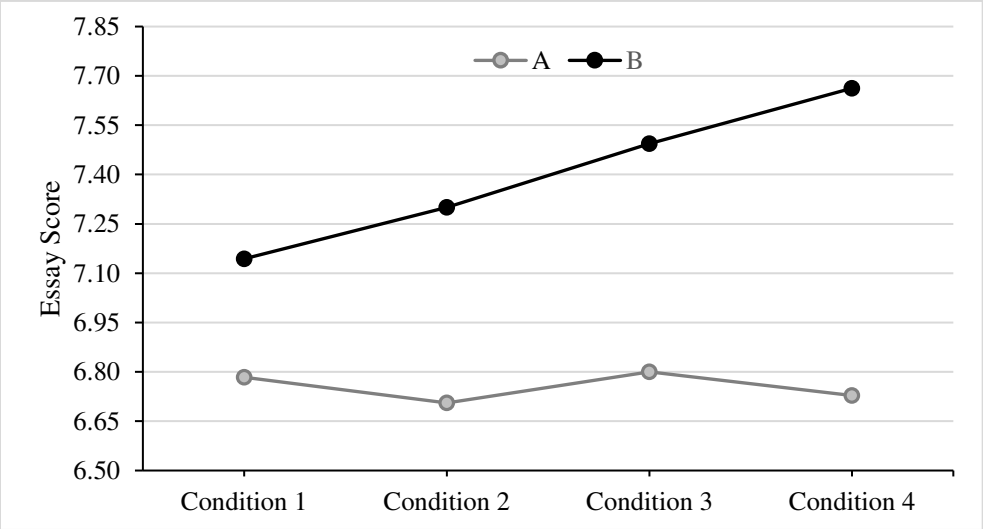
3. Results and Discussion

3.1. Benefits of Incorporating Process-Oriented Feedback on Writing Performance

Because the students wrote four essay types, it is difficult to chart progress across the semester, as they are constantly adapting to new genres. Moreover, studies have shown that development over the course of one semester is often minimal at best (e.g., Mazgutova & Kormos, 2015). Nevertheless, Group B showed steady improvement throughout the semester on first draft scores, whereas Group A showed little improvement, as shown in Figure 3. Specifically, there were significant differences between groups on their first draft mean scores for Condition 2 ($p < .01$), Condition 3 ($p = 0.019$), and Condition 4 ($p < .01$). There was no significant difference between second draft group scores on any of the conditions.

Figure 3

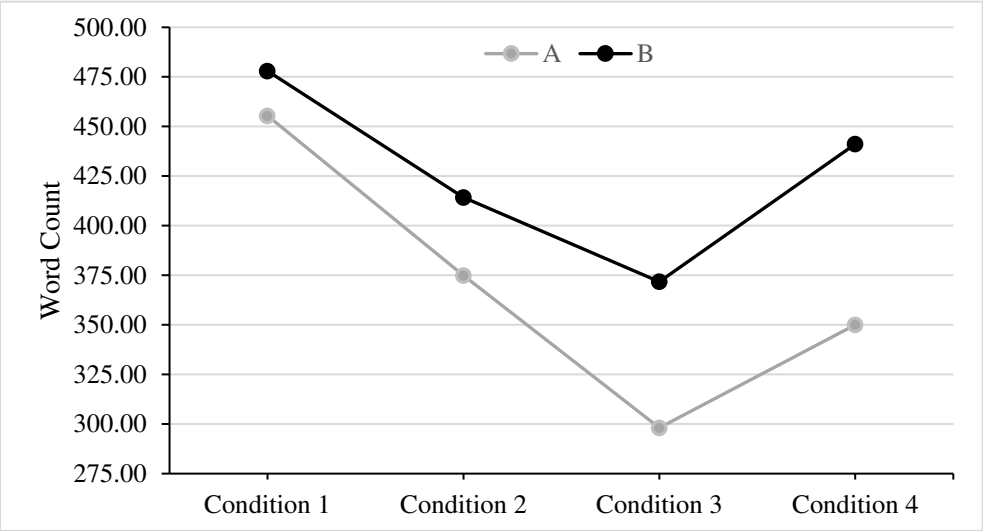
Mean essay scores on first drafts across the four conditions (essay types)



Moreover, across the four conditions, Group B consistently typed more words than Group A on their first drafts, with the difference approaching significance in Condition 3 ($p = .068$) and becoming significant in Condition 4 ($p < .05$), as shown in Figure 4. The total number of words typed during the writing process can be seen as a general, but stable, indicator of text quality (Bennett et al., 2020). Hence, these results might indicate that Group B students' writing processes were more fluent as reflected in higher text production and revision ratios (see Van Waes & Leijten, 2015).

Figure 4

Mean word counts across the first drafts for each of the four conditions (essay types)



Although our sample size is small, such results have important implications. Namely, even though our other-regulated treatment may not seem to have much effect on overall performance across a semester if we only gauge student performance on final drafts, it does appear to be beneficial for improving students' performance when writing to strict time limits, which is an essential skill in formal examinations and other, timed writing tasks.

Results from the pre- and post-experiment tasks somewhat support this hypothesis. First, there were no significant differences in the pre-experiment mean scores and word counts between groups. There was, however, a significant difference in the post-experiment mean scores, $t(34) = 2.43$, $p < .05$, between Group B (increased other-regulation; $M = 76.75$, $SD = 7.54$) and Group A ($M = 70.83$, $SD = 6.66$), and significant differences within groups across pre- and post-experiment mean scores as shown in Table 2.

Table 2

Pre- and post-experiment measures

		Pre-experiment Means (SD)	Post-experiment Means (SD)	t-value	*p*
A ($n = 18$)	Word count	383.17 (86.84)	364.67 (55.57)	0.92	0.37
	Score	63.06 (5.49)	70.83 (6.66)	-3.68	< .01
B ($n = 16$)	Word count	405.00 (87.28)	383.06 (21.72)	1.04	0.32
	Score	66.13 (7.52)	76.75 (7.54)	-7.58	< .01

Table 2 also shows that both groups significantly improved in their scores on the timed narrative task over the 16-week period, with a small effect size for Group A ($r = .25$) and large effect size for Group B ($r = .72$).

In addition to these effects on writing performance (text quality and word count), the increasingly other-regulated treatment also appeared to have an effect on process-related performance. We compared the processes of Condition 1 (narrative essay, first draft) to Condition 4 (opinion essay, first draft)

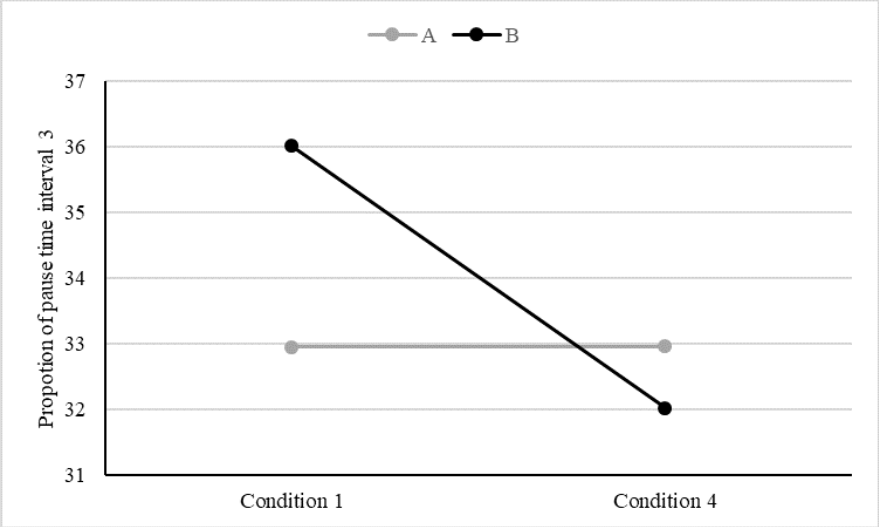
through repeated measures analysis to gain insight into the impact of the complete intervention on the students' writing process. As different genres were present in the two conditions, and as there are indications that genre can influence the writing process (Medimorec & Risko, 2017; Vandermeulen, De Maeyer, et al., 2020), it is not sufficient to use time as the controlling factor in the analysis. Therefore, we only report significant effects for the interaction between time (within subject, Conditions 1 and 4) and group (between subject, Groups A and B). This way, we obtain insights into how the impact of the intervention on the writing process differed for Group A compared to Group B (increased other-regulation group).

