

Design and Implementation of a Pedagogic Intervention Using Writing Analytics

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Abstract: Academic writing is a key skill required for higher education students, which is often challenging to learn. A promising approach to help students develop this skill is the use of automated tools that provide formative feedback on writing. However, such tools are not widely adopted by students unless useful for their discipline-related writing, and embedded in the curriculum. This recognition motivates an increased emphasis in the field on aligning learning analytics applications with learning design, so that analytics-driven feedback is congruent with the pedagogy and assessment regime. This paper describes the design, implementation, and evaluation of a pedagogic intervention that was developed for law students to make use of an automated Academic Writing Analytics tool (AWA) for improving their academic writing. In exemplifying this pedagogically aligned learning analytic intervention, we describe the development of a learning analytics platform to support the pedagogic design, illustrating its potential through example analyses of data derived from the task.

Keywords: academic writing, writing analytics, learning analytics, learning design, pedagogy

1. Introduction

Academic writing is a key professional skill for students to develop. Despite its importance, students are seen to lack proficiency in writing (National Commission on Writing, 2003). Support for academic writing has been limited, mostly taking the form of English for Academic Purposes (EAP) for non-native speakers, or remedial action to improve writing skills in an ad-hoc manner (Wingate, 2012). There is a need to help students with their academic writing in an ongoing and integrated way. Formative feedback on writing aids students in gaining awareness regarding their progress against their goals. Through such formative feedback, students can close the feedback loop by applying the feedback that they receive to improve their work, to address the gap between their performance and instructor expectations. This approach arguably results in greater impact on students' learning than summative assessments (Sadler, 1989).

However, for large classes, it is not practically possible for the instructor to provide formative feedback to all students since the process is time-consuming. To overcome this issue, automated tools have been developed that use computational techniques to assess writing. The scope of such tools varies from Automatic Essay Scoring (AES) systems that provide a score based on the assessment of standardized writing to Automated Writing Evaluation (AWE) systems that provide additional feedback to students on their writing (Warschauer & Grimes, 2008). Learning Analytics, which makes uses of analytics techniques on student data to improve learning, can be used for providing formative feedback which is almost immediate. Several tools have been employed for university and school students to analyse text in the context of essays, problem solving, free form and collaborative writing. One such tool is the Academic Writing Analytics (AWA) tool that provides formative feedback on students' academic writing. AWA uses natural language processing techniques to identify sentences in a text that match specific rhetorical functions, like emphasizing an important point or summarizing, by using linguistic markers that indicate these rhetorical moves (Knight et al., 2016). These kinds of moves are a key component in good academic writing and are seen to be correlated to essay quality (Simsek et al., 2015). Feedback on the presence of these moves should help students reflect on their writing and the rhetorical structure of it.

Regardless of the quality of such technology, a concern in technology-enhanced learning is that technologies may not be used unless they are embedded in the curriculum (Wingate, 2012). The

alignment of learning analytics to learning design has also been increasingly emphasised to provide a contextual framework for the pedagogic intent of analytics applications (Lockyer, Heathcote, & Dawson, 2013). A clearly defined pedagogical design closes the gap between the potential and the actual use of technologies, by helping students put these tools to appropriate use in order to add value to their learning. This forms the basis for learning analytics pedagogic interventions design which moves from developing learning analytics technologies to integrating them as part of a larger educational context (Wise, 2014). The integration of learning analytics tools in pedagogic design should also be aligned to subject curriculum in order to find new ways of solving existing pedagogical issues using learning analytics. Good design of learning analytics platforms also makes collection of data much easier, which can give useful insights for guiding students during the length of the course and in future interventions. The aim of this study was therefore to design an effective pedagogical intervention and a learning analytics platform to introduce the automated writing analytics tool AWA to students to help them write better essays for their subject. The contribution of this paper is to provide an exemplification of a pedagogically aligned learning analytics intervention and platform developed to gain research and learning insight into student writing.

