Quantext pilot study

Project report

June 2020

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Quantext

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Executive summary

Quantext is a text analysis tool designed in partnership with tertiary educators and students operating in real classroom settings. This project is a collaboration between a private educational software social enterprise company (McDonald & Moskal Limited) and three NZ tertiary providers (Victoria University of Wellington, University of Auckland and Otago Polytechnic). The project had two aims: firstly, to develop and evaluate Quantext in authentic tertiary education contexts and secondly to reflect on the value of the project collaboration to overcome issues of sustainability known to affect learning technology innovations in tertiary institutions.

Teachers from many different disciplines came to the Quantext pilot study with a range of expectations and unanswered questions about their teaching and student learning. The majority of pilot participants gained useful insights and saw potential for further benefits from continued use. Teachers used Quantext to identify misconceptions, solicit certain types of responses, gain deeper understanding of particular aspects of student learning and knowledge, and to explore student attitudes to different aspects of their course. The use of Quantext for curriculum mapping and to analyse student evaluations of teaching was also explored.

The first section of this report describes Quantext and provides details to access the application, source code and associated support materials. It also describes, in detail, the context and findings from a total of 12 diverse use cases. Key themes identified include:

- Quantext can be used as an aid to reflective practice and for Scholarship of Teaching and Learning (SoTL) research. Support from academic or educational developers will likely be required to promote initial uptake.
- Some teachers demonstrated benefits from sharing the results of text analysis with their students and several pointed to the potential for integration with associated student data.
- There is potential for Quantext to be used as a triage tool to support formative and summative marking at scale (i.e. in large classes).
- Quantext can be used to summarise free text comments from Student Evaluations of Teaching (SETs) and there is potential to develop this further.
- Integration of Quantext with institutional single sign-on systems and teacher portals alongside supporting easy upload and/or integration of learner data will help to promote adoption and use.

The second section details the extent of interest from tertiary institutions and educators to use Quantext beyond the pilot study. It also provides brief reflections from the project team relating to our private-public collaborative partnership and the question of whether this approach mitigates known issues of teaching and learning innovation sustainability.

Quantext and use cases

Introduction

Overarching aims

The primary aim of this project was to implement and evaluate Quantext, a text analysis tool designed in partnership with tertiary teachers and students operating in real classroom settings. Quantext supports teachers to aggregate and summarise trends or patterns in short-form student writing, monitor writing and disciplinary knowledge development and potentially, trace conceptual understanding back to source in teaching resources and lecture content.

Project background

Student success in many higher education contexts depends on the ability to interpret, synthesise and produce text. With each student cohort, enormous volumes of text are produced and routinely uploaded to institutional Learning Management Systems (LMS). As far back as the 1980s and 1990s, it was recognised that the most valuable source of data to monitor what students are actually doing in computer conferences (now known as online discussions) was, paradoxically, the least used (Mason, 1992). Today, save for the purpose of assessment and credentialing, seldom is student writing leveraged as a source of practical insight for teachers (McDonald & Moskal, 2017).

The original idea of Quantext was to bring to practicing teachers analytic tools to facilitate the analysis of student writing. An earlier Ako Aotearoa funded project, *Building an evidence-base for teaching and learning design using learning analytics data* completed in 2017, demonstrated that the use of existing tools for analysing text required specialist linguistic and technical skills that were beyond the reach of most busy, practicing teachers. Nevertheless, it was clear that teachers appreciated the insights that such tools could provide. We wanted to create a simple tool that teachers could use to gain practical pedagogic insights from their students' writing.

To help readers of this report understand what Quantext does, we begin with a brief description of the tool and its key features. While some of the basic functions were there from the outset of this project, at least in rudimentary form, it is important to recognise that Quantext has evolved considerably. In our view, this is as it should be. The current Quantext form and function reflects its evaluation in authentic teaching contexts and the input, feedback and design contributions made by pilot participants in partnership with us.

The remainder of this section provides a brief description of the design and operation of the pilot study, descriptions and findings from each of the contexts, or use cases, in which Quantext was piloted and concludes with a summary of findings and plans for further work.

Quantext description

What does Quantext do?