Results showed a significant difference for pause time ($F(1,24) = 10.28$; $p = .004$), fluency ($F(1,27) = 5.28$; $p = .030$), and source time ($F(1,27) = 4.25$; $p = .049$) in Interval 1 (0–50 min), and for pause time in Interval 3 (1 hr 40 min–2 hr 30 min), $F(1,27) = 5.99$; $p = .021$. The variables, pause time and source time, are defined as the proportion of time spent on pausing/source use in a certain interval in relation to the pausing/source time in the entire process. The variable, fluency, is defined as the number of keystrokes per minute in a certain interval. Before conducting the repeated measures analysis, assumptions of normality and sphericity were tested. As the data for pause time in Interval 1 were not normally distributed, two outliers were removed before conducting the analysis for this specific variable.

Whilst the proportion of time spent pausing during Interval 3 was more or less the same for the first draft of Condition 1 (narrative) and Condition 4 (opinion) for Group A, it decreased in Group B (Figure 5). This might indicate that increased other-regulation had an effect on this particular process aspect.

Figure 5

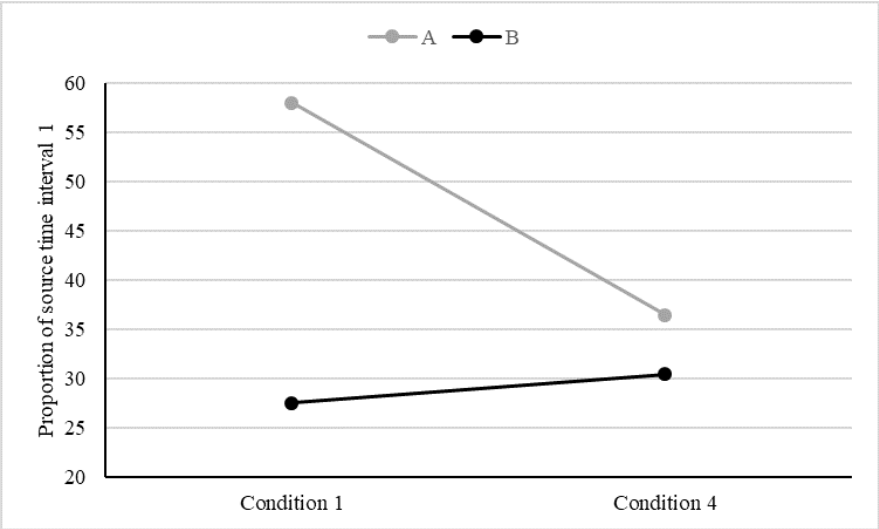
Pause time in Interval 3 during writing of firsts drafts for Conditions 1 and 4



For source time in Interval 1, we see an opposite trend, as increased other-regulation might have caused more stable source use in Group B, compared to a downward trend in Group A (Figure 6).

Figure 6

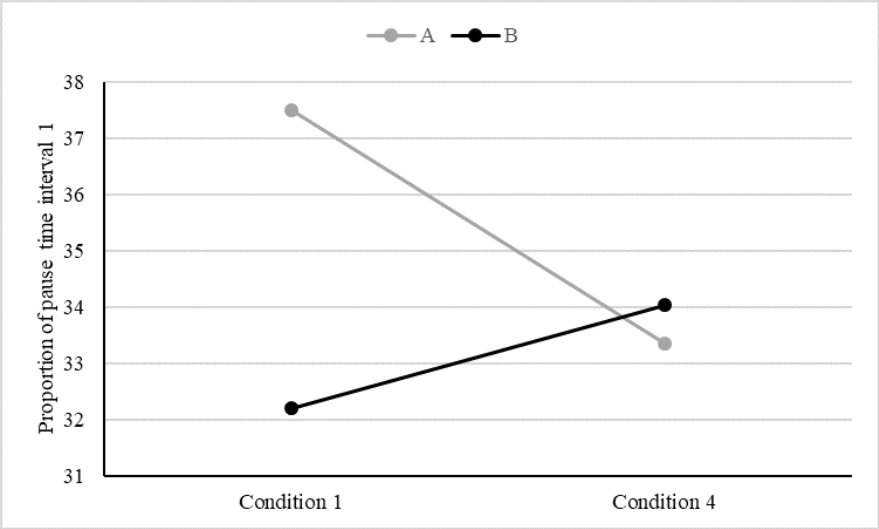
Source time in Interval 1 during writing of first drafts for Conditions 1 and 4



For the variables pause time and fluency in Interval 1, we see opposite movements when comparing the two groups. Namely, when writing the first draft for Condition 4 (opinion essay), the proportion of pause time in Interval 1 for Group B was higher than when they were writing the first draft for Condition 1 (narrative essay); for Group A, however, we see the opposite, as pause time was lower when they were writing their first drafts for Condition 4 as compared to Condition 1 (Figure 7).

Figure 7

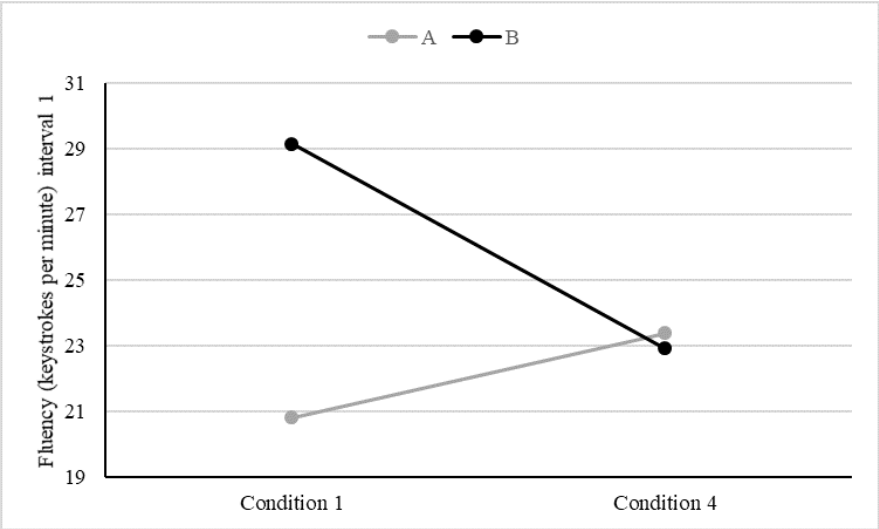
Pause time in Interval 1 during writing of first drafts for Conditions 1 and 4



Moreover, students in Group A, increased their writing fluency in Interval 1 (Figure 8), whilst students in Group B wrote less fluently as the course went on.