2. Techno-Pedagogical Design: Aligning Learning Analytics with Learning Design

2.1 Research Context

This study was designed for 367 undergraduate law students enrolled in a Civil Law subject. The study described was co-designed with the instructor and piloted by students and subject tutors as a pedagogic intervention in one of their weekly tutorial sessions. Writing is a key disciplinary skill for law students with emphasis on clear and engaging writing with the use of appropriate arguments (Knight et al., 2016), and was identified as an area to target student learning. As part of their curriculum, law students are expected to write academic essays that discuss an assigned topic, clearly outlining the legal arguments. In their key written assignment, the instructor has developed a marking rubric consisting of the following elements: Statement of argument, Statement of essay plan, Identification of issues, Analysis, Sustained thesis & Original insight, and Engagement with literature/cases. The intervention designed required students to complete an online activity in class during a tutorial session consisting of several sub-tasks. The rationale was to help students write better essays during the course of their subject by understanding the instructor’s rubric for assessing an essay and practising revision skills.

2.2 Intervention and Platform Design

The objective of the study was to design a pedagogic intervention for students to improve their ability to evaluate the quality of writing and revisions and improve a draft based on feedback/ self-assessment. The design was developed to provide both a learning experience for the students and to facilitate the development and evaluation of learning analytics interventions by the researchers. The sequence in Figure 1 is a simplified workflow of tasks that the students will carry out. All these tasks will be explained along with the pedagogical reasoning behind their design in this section. They will also be carrying accompanying technical information on how these tasks were implemented in a learning analytics platform.



Figure 1. The workflow of tasks designed in the intervention

Students were randomly pre-assigned to one of the three groups by the instructor based on the feedback they would receive in the revision task as follows:

1. AWA Feedback Group – These students received feedback on request from the AWA tool. They can request feedback on their revised text as many times as required. They watched a short video on how to use the tool at the start of the activity.
2. Instructor Feedback Group – Students from this group saw an instructor-highlighted PDF file with static feedback on the parts that need improvement, text that could be improved, and the text that is a good example of academic writing based on the given essay.
3. No Feedback Group – This set of students received no feedback on the essay to make improvements. They worked on the text based only on their assessment of it.

These conditions were designed to address a key concern of the research questions: understanding the efficacy of different feedback types for student revision, in order to identify helpful feedback for students.

Students worked individually on the activity using their own laptops. They entered the system by accessing the platform from the web. The URL for the activity was supplied from the LMS as part of their weekly lesson. The tasks were almost identical for students from all the groups, except for the feedback received to complete the revision task. Student details were pre-stored in the database and each student was directed to a specific group’s tasks upon login. The pedagogical design was supported by a learning analytics platform that facilitated the online activity with several sub tasks. The technical platform (developed in PHP) for the activity was built to be scalable and flexible in order to adapt to the needs of learners and instructors in different contexts. The platform architecture of how this activity was implemented is shown in Figure 2. Traces of student activity are stored in database tables by different components of the web interface as students use the platform. The time spent for the whole activity to complete all tasks from the start to the end is also recorded for all students. The different subtasks in the activity and student activity data stored by different components of the web interface are explained in the following sub-sections.