Quantext is designed to quickly extract insights from student text. For example, student responses to short-answer questions, discussion forum posts or student evaluation and feedback data. It does this by summarising text from the class as a whole and displaying the most common words and word groups using simple visualisations such as bar charts and wordtrees. A range of settings allow teachers to customise visualisations and search for specific words or phrases. Quantext provides summary statistics including the total number of student responses, average length of response and a range of readability indices. The ability to quickly dive into summary data to an individual student's response and to group and label text from students in a variety of ways, marks Quantext out as a valuable exploratory tool. The ability to easily create reports and export data helps teachers to give timely, formative feedback to students as well as to develop and reflect on the impact of their teaching and course design.

Quantext functionality

An introductory guide to Quantext functionality is provided at https://workbench.quantext.org/userguide.

In brief, a typical Quantext workflow is as follows:

Text is imported from any UTF-8 CSV file. One or more columns in the CSV file should contain the text to be analysed. For the pilot system, we recommend keeping the CSV file size below 1Mb. Users are prompted to select the columns for analysis when they select the analyse option.

To analyse the file, a new analysis is created, the required file is selected and the column, or columns, containing text are chosen. The analysis is given a name and run. When Quantext analysis is complete, data is presented in summary format as shown in Figure 1, on page 9.

From this point on, several options are available via a tabbed interface: Explore, Visualise, Indices, Label and Settings.

Explore: Users can explore the text in detail and may choose to begin with most frequent words and key multi-word groups (bigrams and trigrams) identified by Quantext. Words that are collocated with specific words of interest can be identified using the search function and patterns of use can be discerned through use of the keyword-in-context or KWIC function.

Visualise: Wordtree visualisation is available for search terms. An example is given in Figure 3, on page 10.

Indices: Provide a range of commonly used summary readability indices for text such as the Flesh reading ease score. The Quantext user guide outlines the indices provided and suggests caveats for their use.

Label: A rudimentary labelling tool allows users to code text with their own labels and export these to a spreadsheet.

Settings: Provides the user with tools to customise words to exclude or include in the analysis. Quantext uses a default stopword list but many users need to adapt this for their own purpose. For example, in teaching contexts, it is often helpful to remove the words contained in the question text before reviewing the summary analysis.

Finally, the pilot version of Quantext includes basic reporting and sharing features. The reporting tool provides a pdf version of the summary analysis and may include label summaries and examples where individual texts are labelled. The share feature allows users to share specific analyses with others.

Accessing Quantext

A key output of the pilot project is the Quantext application itself; a tool designed for teachers and adapted to fit the kinds of tasks they want to complete and to reflect their feedback from trials in use. The pilot study version of Quantext is available at https://pilot.quantext.org and anyone can create an account, login and try it out. In addition, the Quantext source code is freely available for download at https://github.com/quantext and is released under an opensource software licence (GPL 3.0).

We plan a soft (limited number of users) release of a hosted version of Quantext in the first quarter of 2020 which contains updates and fixes that are beyond the scope of the pilot. This will be the best option for teachers and institutions who do not wish to host their own version of Quantext. We discuss this further in the second section of this report, *Beyond the Pilot Study.*

To support end users and promote development of an end user community we have also setup the Quantext Workbench website at https://workbench.quantext.org. Here, you will find abridged versions of some of the use cases described in this report, a number of introductory screencasts, an online user guide and a blog that contains news and updates from the project team.

Pilot study design

Original design

Our initial focus was on developing a tool to analyse student responses to short-answer questions in large class settings; typically, science or health science classes. Our original plan was to follow a design-based research approach[1] utilising a series of similar case-studies. Early in the pilot project, it became clear that there were many more applications and potential end users than we originally anticipated and at least three erroneous assumptions embodied in our original design.

The first was that while there was some use of open-ended, short-answer questions among our pilot participants, for largely practical reasons, the majority of these teachers did not use them. For example, in large-class settings, a range of other formative and summative tools are used: e.g. multiple-choice quizzes, discussion forum-based activities and some peer assessment. The second was that short-answer questions where they are used do not take a simple single form. For example, depending on the context, answers may range from a few words to a paragraph or two and questions can consist of multiple parts. The original, rudimentary version of Quantext that existed at the start of the pilot study was built around a single use case. While the use case existed in real life (McDonald, Bird, Zouaq & Moskal, 2016) it was arguably aspirational and research- rather than practice-based. The third assumption was that we would be able to select suitable cases from a pool of potential candidates. In fact, all our use cases ended up being largely opportunistic. They are drawn from staff who: had attended Quantext research presentations; were connected with the institutional academic development centre, for example through innovation grants or teaching development activities; or were recognised as innovators/early adopters by members of the project team.