Figure 8

Fluency in Interval 1 during writing of first drafts for Conditions 1 and 4



In both conditions, students' writing processes changed during the course of the intervention, but the effect differed according to the condition. Namely, we see that students who received increased other-regulation via more focused feedback tasks (Group B) spent more time on pausing and wrote less fluently in the beginning of the writing process at the end of the intervention. Source time, however, remained stable throughout the intervention. This seemingly indicates that students in this group consistently spent time consulting sources and on planning their text at the start of each session, rather than starting to write from the beginning. Group B's process at the end of the intervention also showed a lower proportion of pause time. This might be a consequence of the fact that they already spent more time planning their writing in the beginning. The strategy adopted by the students in Group A after processing the feedback, however, is somewhat different. In Condition 4, students in Group A wrote more fluently in the beginning of the writing process compared to what they did before the intervention. Their focus shifted to producing text and thus they paused less and spent less time in the source windows.

Given the rather small sample and the different essay types, we cannot draw definite conclusions. However, the significant effects for the interaction of condition and group indicate that the process-oriented feedback had an influence on several aspects of the students' writing process, and that the effect differed according to condition. Namely, although these findings contradict what we know from theory on "good" writing processes—particularly the importance of improving writing fluency (Van Waes & Leijten, 2015)—the fact that Group B students decreased in writing fluency as the course went on needs to be seen in relation to two points. First, although Group B were less fluent in their writing, they seemingly spent more time on planning and consulting sources, which probably reflected the increased difficulty of the text-types they were tasked with. Second, the changes we see are not indicators of improved writing processes as such, but represent changes in the writing process that are indicative of increased self-regulation and reflective practices, perhaps in relation to increased analogical thinking.

3.2. Benefits of Incorporating Process-Oriented Feedback on Writing Strategy Use

To test for changes in strategy use, we administered the Writing Strategies for Self-Regulated Learning Questionnaire (Teng & Zhang, 2016) in Weeks 2 and 16 (see Appendix G for full results). Interestingly, both groups showed a significant increase in their reported use of *peer learning* strategies

(Group A, $p < .01$; Group B, $p = .01$), with the item, "I brainstorm with my peers to help me write", reporting the largest increase—Group A increased from 2.79 to 4.11 ($p = .007$), and Group B increased from 2.63 to 4.06 ($p = .036$). This increase may have stemmed from the students having to work together to interpret their feedback reports, and in discussing how their reports differed from their peers (discussed later). Moreover, the difference between the groups may reflect the reduced level of other-regulation given to Group A in terms of guided feedback tasks (i.e., reduced access to analogically focused material).

Another interesting finding was that Group B reported a significant overall increase in their use of writing strategies linked to metacognition. Namely, *idea planning* increased from 5.06 to 5.75, $p = .012$, and *goal-oriented monitoring* and *evaluating* increased from 4.44 to 4.81, $p < .05$. The largest increase was seen in the item: "Before writing, I use the internet to search for related information to help me plan. (IP)" ($p = .012$). Idea planning most closely relates to Intervention 1 (time management), whereas goal-oriented monitoring and evaluating could relate to any or all of the interventions. Group A, meanwhile, also showed an increase in their reported use of the same strategies, with idea planning approaching significance ($p = .053$), yet none of the individual items increased significantly.

In addition to a reported increase in certain writing strategies, students also demonstrated increased awareness of writing-related activities in their answers to the reflective questions, future goal setting, and in the group interviews. Specifically, they made repeated reference to activities and processes such as time management (e.g., "I don't think that I spent too long not writing, because I used that time for searching about the topic and preparing to write"), planning (e.g., "It took me less than three minutes to start my writing, because I planned the content before class"), micro- and macro-level revisions (e.g., "I focused on the overall content. I usually added new sentences to the paragraph that I have already finished when I felt that something was missing"), fluency rates (e.g., "I was most fluent on the middle and the end, because I had already planned the outline of the body part before I started to write"), free-writing techniques ("I often ran out of ideas. Maybe I have to plan and prepare myself before writing"), and so on. These are all key components when it comes to writing development, yet it is easy to lose sight of them when there is often an implicit bias toward the finished product via teacher feedback and grades awarded for finished drafts. Consequently, whilst it is true that in many writing courses students are asked to reflect on their writing processes at the end of a writing project, which can give insights into regulatory processes through consciousness raising, we believe that additional process-oriented feedback through KSL can provide concrete and contextualised feedback in the form of visualisations, and that this is particularly useful in online writing classes.

In sum, the intervention seemingly had an effect on several aspects that are considered to contribute positively to L2 writing. For example, from previous studies, we know that peer interactions facilitate audience awareness and motivation to revise (Pritchard & Morrow, 2017), and that increased awareness of writing strategies can contribute to increased writing performance (Graham & Harris, 2018). More concretely, idea planning has been shown to have a positive effect on various aspects of second language learners' written output (Abdi Tabari, 2021), and students who set goals tend to write significantly better texts than those who do not (Miller, 2020). Finally, self-assessment can be a powerful tool to enhance self-regulation as it places learners at the center of the assessment process (Wong & Mak, 2019). Hence, students can be empowered through support, guidance, and training in evaluating their own learning and work (Nicol, 2020; Thomas et al., 2021).

3.3. Students' Perceptions on Using Process-Oriented Feedback

Perhaps as to be expected, most students reported feeling nervous about using the software at first because of its novelty, with some stating that it was a little stressful as it felt like someone was watching over them. Others stated that they were nervous because they thought that it would show all the mistakes they had made in terms of deleted words, and that they would lose marks for this. However, these feelings dissipated as the course progressed, and students reported that they enjoyed using the program and being able to see a visual representation of their writing activity.

In terms of difficulties with the program and their feedback reports, most students remarked how their initial feedback reports confused them, as they had not seen anything like them before. Yet, many of them were also intrigued by their process graphs and their level of detail, with some remarking that it was "fantastic", "shocking", and "cool", and that "it was surprising to see how many words I had deleted". Others commented on their frustration at the university computers freezing during writing and felt that this interrupted their writing process. Clearly, this issue needs to be addressed in the future. We recommend that a minimal number of programs be running in the background, and that students save to memory sticks rather than cloud storage as poor connections may slow down the saving process. However, these were minor issues, and all students agreed that it became easier to use the program and interpret their reports as the course continued, particularly by the time that had reached Condition 3.

As mentioned in Section 3.2., students in both groups also showed increased awareness of their writing processes, as evidenced in their answers in the group interviews, making comments such as "I produced text slowly at first, and didn't focus on my work that much as I often switched from the essay to the internet, but I found it helped to focus on typing more fluently in the middle of the session and leaving the revision until about 20 minutes before the end". Others noted how the reports helped them to see "weaknesses" in their writing process, such as "I tended to struggle to produce text and edits toward the end of the session. I think I was just burnt out and needed to pace myself better" and "I sat around doing nothing for ages when I should have just typed something". At the end of the course, all students thought that the process-oriented feedback had helped them improve their writing, gave them an advantage over other cohorts who were not using it, and that they would recommend using the reports in future writing courses. However, there were a few caveats.