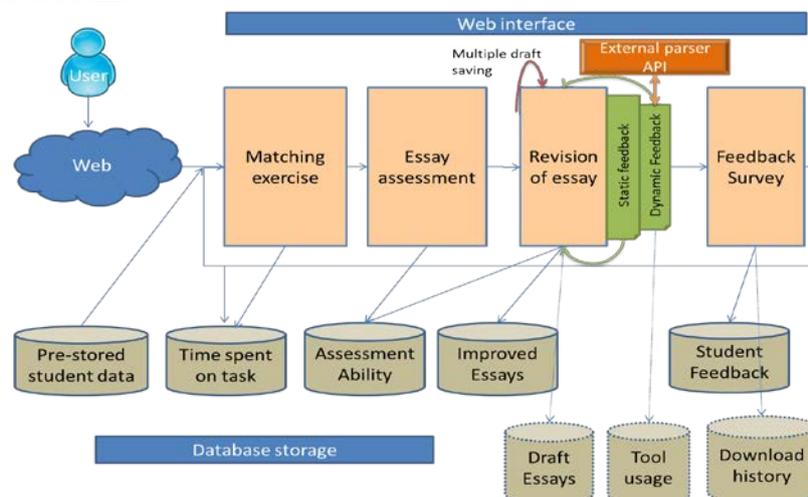


Figure 2. Platform architecture

2.2.1 Rubric Understanding

In our learning context, although students are already aware of the instructor’s marking rubric, they may not know how to apply the rubric, and how particular rubric facets are related to linguistic features that automated tools might help them identify. Therefore, the first task was a matching exercise (implemented using a customized DHTML drag and drop quiz script <http://www.dhtmlgoodies.com/index.html?whichScript=drag-drop-quiz>), where students were asked to identify sample sentences from an essay that would match elements of the instructor’s marking rubric. This engagement with exemplars is seen as an effective method for students to understand the assessment criteria (Hendry, Armstrong, & Bromberger, 2012; Rust, Price, & O'donovan, 2003). The task thus supports understanding the different rhetorical markers from sentences that would be useful to signal to the reader the important components of their essay with respect to the rubric. In the AWA feedback group, students also saw the corresponding AWA tags for the exemplar sentences to support understanding how the tags were related to the rubric. A screenshot from the matching exercise is shown in Figure 3, where green indicates correctly matched elements and red indicates wrongly

matched elements. Students were required to match all instances correctly before moving to the next task. In the analytics platform, the matching exercise stores the duration taken by students to complete this task by matching all elements correctly.

Matching Task

To help you in your assignments, it is important that you understand the rubric you will be assessed against. In this task, you should identify the sample sentences from an essay (on the left) that correspond to the elements of the rubric (on the right). Use the drag and drop interface to match the sentences to the elements. Once you have completed the task, you will automatically be redirected to the next page.

Sample Sentences	Drop here	Rubric Elements
The concept of good faith has previously been thought to be a 'work in progress' in Australia. Elucidation of Mason J's three indicia have revealed the concept to not only be moulded by the context in which the obligation is imposed, but to guide the aspects of behaviour required of practitioners in negotiation and dispute resolution settings upon whom the obligation is imposed.		Statement of thesis/ argument
This essay contains three parts. The first part will talk about the origins of good faith. The second part explains its origin in the common law to a three element representation of good faith espoused by Sir Anthony Mason. Finally, It concludes by illustrating behaviour which may guide practitioners how best to adopt and demonstrate good faith.	Essay plan	Identification of relevant issues
However, where the obligations are found in statute and they conflict with contractual obligations, it is important to note that the former must prevail. Such conflict in duties is something to which the court must have regard.	Engagement with the law and scholarly literature	Drawing together themes and reaching logical conclusion
In conclusion, the reasonable behaviour required under the standard of good faith does not preclude strong bargaining techniques, and facilitates the goals of legislative and contractual requirements to undertake dispute resolution processes.		Critical analysis, evaluation, original insight

Figure 3. Sample examples from the matching exercise

2.2.3 Understanding Task Requirement

In the second task, students viewed a sample essay which was revised by the instructor to give them an idea of the kind of features to focus on and how revisions to an existing text might be used to improve that text towards the rubric. The process of revision could otherwise include anything from making surface level changes like spelling and grammar to modifying the content of the topic. For this particular revision task, students were encouraged to focus on rhetorical structures in the text that could be improved. This task did not collect any data for assessment, but was designed for students' understanding only.

2.2.4 Essay Assessment

The third task consisted of an essay assessment in which a low quality essay exemplar was provided. Students first provided an assessment of the essay's quality, which, in the fourth stage, they then worked on to revise. This task was designed for students to acquire evaluative expertise by transitioning from feedback to self-monitoring (Sadler, 1989), with the self-assessment intended to enhance students' capacity to make judgements and self-regulate their work for sustainable learning (Boud, Lawson, & Thompson, 2015). The essay assessment component stores students' assessment data on the given essay in the form of grades, confidence level that it would match an instructor's grading, and qualitative comments on the problems identified in the essay and recommended improvements.