First, students preferred product-oriented feedback to process-oriented feedback and agreed that the latter should not replace the former. This is somewhat unsurprising to us as our participants are entrenched in an education system that is driven by authoritative, transmission-based teaching (Buasuwan, 2018), and thus they may not immediately see the benefits of mediation via symbolic and material artefacts. It is also possible that students associate feedback provided by a teacher as an interpersonal experience in which teachers show their care for students by providing detailed feedback (see Rowe et al., 2014). Second, most students expressed that reports, or more specifically the process graphs, should be made easier to understand, and perhaps be accompanied by some form of handbook to help with their interpretation. Many students commented that the graphs in the example reports were easy to understand because of the accompanying descriptions, and asked for such descriptions to be added to their own graphs. We agree that it is a good idea to provide some kind of guide or infographic for the graphs, and would recommend its inclusion in any future endeavours. However, providing detailed explanations of each individual graph would be too time consuming so we would advise against this. Third, students reported varying levels of usefulness with regard to each aspect of the feedback reports.

Specifically, they believed that time management was the most beneficial (n = 21), followed by the process graphs and how they showed revision behaviour and fluency (n = 8), then everything in the report as a whole (n = 7), and finally information concerning source use (n = 3).

Overall, students' perceptions of using process-oriented feedback were as to be expected, given the trajectory that most students expressed experiencing: from intrigued, yet initially confused, to feelings of joy and of experiencing a novel, advantageous learning tool as the course progressed. This is consistent with existing literature on the implementation of novel means of providing writing feedback (see Cunningham, 2019). As noted by Elwood and Bode (2014), "e-feedback needs to proceed with due attention paid to inculcating students to its use" (p. 341), which we accomplished via the use of staggered intervention activities. This is particularly important in writing classes as students' perceptions of the feedback they receive can affect their writing self-efficacy (Ekholm et al., 2015). Accordingly, as our participants' self-efficacy towards using the process-oriented feedback improved over the course of our study, so too did their perceptions of it. Ultimately, when students perceive feedback to be effective for improving their writing, they become more open to it, creating a positive feedback loop that structured class activities may help to engender (Zumbrunn et al., 2016).

4. Conclusion

Overall, we have attempted to show one means by which process-oriented feedback can be integrated into a 16-week online writing course (OWC) by utilising current advancements in KSL. Consequently, we hope to have made a number of contributions to the field of writing pedagogy and feedback, and to using computers in composition, particularly in terms of developing self-regulatory writing capacity through material/technological co-regulation (via process-oriented feedback reports) and other-regulation (mandatory, iterative tasks from a teacher).

First, by designing a four-stage intervention around strategies that are known predictors for increasing text quality, we have attempted to show that it is beneficial to include process-oriented feedback alongside product-oriented feedback in OWCs. Accordingly, our results indicate that guided intervention tasks can lead to significantly increased student performance on timed writing tasks, as evidenced in the pre- and post-experiment scores, as well as in the first draft scores across the 16-week period. Moreover, results indicate that such interventions can lead to increased writing activity, as Group B consistently produced more words than Group A, with this difference being significant after Condition 3. We also explored the effect of the overall intervention on the writing process by comparing aspects of the writing process in Condition 1 to that of Condition 4. Results indicated an interaction effect between condition and group for pause time, fluency and source time in the beginning of the writing process, and for pause time at the end of the writing process. Though more research is needed to understand the changes occurring in the writing process, we can conclude that the intervention resulted in changes in the students' writing approach and that the changes differed between the groups.

Second, by challenging students to reflect on their writing processes, we hoped to improve their self-regulation in terms of writing strategies. Results from the WSSRLQ survey indicate that students did report increased use of several strategies, namely those related to social behaviour and metacognition, yet this progression was markedly more so in Group B (increased other-regulation). Theoretically, these findings are promising, as a number of researchers posit that metacognition is a prerequisite for successful self-regulated learning (see Teng & Zhang, 2016; Zhang & Zhang, 2019). Such findings also extend

previous process-oriented writing research that has demonstrated that metacognition and writing performance benefit from explicit strategy-based instruction (e.g., De Silva & Graham, 2015; Lam, 2015; Teng & Zhang, 2020).

However, the novelty of our study is that this "instruction" took place mostly through the technological co-regulation of the students' writing processes using Inputlog's KSL feedback reports. After front-loading explicit training on how best to use the reports, the teacher's role in the experiment shifted to that of an important, yet less visible, orchestrator and macro-level other-regulator of the learning process. The teacher assigned structured, mandatory tasks that provided opportunities for students to develop their self-regulated learning capacity over a relatively short-term intervention, while offloading the provision of process-oriented feedback to the software. This, in turn, enabled students to co-regulate their learning with a technological resource and increase their chances of becoming successfully self-regulated writers over time; such activity is typically viewed as the purview of the teacher (Andrade & Evans, 2013), although other recent advances show how this might be changing (see Azevedo et al., 2019). We expect that such a shift will be a welcome change for busy writing teachers in many contexts.

Third, by eliciting student perceptions of process-oriented feedback, we saw how such an approach could lead to increased awareness of the cognitive components of writing, which is an aspect that can be easily overlooked in writing classes, particularly those that take place online. Moreover, students saw the benefit of such an approach whilst also finding it engaging and interesting. However, they also reported feeling that some interventions were more beneficial than others were, with time management being seen as the most useful. We agree that some interventions may be more useful than others may, and in future courses, we would focus on time management and revision. Moreover, although we recognise source use as an important component in writing, we feel that the current capabilities of Inputlog make it difficult to create an understandable metric of source use, and that this particular skill may not really necessitate the use of KSL—students may benefit just as much from explicit instruction on source use that is independent of individualised feedback.

5. Limitations, Challenges, and Future Directions

First, we recognise the importance of repeated exposure to KSL and feedback reports. Consequently, in hindsight, we should have given the students simplified feedback reports on their pre-experiment essays. This would have helped us to introduce the layout of the reports, alleviated any anxiety as to what the KSL program actually did, and given us an early opportunity to explain that it is just a tool with which to reflect on writing processes—some students were initially concerned that their process graphs did not look like the examples and they took this to mean that they had poor writing skills.

Second, we are limited in the generalisability of our results due to the relatively small group sizes. We hope that future studies may include more classes/students to increase the sample size. This is not without increased complexity, however, as researchers would then have to take into consideration individual teaching styles and increased task variability. For instance, researchers would need to use a variety of writing prompts for each essay type or run the risk of students sharing information between cohorts, thus giving students time to prepare/pre-write their first drafts as not all classes would be on the same day.

Third, although we found indications of interesting changes for several process aspects, we were not able to draw general conclusions as the essay type differed across conditions. Therefore, future studies could include tasks across comparable conditions to explore these possible changes more rigorously.

Finally, students also reported a number of technical issues related to the performance of the hardware they used (i.e., university computer facilities). Such technical difficulties would need to be mitigated in future research, and have implications for the suitability of such interventions at institutions where technological support may less than ideal.

Overall, by incorporating KSL feedback reports into writing classrooms, we believe that teachers can supplement traditional methods and address some of the inconsistencies sometimes seen in process-based classrooms (see Graham, 2019, for an overview). Namely, KSL feedback reports allow teachers to incorporate additional evidence-based practice and increased use of digital tools in the classroom, whilst also helping teachers to individuate and explicitly focus on key writing processes, such as planning and revising. Moreover, we are excited at the potential benefits of using multimodal elements (e.g. process graphs) alongside written feedback in future courses and research, as well as for further pedagogical applications of KSL that can take advantage of its potential for self-assessment and self-reflection amongst students. We feel that this last aspect is particularly important, as it enables teachers to incorporate analogical thinking that goes beyond comparisons of model texts and finished drafts, and affords students opportunities to make tangible comparisons of the actual activities they are engaged in.

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Appendix

Appendix A

Intervention 4

Reflecting on writing activity

*Answer the questions in this section from memory (i.e., **do not** look at your feedback report).

1. I'm satisfied with how I managed my planning/writing time.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

2. Only after I've finished my essay, do I reread what I've written.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

3. I interrupt the writing from time-to-time to correct the text.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

4. If I proofread and rewrite my text, its structure can still change a lot.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

5. If I proofread and rewrite my text, the content can still change a lot.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

6. I know how to avoid plagiarising from my sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

7. I know how to evaluate the quality of the sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

8. I reread the sources while I was writing to find ideas to put in my essay.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely *Completely*

9. I can select relevant information for my essay from sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

10. I can make connections in my essay between information from the various sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

Examining writing activity

*Look at your report. Read the introduction and overview, and then **type** your answer to the following questions in the spaces provided:

Time:

1. How much time did you actually spend writing? How does this compare to the two example reports I have given you?
2. On average, how long did you spend reading, researching, thinking, or taking break? How does this compare to the two example reports I have given you?
3. Look at your process graph. Along the x-axis you see time. How long did you wait before you started writing (blue line=process)? Draw an arrow from left to right to show the amount of time you took to start writing; this is most likely your main planning stage. What were you doing during this time?

Text Production:

1. In which stage of writing did you produce most of your text? How does this compare to the two example reports I have given you?
2. Look at the right-hand y-axis. This displays the number of characters you typed. Approximately how long did it take for your solid green line (product) to get to the half-way point of its total (the point at which the solid green line touches the right-hand y-axis)? Mark this point on your graph with an "X".

Pausing:

1. How does the time you spent reading, researching, thinking, or taking a break in each stage of writing compare to the example reports?

Writing Fluency:

1. On your graph, indicate where you had bursts of writing activity. i.e., moments of increased fluency where the green line ran uninterrupted by lines dropping straight down. Mark these moments with arrows. At which stage in your writing did these bursts occur? Are they evenly distributed or do they occur in a certain part of your writing?
2. When were you most fluent and why do you think you were most fluent during this stage?
3. How does this compare to the two example reports I have given you?

Revision:

1. Is your percentage lower or higher than that of the example reports?

If it is lower, it means that, overall, you revised your text more than the authors of the model text(s).
If it is higher, it means that, overall, you revised your text less than the authors of the model text(s).

2. Look at the graph from Example 1 I have given you. Several points along the green line (essay word count) are highlighted with circles and downward arrows. These indicate revision activity. In Example 1, most revision occurred between 01:30:00 and 02:15:00 (x-axis). The downward arrows show the writer moved backwards in their essay document: the longer the arrow, the further back they moved from where they were previously typing. The circles then highlight forward movement through the essay document--sometimes this coincides with an increase in the essay's word count (right-hand side y-axis).

Draw downward arrows on your process graph to show when you moved backward through your essay document. Then draw circles where you moved forward, possibly making small (or large) changes on your way. I.e., highlight your revision activity.

3. What types of revisions you were making? For example, did you focus on revising individual words? Or did you revise larger units like sentences or content? Or did you do both?

Source Use:

1. In which stage of writing did you rely most on sources? And how does it compare to the example feedback reports?

2. Look at the number of orange/brown vertical lines at the bottom your graph. The more vertical lines you have, the more times you switched between sources. In which stage of writing did you switch most (beginning, middle or end)? And how does your orange/brown line compare to the example feedback report? i.e., did you switch more often or less often? Did you consult more sources (no. of vertical lines) or less? And when did you stop to consult sources?

Setting Future Goals for Source Use

*When writing my next first draft I will do the following to improve:

- In order to better manage my time, I will…
- When it comes to revising, I will ...
- When it comes to dealing with sources (spending time in various types of sources, switching between sources, etc.), I will ...

Appendix B

Inputlog's Feedback Report

Introduction

This report shows what you did when you wrote your first draft.
Use it to reflect on your writing and to compare your writing process with that of a writer who received a high grade for this task.

Overview

In this report you will find information about:

- Time
- Text production
- Pausing
- Writing fluency
- Revision
- Source use

Time

The time you spend writing, we call active writing time. The rest of the time you read

(your text or others), research information, translate words, or take a break. Below, you will see how you divided your time (hh:mm:ss).

- Total time on task: 02:10:24
- Active writing time: 01:04:29
- Reading, researching, thinking, or taking a break: 01:05:55
- On average, you used 50.55 % of your time reading, researching, thinking, or taking a break.

Text production

In which stage of the two hours did you produce most of your text?

- beginning (0–50min): 34.76 %
- middle (50min–1hr 40min): 44.14 %
- end (1hr 40min–2hr 30 min): 21.09 %
- To compose your text of 646 words (3331 characters), you produced a total of 796 words (4274 characters)—excluding copied text.

Pausing

In which stage of the task did you spend most time reading, researching, thinking, or taking a break?

- beginning (0–50min): 30.67 %
- middle (50min–1hr 40min): 27.27 %
- end (1hr 40min–2hr 30min): 42.06 %

Writing Fluency

Your writing speed constantly changes. This is because some parts of your essay are harder to write than others. In which stage you write most/ least fluently?

- beginning (0–50min): 28 letters per minute
- middle (50min–1hr 40min): 35 letters per minute
- end (1hr 40min–2hr 30min): 17 letters per minute
- average speed: 27 letters per minute

Revision

You usually type more text than ends up in the final text. The following figure tells you how much of what you have wrote can be seen in the final text (the lower the percentage, the more you have deleted): 42.79%