2.2.5 Essay Revision

Students thus, fourthly, worked to act on the issues that they identified in the text, with encouragement to engage in the kinds of revisions cycles that support learning to write (MacArthur, 2007). In this task, students received different types of feedback on the essay to make revisions based on their group (AWA Feedback Group, Instructor Feedback Group and No Feedback Group). To facilitate the use of feedback, it was provided in a frame to the right of the editor frame in which they revised their text. The revision task interface for Instructor Feedback Group is shown in Figure 4. For the AWA feedback group, the frame on the right contained feedback on the editor text from the AWA tool. A sample analytical feedback from AWA is shown in Figure 5. The no feedback group was provided with the text editor only to make revisions. A basic document editor from CKEditor was used for the revision task (<http://ckeditor.com/>). This preserves formatting of text which would be lost in a normal text box. Text cleaning and formatting were then performed in PHP to provide live feedback on the text, or post-task processing. As mentioned before, students in the AWA group could get feedback from the tool on any

of their drafts as needed. The analytical engine that provides feedback on the text was accessed from a version of Xerox Incremental Parser (<https://open.xerox.com/Services/XIPParser>). After revising the essay, students completed a self-assessment on the revisions made, to reflect on the improvements they made in the essay.

Revision Task

On the right, there is feedback from an academic on the sample essay. Please use this feedback to insert, delete, or amend the text in the editor to improve it (you do NOT have to track changes).

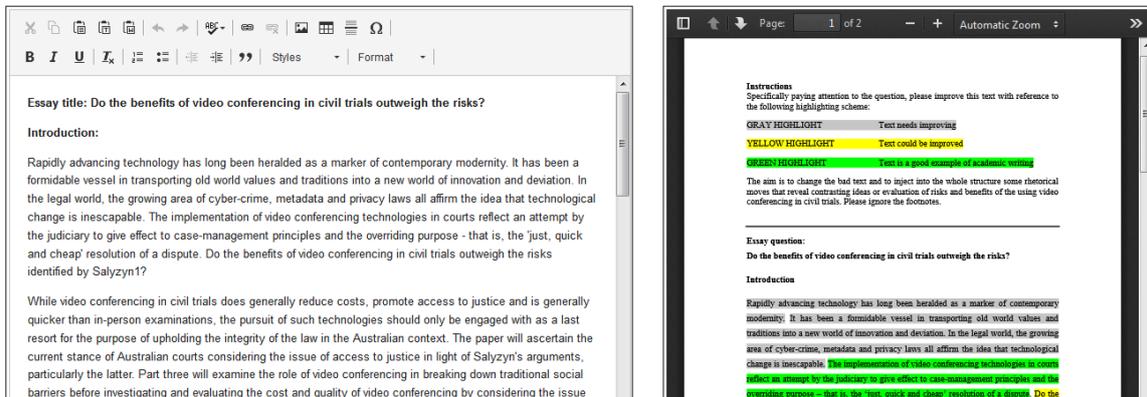


Figure 4. Sample screenshot from the revision task (Instructor feedback group)

For this revision task, students can be provided with different types of feedback as required by the pedagogical design. In the current setting, there was a static feedback by the instructor in the form of a pdf which gave comments on the given essay, and a dynamic feedback from the automated analysis tool AWA that can be accessed to get feedback at any particular version of the essay as required. This sends and receives data from an external parser to provide feedback on analytical writing. Data cleaning might be required to format the data from the editor in the correct format required by parser. From the provided text editor, data was also stored in specific intervals (every one minute) to capture students' drafting process. The final improved essay was stored in the database for all students. The dotted database tables in Figure 2 show data that will be different for different students based on their usage behaviour. The number of draft essays stored depends on the time they spent working on the task-higher time spent stores more drafts. AWA use also varies from student to student – ranging from students who made few requests for feedback to students who requested feedback many times.