Source Use

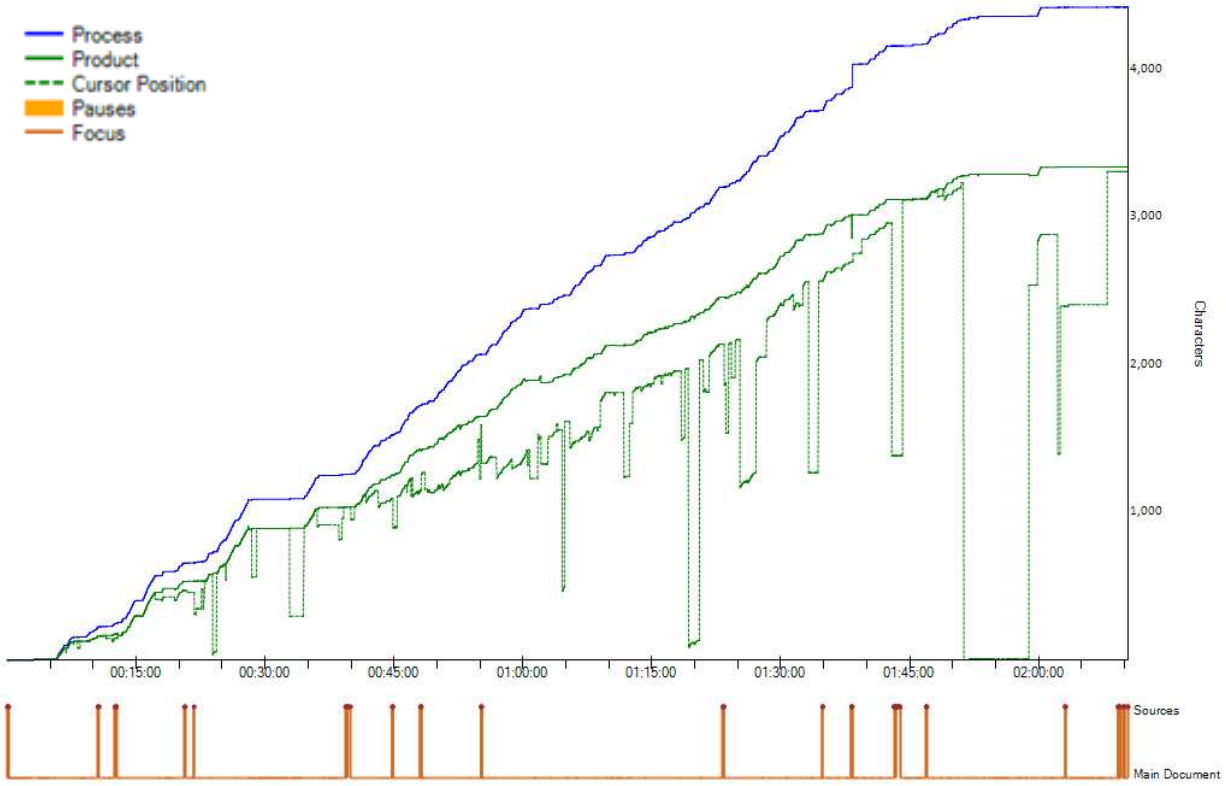
The following shows time spent using the internet for research, translating words, etc.

- beginning (0–50min): 43.24 %
- middle (50min–1hr 40min): 5.98 %
- end (1hr 40min–2hr 30min): 50.79 %

Process graph

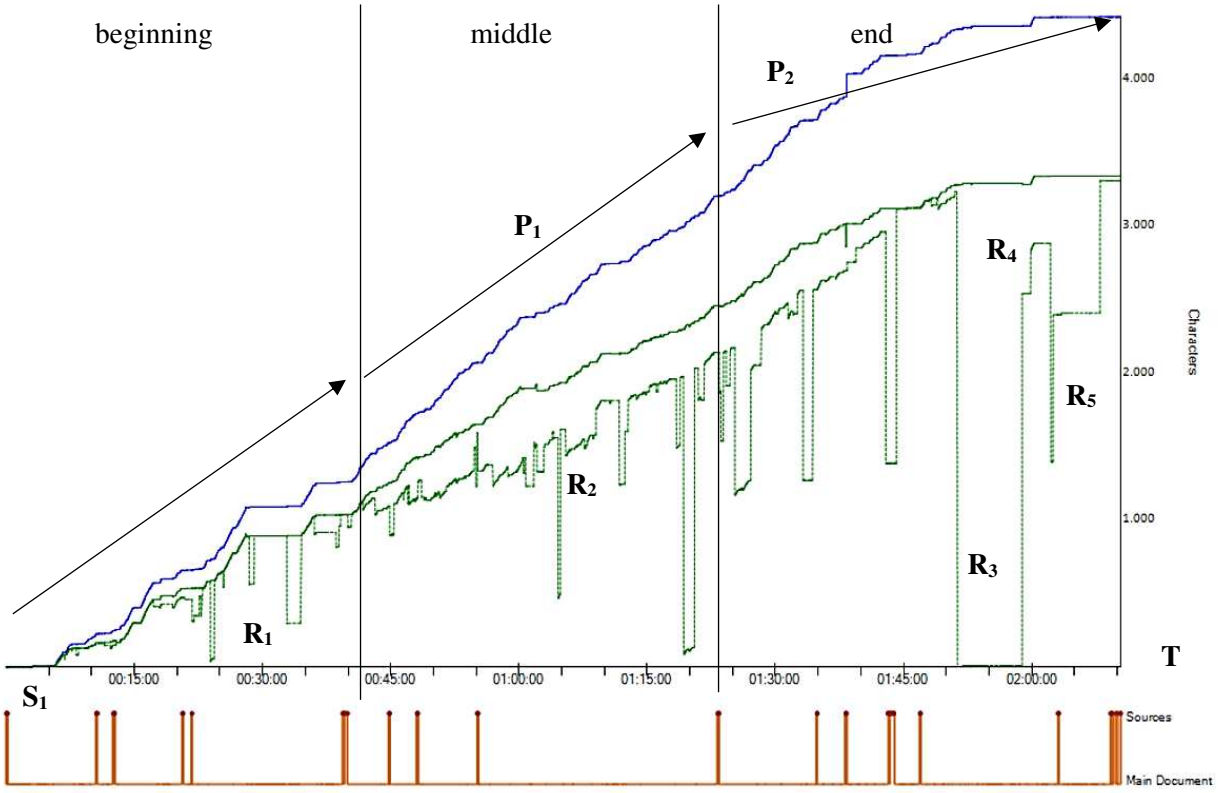
This process graph shows a graphical representation of your writing process.

- The x-axis shows the time it took you to write your text.
- The blue line shows the number of characters you produced during the task. The steeper the line, the more text you produced in a short time. The number of letters can be read on the right y-axis
- The green line shows the length of your text at any time. The greater the distance between the blue and green line, the more text you have deleted.
- The green dotted line indicates when you were revising or inserting new text. If this line overlaps with the full green line, you are working at the end of your text. When the line goes down towards the x-axis, you are inserting text or revising text at the beginning of your document.
- Finally, there is an orange line at the bottom. It represents the sources you consulted.



Appendix C

Example Process Report from a high-scoring essay



1 Timing: writing time and pausing time

The writer worked on task for 2hr 10 min [**T**]. They were writing for 1hr 4min and reading, researching, thinking or taking a break for 1hr 5min. On average, the writer was "pausing" (not actively writing) 50.52% of the time. The percentage of time pausing (reading, researching, thinking or taking a break) was highest during the "end" of the task (42.06%). The writer paused for 30.67% of the time in the "beginning" and 27.27% in the "middle".

2 Production and fluency

Fluency was highest in the middle of the task [$\mathbf{P_1}$] when the writer typed 35 letters per min (compared to 28 per min in the beginning and 17 per min at the end). At the end of the task, the writer was less fluent [$\mathbf{P_2}$]. In the beginning, the writer consulted some internet sources [$\mathbf{S_1}$]. After 5 min, they started writing. After the "beginning" stage, 34.76% of the essay was written. After the "middle", 78.90% of the essay was written. In the "end", 21.10% of the essay was written. So, most of the essay was written in the "middle" of the 2hrs.

3 Revision behaviour

The writer mainly revised in the middle and end of the task. The blue process line and the green product line move further and further apart in the middle and at the end. The percentage of words that ended up in the essay was 42.79%. In the "beginning", the writer made some minor revisions while writing [$\mathbf{R_1}$]. In the "middle", the writer went back to an earlier written part of the text (the green dotted line indicates the place in the text where the writer was working on the text). There the writer inserted text and kept on writing [$\mathbf{R_2}$] (the green line and the green dotted line do not touch). In the "end", the writer made small revisions [$\mathbf{R_{3\text{-}5}}$]. The text length (green product line) did not really increase here.

4 Source use

The writer spent time looking things up on the internet mainly in the beginning [$\mathbf{S_1}$] and end of the task [$\mathbf{S_2}$]. Half (50.79%) of the time using the internet came at the "end" of the task. In the "beginning" it was 37.23%. In the "middle" the writer spent almost no time consulting sources (only 5.98%).

Appendix D

Intervention 1. Time-management

Reflecting on your writing activity

Answer the questions in this section from memory (i.e., **do not look at your feedback report).*

1. How satisfied were you with how you managed your time when writing (choose only one)?

☐ ☐ ☐ ☐ ☐ ☐ ☐

Very satisfied *Very unsatisfied*

2. How satisfied were you with how much time you spent planning (choose only one)?

☐ ☐ ☐ ☐ ☐ ☐ ☐

Very satisfied *Very unsatisfied*

3. How satisfied were you with how much time you spent actually writing (choose only one)?

☐ ☐ ☐ ☐ ☐ ☐ ☐

Very satisfied *Very unsatisfied*

4. How long did it take you to start writing your draft?

5. When you started writing, how long did it take before you encountered a "mental block" and ran out of things to write about?

6. At which stage in writing do you think you were most fluent? When did you do most of your writing?

Examining your actual writing activity

Look at your report. Read the introduction and overview and then answer the following questions:

Time:

1. How much time did you actually spend writing? How does this compare to the two example reports I have given you?
2. On average, how long did you spend reading, researching, thinking, or taking break? How does this compare to the two example reports I have given you?
3. Do you think you spent too long "not writing"? If so, what can you do to improve this?
4. Look at your process graph. Along the x-axis you see time. How long did you wait before you started writing (blue line = process)? Draw an arrow from left to right to show the amount of time you took to start writing; this is most likely your main planning stage. What were you doing during this time? Could you have done any of the activities prior to class? For example, could you have done **P** (Pick my idea) before coming to class? Or **WWW** (What = 2, How = 2)?
5. The third step of planning for a story is **W** (Write and say more). Look at the dashed green line (cursor position) on your graph. When this is a straight line going down, you have moved backwards in your essay. The longer the line, the more you have moved the cursor. A longer line could indicate a break in "freewriting"—a strategy to increase the flow of ideas and fluency, which is particularly useful during planning. When did your first downward long line occur?
6. Do you think this break in freewriting came too early? If so, do you remember what you were doing at this stage in the writing? Did something distract you or did you simply run out of ideas? What could you do to avoid this in future?

Text Production:

1. In which stage of writing did you produce most of your text?

2. How does this compare to the two example reports I have given you?
3. Look at the right-hand y- axis. This displays the number of characters typed. Approximately how long did it take for your solid green line (product) to get to the half-way point of its total (the point where the solid green line touches the right-hand y-axis)? Mark this point in your graph with an "X".
4. Do you think you left yourself enough time to add the other half of the content that made it into your final essay? If not, how could you have reached this half-way stage sooner?

Pausing:

1. How does the time you spent reading, researching, thinking, or taking a break in each stage of writing compare to the example reports?

Writing Fluency:

1. On your graphs, indicate where you had bursts of writing activity. i.e., moments of increased fluency where the green line ran uninterrupted by lines dropping straight down. Mark these moments with arrows. At which stage in your writing did these bursts occur? Are they evenly distributed or do they occur in a certain part of your writing?
2. When were you most fluent and why do you think you were most fluent during this stage?
3. How does this compare to the two example reports I have given you?

Revision:

1. Where do you find most of the downward lines? These probably reflect more revision activity. Usually, these are more frequent after the halfway point of writing; i.e., after you have created most of your text, revision should occur toward the end. When did most of your revision occur?
2. Is your revision percentage lower or higher than that of the model texts?

   If it is lower, it means that, overall, you revised your text more than the authors of the model text(s).

   If it is higher, it means that, overall, you revised your text less than the authors of the model text(s).
3. Think about what types of revisions you were mostly making. For example, did you focus on individual words? Did you focus on grammar? Or did you change the content a lot?

Source Use:

1. While writing, you looked up information on the internet. What kind of information you were looking for? When did you use the internet the most?
2. Was there one particular point during the process when you relied a lot on sources from the internet or did you use sources throughout the process?
3. How could you increase the proficiency with which you search for and select information from the internet?
4. How does your use of the internet compare to the reports from the two example reports?

Setting Future Goals

1. In order to improve my next first draft, I need to spend more time _____ and less time _____.

2. In order to better manage my time on my next first draft I will…

3. The next first draft I write will be for a descriptive essay. I will do the following things to make better use of my planning time:

Appendix E

Intervention 2. Revision

Reflecting on your writing activity

Answer the questions in this section from memory (i.e., **do not look at your feedback report).*

1. While writing, I regularly check for poor sentences or sentences that are too long (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

2. Only after I've finished the whole text, I'll reread what I've written (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

3. When I write, I stop writing after every few sentences to reread what I have written (choose one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

4. I interrupt the writing from time to time to correct the text (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

5. When I re-read my text, I usually have to revise a lot (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

6. If I proofread and rewrite my text, the structure of the text can still change a lot (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

7. When I have finished my text, I always have to re-read it very carefully, to make sure there are no redundant/unnecessary things in it (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

8. If I proofread and rewrite my text, the content of the text can still change a lot (choose only one).

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

9. How much time do you think you spent revising your essay?

10. At which stage in writing do you think you revised the most?

Examining your actual writing activity

*Look at your report. Read the introduction and overview, and then answer the following questions:

Time:

1. How much time did you spend writing? How does this compare to the two example reports?

2. On average, how long did you spend reading, researching, thinking, or taking break? How does this compare to the two example reports I have given you?
3. Do you think you spent too long "not writing"? If so, what can you do to improve this?

Text Production:

1. In which stage of writing did you produce most of your text?
2. How does this compare to the two example reports I have given you?

Pausing:

1. How does the time you spent reading, researching, thinking, or taking a break in each stage of writing compare to the example reports?

Writing Fluency:

1. When were you most fluent and why do you think you were most fluent during this stage?
2. How does this compare to the two example reports I have given you?

Revision:

1. Is your percentage lower or higher than that of the example reports?

   If it is lower, it means that, overall, you revised your text more than the authors of the model text(s).

   If it is higher, it means that, overall, you revised your text less than the authors of the model text(s).

Look at the graph from Example 2. Several points along the green line (word count of the essay) are highlighted with circles and downward arrows. These indicate revision activity. You see that in Example 2, most revision occurred between 45min to 1hr 45min (x-axis). The downward arrows show the writer moved backwards in their essay document: the longer the arrow, the further back they moved from where they were previously typing. The circles then highlight forward movement through the essay document. Draw downward arrows on your process graph to show when you moved backward through your essay document. Then draw circles where you moved forward, possibly making small (or large) changes on your way. I.e., highlight your revision activity.

2. How does your revision activity compare to that of Example 2? E.g., when did you start revising? How much revision did you actually do? When did most of your revision take place? Did you move around your essay document a lot (mostly large arrows) or did you mainly just focus on adding new content without going over old content (no arrows or mostly very small arrows)?
3. What types of revisions you were making? For example, did you focus on revising individual words? Or did you revise larger units like sentences or overall content? Or did you do both?
4. Think back to the types of revisions you made. Did you make any revisions based on any of the items on the scoring rubric? If not, then why not?

Source Use:

1. When did you rely most on the internet or did you use it equally as much in each stage?
2. How does your use of the internet compare to the reports from the two example reports?