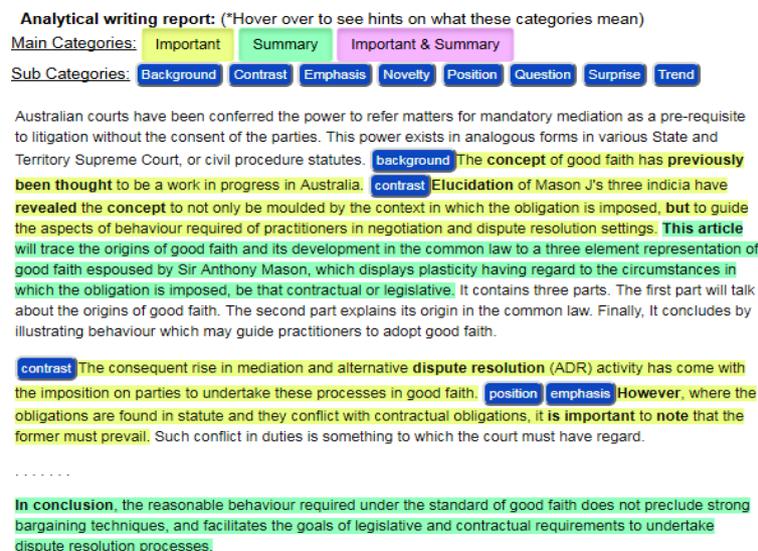


Figure 5. Sample AWA feedback

2.2.6 Feedback Survey

In the final part, students provide feedback on the task and the feedback obtained for revision by answering a few questions. At the end of the activity, students were provided with an option to download a version of their revised essay (dynamically generated using <http://www.fpdf.org/>) and a

sample revised essay by their instructor for future reference. This was to help them reflect on the improvements they made in the essay by comparing with an exemplar improved essay from the instructor. The feedback survey stores responses from students on the questions asked about the usefulness of task and feedback. This consists of rating responses and qualitative comments. Details of students who downloaded their own improved essay and instructor’s sample revised essay from the last page for reflection are recorded in the database as download history by tracking the clicks from the respective links.

3. Data Analysis

Development of the learning analytics platform and the pedagogical design described above facilitates capturing student trace data that can be analysed to provide insights into their learning, and the impact of feedback on that learning. Student activity data stored in the database tables can be downloaded as csv files, which could be imported into R for data analysis. Even though the activity was carried out in a tutorial session in class, not all enrolled students completed the activity since it was not a mandatory requirement. For the purpose of this study, only the complete dataset of 201 students who finished all parts of the activity is considered for analysis. This consisted data of 91 students from AWA group, 71 from instructor group and 39 from no feedback (none) group. Preliminary data analysis below shows a sample analysis that can be performed from a subset of the available data.

3.1 Student Perceptions of the Usefulness of the Pedagogic Design

Students rated the perceived usefulness of this activity in order to improve their essay writing in a scale of 1-5 (where 1= not at all useful, 2= slightly useful, 3= somewhat useful, 4= very useful and 5= extremely useful). They further provided qualitative comments on what feedback was found to be useful, what feedback was not useful, and any other additional comments about the whole activity. This data was analysed to see students’ feedback on the perceived usefulness of the activity and on the provided feedback (instructor and automated tool feedback).

The perceived usefulness of the activity across the three groups is shown in Figure 6. The instructor feedback group found the activity to be most useful ($M = 3.34$, $SD = 0.71$), followed by no feedback group ($M = 2.92$, $SD = 1.07$) and AWA feedback group ($M = 2.80$, $SD = 0.56$).

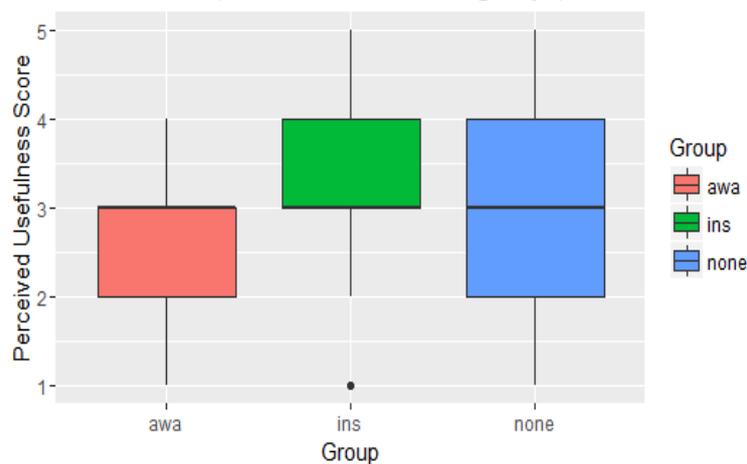


Figure 6. Perceived usefulness of the activity across comparison groups

A one way analysis of variance showed that the effect of groups on the usefulness score was significant, $F(2,198) = 8.32$, $p = 0.0003$. The assumption of homogeneity of variance was satisfied with Levene’s test ($p = 0.12$). Post hoc analyses using Tukey’s HSD indicated that the usefulness rating of instructor feedback group students was higher than the usefulness rating of AWA group students ($p = 0.0002$), and no significant difference was noted amongst the other groups.