Setting Future Goals for Revising

When writing my next first draft I will do the following to improve how I revise:

1. When it comes to revising my next first draft, I need to revise less / more (please delete)
2. When it comes to the time I spend revising and the amount of revising I do, I will…
3. When it comes to the types of revision I make, I will…
4. When it comes to revising the next draft, I will use the scoring rubric to…

Appendix F

Intervention 3. Source use

Reflecting on your writing activity

Answer the questions in this section from memory (i.e., **do not look at your feedback report).*

1. I get my ideas and information from sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

2. I work out my own ideas, and then find sources to support them. I use sources as evidence to support my arguments and statements

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

3. I find it difficult to express source content in my own words.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

4. I reread the sources while I was writing to find ideas to put in my essay.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

5. I paraphrase the sources in my writing.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

6. I can easily divide the time I have between reading sources and writing my essay.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

7. I can select relevant information for my essay from sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

8. I can write an essay based on sources of which the content matches with the content from the sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

9. I can make connections in my essay between information from the various sources.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

10. I can bring together information from the different sources in a sentence or paragraph.

☐ ☐ ☐ ☐ ☐ ☐ ☐

Completely agree *Completely disagree*

Examining your actual writing activity

Look at your report. Read the introduction and overview, and then **type your answer to the following questions in the spaces provided*:

Time:

1. How much time did you actually spend writing? How does this compare to the two example reports I have given you?
2. On average, how long did you spend reading, researching, thinking, or taking break? How does this compare to the two example reports I have given you?
3. Do you think you spent too long "not writing"? If so, what can you do to improve this?

Text Production:

1. In which stage of writing did you produce most of your text?
2. How does this compare to the two example reports I have given you?

Pausing:

1. How does the time you spent reading, researching, thinking, or taking a break in each stage of writing compare to the example reports?

Writing Fluency:

1. When were you most fluent and why do you think you were most fluent during this stage?
2. How does this compare to the two example reports I have given you?

Revision:

1. Is your percentage lower or higher than that of the example reports?

   If it is lower, it means that, overall, you revised your text more than the authors of the model text(s).

   If it is higher, it means that, overall, you revised your text less than the authors of the model text(s).
2. What types of revisions you were making? For example, did you focus on revising individual words? Or did you revise larger units like sentences or overall content? Or did you do both?
3. Think back to the types of revisions you made. Did you make any revisions based on any of the items on the scoring rubric? If not, then why not?

Source Use:

1. In which stage of writing did you rely most on sources? And how does it compare to the example feedback reports?
2. Look at the number of orange/brown vertical lines at the bottom your graph. The more vertical lines you have, the more times you switched between the internet and your essay. In which stage of writing did you switch most between the sources (beginning, middle or end)? And how does your orange/brown line compare to the example feedback report? i.e., did you switch more often or less often? Did you consult more sources (no. of vertical lines) or less? And when you did stop to read sources and when did you work on your essay?
3. Can you remember what type of sources you consulted most…
   a. in the beginning of the writing process?
   b. in the middle of the writing process?
   c. at the end of the writing process?
4. Look at the image with the circles in the B#-ESI file (pdf). The circles represent programs/sources that you spent time in. The bigger the circles, the more time you spent in that program/source. The lines show movement between programs/sources (circles). Compare your

image to the images in the two example feedback reports. What similarities and differences do you see between the two? Did you spend more or less time in certain sources? Did you move around less (fewer lines) or use fewer sources (circles)?

5. When searching information on the internet you find a lot of sources. How do you judge which sources you will use and which sources you won't use?

In the table below, you see information on six sources. Imagine you had to write an essay based on these sources. Judge to what extent you trust these texts by assigning each text a value from 1 to 6. Assign the value 1 to the text you judge to be most reliable, and the value 6 to the text you judge to be least reliable. Assign the value 2, 3, 4, or 5 to each of the other texts, depending on how reliable you think that it is. Motivate your decision by explaining why are some sources reliable or unreliable?

	type of document	**author**	**publication date**	**summary of content**
	textbook for high school	science teachers	02-10-2017	Explains the functioning of cell phones and electromagnetic radiation in relatively neutral academic terms .
	public info text	National Radiation Protection Agency	01-09-2020	States that it is not documented that cell phone use causes cancer but recommends some precautions .
	popular science article	research reporter	15-07-2020	Cites researchers arguing that radiation from cell phones and wireless networks poses serious health risks.
	debate article	chief engineer from cell phone industry	20-07-2020	Takes issue with the message of the previous document)popular science article (and argues that cancer risk related to cell phone use is exaggerated .
	polemic	journalist	15-11-2019	Cites scientific journals and researchers to support the view that cell phones undoubtedly cause cancer and claims a conspiracy involving the industry and politicians to conceal this fact .
	newspaper article	journalist	04-04-2020	Interviews person with brain tumor who suspects that this was caused by heavy cell phone use .

6. Did you evaluate your sources before using them for your essay? And if so, what elements did you take into account for your evaluation?

Setting Future Goals for Source Use

1. When it comes to dealing with sources (spending time in various types of sources, switching between sources, etc.), when writing my next first draft...
   - In the beginning, I will...
   - In the middle, I will...
   - At the end of the writing session, I will
2. Formulate goals for the three following aspects of source-based writing:
   - To avoid plagiarism, I will...
   - To better integrate information from sources into my essay, I will…
   - To evaluate sources, I will...

Appendix G

Table G1

Group A Descriptive Statistics for the Writing Strategies for Self-Regulated Learning Questionnaires (WSSRLQ); (39 items, N = 18)

		Week 3		Week 16		
Dimensions	Writing Strategies	*M*	*SD*	*M*	*SD*	*p*
Cognition	TP (6 items)	4.35	1.52	4.16	1.57	0.2473
	CM (3 items)	4.35	1.37	4.75	1.48	0.1335
Metacognition	IP (3 items)	5.16	1.49	5.63	1.10	0.0552
	GME (6 items)	4.75	1.37	4.83	1.17	0.6404
Social Behaviour	PL (3 items)	2.96	1.51	3.98	1.51	0.0005***
	FH (*3 items)	4.89	1.88	5.14	1.31	0.4662
Motivational Regulation	IE (4 items)	5.47	1.27	5.17	1.33	0.1535
	MST (8 items)	5.05	1.45	5.11	1.36	0.7442
	EC (3 items)	5.26	1.51	5.58	1.32	0.2367

Note: * 1 item removed (Kurtosis)

Table G2

Group B Descriptive Statistics for the Writing Strategies for Self-Regulated Learning Questionnaires (WSSRLQ); (40 items, N = 16)

		Week 3		Week 16		
Dimensions	Writing Strategies	*M*	*SD*	*M*	*SD*	*p*
Cognition	TP (6 items)	4.41	1.50	4.06	1.29	0.8227
	CM (3 items)	4.13	1.57	4.44	1.66	0.3455
Metacognition	IP (3 items)	5.06	1.45	5.75	1.16	0.0118*
	GME (6 items)	4.44	1.37	4.81	1.20	0.0448*
Social Behaviour	PL (3 items)	2.85	1.64	3.77	1.78	0.0100**
	FH (4 items)	5.78	1.51	5.98	1.27	0.4105
Motivational Regulation	IE (4 items)	4.97	1.71	4.97	1.45	1.0000
	MST (8 items)	4.69	1.73	4.81	1.59	0.5483
	EC (3 items)	5.00	1.88	4.81	1.49	0.5483