The qualitative comments of students were explored to understand their views on this activity. The no feedback group provides a baseline group, as these students evaluated the usefulness of the

broad pedagogic activity with no additional feedback component. Across the groups, students found several sections of the task useful in improving their essay writing. A number of students explicitly mentioned that it was useful to have the initial sample text, on which the instructor had modelled the kinds of revisions that could be made to improve a draft, saying things like:

- “The annotated sample with comments was helpful in revising the essay, as it gave examples of what was done well and done poorly.” *Respondent 123, Instructor feedback group*
- “The exemplar answers were very helpful in highlighting the areas of the essay which needed improving, which students may initially overlook. The highlighting of different sentences is also useful in indicating what components of the writing were critical and what sections were maybe unnecessary identification or description. The sentences crossed out and rewritten were especially useful for proposing alternative ways of writing a sentence in an improved manner” *Respondent 82, AWA feedback group*
- “It was useful to see how a simple change (like swapping one paragraph for another) can make an essay a lot clearer and relevant to the topic at hand. I will make sure I apply this kind of task to my own essays - asking myself if my essay would be clear to a pair of fresh eyes.” *Respondent 180, No feedback group*

Students also appreciated having access to both their own text to download, and a sample revision of the same text they had edited which the instructor had marked up with improvements, saying for example:

- “A very good exercise! Glad we can download both our improved version and the instructor's improved version. Hopefully this will be a way we can get feedback on the feedback we provided in our edit.” *Respondent 145, Instructor feedback group*
- “The provision of the instructors improved essay provides a useful benchmarking tool to compare my changes against the changes made by the instructor” *Respondent 109, Instructor feedback group*

3.1.1 Evaluating Design Decisions

Some students felt that it would have been useful to have some readings beforehand on the topic to have a better idea on the essay they work with.

- “I really love the idea behind this exercise. I think it would be more beneficial to complete if we had to do some prior reading - for example of the Salyzyn essay that was referred to in the paper so that we could have some context. I find it difficult to write or revise something without having a background in the area.” *Respondent 179, No feedback group*
- “It didn't make sense to be asked to revise an essay on a topic we haven't really studied ... because in terms of content, I'm not sure how to improve it” *Respondent 28, AWA feedback group*

This could be incorporated if a revision task is designed in the future for modifying the content of the essay as well. The focus of the current task was on the rhetorical structure improvements and hence there was no emphasis on the content.

Some students were unsure of the usefulness of the revision task which required them to work on essays written by others. On the other hand, few others found it useful to apply their critical lens to an essay written by someone else, as it would eventually help them look critically at their own essays.

- “Everyone has their own unique styles that should translate on to a page of work that is of their own design. Not sure if people learn from someone else's mistakes at the very end of a Uni day.” *Respondent 167, No feedback group*
- “I believe having to personally assess an essay forces you to critically engage to a greater extent than one may have to. From looking at an essay from a marker's perspective one can take a step back and understand the little details that a marker is looking for. I also feel that by assessing someone else's work it provides you with better skills to assess your own work from a more neutral perspective. Self-reflection and editing are a key aspect of writing a poignant and quality academic essay that accurately engages with the criteria.” *Respondent 32, No feedback group*

The allocation of time was not incorporated in the platform, but was provided as a run sheet with an approximate time division for the sub-tasks. This led to some incomplete submissions as some students stayed in the first few tasks longer than expected, not allowing them enough time for the rest of the activity. The activity could be re-designed in the future to incorporate time allocation for sub-tasks in

the platform for smooth task completion. It could also be built as an out-of-class activity where students can engage with the tasks in their own time out of class, independent of the pace of other students.

- “The activity was engaging but it would be more enjoyable if it was clear of the time allocation for the tasks and the number of tasks involved” *Respondent 204, No feedback*
- “I think it would have been useful to know how much time I had...I feel as though I rushed myself with the editing and therefore didn't do my best work” *Respondent 109, Instructor feedback group*
- “A bit more time in amending the essay would have been greatly helpful.” *Respondent 135, Instructor feedback group*

3.1.2 Evaluating the Provision of Meaningful Feedback to Students

In terms of the feedback provided to improve their essay, students from the instructor feedback group felt that more explanations were necessary to understand the changes that they needed to make in their essays. They wanted to learn how to resolve the identified problem by receiving suggestions for improvement. Such direct recommendations would help students solve the current problems in hand and aid them in resolving similar problems in the future. Similar comments on the given feedback were also seen in the AWA group. They wished to receive more direct feedback in the form of corrective advice on what to improve, rather than highlighting the key sentences.

- “Rather than just highlighting the text, I think it would have been worthwhile to have colour coded explanations of why each section was highlighted... Sometimes I was unsure about why a piece of text was highlighted so I wasn't sure how to make a change.” *Respondent 109, Instructor feedback group*
- “Didn't give many alternatives as to how the phrasing could be improved” *Respondent 143, Instructor feedback group*
- “The highlighting only alerted to me what was good. However, there should be highlight to alert me to problems in the essay as well. the highlighting only showed me what was a 'summary' etc. There should be more categories and types of feedback such as grammar issues, sentence structure.” *Respondent 11, AWA feedback group*
- “It could offer an alternative or some tips regarding essay writing so a student who has seen where they go wrong can understand how to amend the essay they have written.” *Respondent 95, AWA feedback group*
- “I found the feedback unhelpful as I couldn't distinguish which parts needed fixing, even though it was stated as "important". Couldn't understand what 'important' meant in this context - important to fix or important as in it was a good part of the essay that didn't need to be fixed?” *Respondent 47, AWA feedback group*

Student feedback from this task could be used to find ways in which the tool can be tweaked to provide better feedback. However, few of the suggestions students made with regard to the feedback received provide direct actionable alterations for that feedback. It is crucial for students to recognise the intended usage of the tool and how to use it best to help in their writing context. The scope of the tool must be explained clearly in terms of what it can and cannot do. For example, some students noted that they would have liked grammar and spelling feedback, but this is not a feature targeted by the task or the tool deployed in this research. Students noting that the focus of the tool is on rhetorical markers of academic writing should set expectations of the tool to students in order to effectively use the tool. Further guidance regarding the use of the AWA tool, in the form of examples of use, and a user-guide, would also support this effective use. Directing students to lessons where they can read more about effective writing practices would also be beneficial.

Some students were not comfortable in receiving automated feedback and felt that a tool cannot provide context-sensitive feedback like a human. This is a known problem with the incorporation of such tools. Students should be made aware that automated tools are not a replacement for instructors/tutors, but rather a support mechanism they can use to get additional feedback when required. As discussed earlier, making students understand the scope of the tool would help them put the tool to appropriate use it was designed for. This will help them know the context of using a machine versus a human for the desired feedback.

- “I don't feel as comfortable with an online tool. I think I would feel more comfortable with a human providing feedback” *Respondent 21, AWA feedback group*

- “An automated program would not be able to tell me what points I am missing information-wise like a lecturer or tutor would be able to” *Respondent 25, AWA feedback group*

Students who received automated feedback from AWA also rated their level of comfort (1-5, where 1 = not at all comfortable and 5 = extremely comfortable) in receiving feedback from a tool. Students were generally not comfortable in receiving feedback from a tool ($M = 1.25$, $SD = 1.56$). Students' comfort level in receiving automated feedback was also found to be positively correlated to their perceived usefulness of the activity, Pearson's $r(199) = .44$, $p < 0.0001$. This could provide a possible explanation for the low usefulness score of the AWA feedback group. The low usefulness score of AWA group students in this activity is in contrast to the findings from the previous study (Knight et al., 2016) which reported that students found AWA to provoke useful reflection regarding their essay writing. Students seemed to have judged the usefulness of the current activity in terms of their tool usage rather than the wider pedagogic design of the tasks targeting improving their essay writing. Thus, the expectations for different types of feedback by the tool and their comfort level to receive automated feedback could have contributed to the usefulness score for this group.

3.2 Further Analysis and Platform Capabilities

A limitation of the current design is that the intervention is run as a one-time study, so how this activity contributes to improved essay writing of students in the long term is not studied. A continuous assessment of the influence of this activity on students' overall improvement in writing skills would be beneficial. This could be conducted by investigating future essays and their corresponding grades.

From this existing dataset, a detailed analysis is currently underway. The improved essays that students submitted are being graded by the tutors using the rubric. This additional data allows us to address questions around (1) the impact of different kinds of feedback on performance, at a criterion level; and (2) to associate different editing behaviours with performance, again at a criterion level. The former dataset provides an evaluation of feedback, while the latter provides further insight into the kinds of revisions we might target our feedback at. Specifically, the dataset provides for analysis of tool usage, time spent on the task, click stream history of downloads, demographics, and particular revisions made. The different types of revisions made by students could be characterised in terms of surface text metrics (how much text has been edited, word count, sentence length, cosine similarity to the original document) or with regard to particular features (including the introduction/deletion/editing of rhetorical features in the text, cohesion, etc.). These metrics can then be studied with respect to the marking grades, which can provide useful measures for automatically assessing text quality in the future.

In addition, the platform collected 1 minute (an adjustable parameter) snapshots of students' writing. These can be analysed to study the drafting process of different students in terms of number of revision actions like addition, substitution, deletion etc. and how these contribute to the final improved essay. Given that students identified issues in the original text alongside an assessment of that text, we can also investigate the relationship between the student assessment (both grade and qualitative comments) and their revisions, particularly with regard to their subsequent self-assessment of the improved draft. The interpretation of results from this data can be presented to students and instructors as reports to provide feedback on their writing and teaching practice. There is thus a huge potential for the analysis of data collected to provide insights to researchers, as well as instructors and students.

4. Discussion and Conclusion

In this study, we designed a pedagogic intervention to support student learning, and both implemented and evaluated the potential of the writing analytics tool AWA. The pedagogic design and development of a learning analytics platform to support the intervention exemplifies a learning-oriented approach to learning analytics. Traces of student data made available by the platform enable many types of analysis with the use of quantitative, qualitative and data science techniques. These can be used to provide insights for both students and educators. Based on our preliminary findings, students generally found this activity useful in developing their writing. Qualitative analysis of students' comments on the activity sheds light on the usefulness of different subtasks in the pedagogic design that contribute to their writing skills. It was observed that students found the exemplars, self- assessment and revision

skills applicable for their own writing in the future. Such interventions are seen to improve students' understanding of the instructor's rubric and their writing skills by deliberate practice of these skills.

Analysis of students' comments regarding the feedback they received provides information to instructors and researchers on the types of feedback that students find useful, and their expectations of feedback from instructors and automated tools. Students particularly highlighted a desire to receive explanations on why certain sections are highlighted and how to improve the text further. Giving such actionable feedback for students to close the gap between the expected and current performance is a principle of good feedback practice, which has to be followed for any kind of formative feedback to be given to students (Nicol & Macfarlane-Dick, 2006). When tools are used, students also require proper guidance to interpret the results and use the tool for its intended purpose. These findings will help researchers to evaluate automated feedback, and thereby design tools that provide meaningful and actionable feedback to help students in their academic writing. It is also crucial to design effective pedagogical practices keeping in mind the inherent limitations of automated tools.

The pedagogic intervention could be re-designed in many ways to suit the educational context in hand across different scenarios. The same activity could be implemented for other subjects by modifying the instructor rubric elements and exemplars pertaining to that particular subject. The pedagogical elements of the activity can be modified by adding and removing the sub tasks as required. The task could be re-designed to evaluate the different types of feedback from other tools and other forms of feedback from an instructor. Different versions of a tool can also be tested by using a specific portion of the activity. In another setting, students could also use this tool to work on their own writing for assessment and improvement instead of an assigned writing. These changes can be easily made in the platform by modifying specific components. Thus an alignment between learning design and learning analytics fosters both pedagogically-grounded activity for students, informs the design of automated feedback, and generates research data for the evaluation and development of novel writing analytics tools.

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