Revised design

Because this was a pilot project, we chose to be flexible in our approach and work with the real needs of real teachers working at the chalkface. No opportunity for exploration was turned away and the variety of contexts and applications are evident in the use cases that follow. They range from short observational and exploratory cases, to detailed examination of specific practice or problems from undergraduate teaching, massive open online course (MOOC) design and teaching and educational research.

This flexible and exploratory approach has presented us with some challenges: managing the variety and volume of text; dealing with the tension between adding features and retaining simplicity; negotiating the space between pedagogical ideals and institutional imperatives; and riding the waves of our own and others' raised expectations and dashed hopes!

On the plus side, with the challenges came opportunities for deeper understanding of teacher aspirations, learner knowledge and practical potential. These are discussed in the following section in relation to each use case. While the pilot study design was relaxed to accommodate the range of use cases, we have remained consistent throughout in seeking to identify enhancements to Quantext which promote benefits to teacher and learner development.

[1] Design-based research is a cyclical process of theory informed design, implementation, evaluation in use and revision based on experience.

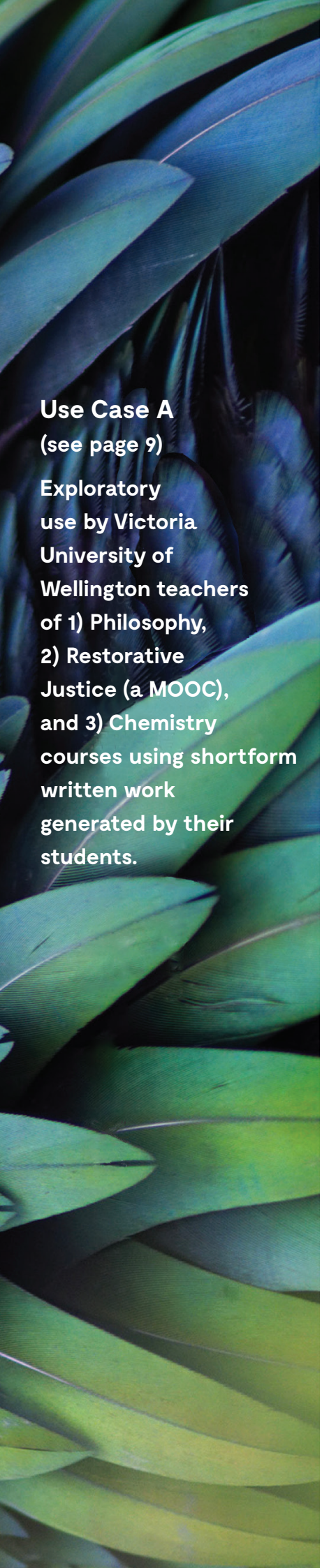
Findings

Use case overview

Over the timeframe of the pilot study (July 2018-December 2019), use cases were identified at the University of Auckland, Victoria University of Wellington and Otago Polytechnic. In addition, three further cases were identified from beyond NZ. One from the University of South Australia and two from the University of British Columbia.

Each use case is briefly introduced below and described in detail in the next section. Where use cases primarily involve exploratory observations of individual teachers working with their students' data, we have grouped these together and aggregated findings (A and B).

A. Exploratory use by Victoria University of Wellington teachers of 1) Philosophy, 2) Restorative Justice (a MOOC), and 3) Chemistry courses using short-form written work generated by their own students. A total of three short use cases involving the exploratory use of Quantext and one 1-hour observation session.
B. Exploratory use by University of Auckland teachers of 1) undergraduate engineering, 2) philosophy, and 3) anatomy and physiology courses using short-form written work generated by their own students. A total of three short use cases involving the exploratory use of Quantext and one 1-hour observation session.
C. Regular, weekly analysis of short-form written work by students undertaking a first-year course in Education at the University of Auckland. Selected insights gained from this analysis formed part of the feedback provided to students by the course co-ordinator.
   Exploratory analysis of discussion forum data from seven runs of a University of Auckland statistics MOOC over a five year period (2014-2018). The analysis is being conducted by a course designer and educational researchers in consultation with MOOC teachers from the Department of Statistics.
D. Exploratory analysis of discussion forum data from one run of a Victoria University of Wellington MOOC on Antarctica.
F. In-class evaluation of Quantext in a foundation studies class to identify assignment topic areas of interest to students at the University of South Australia.
G. Students from the University of British Columbia studying a Masters programme in educational technology were offered the option to evaluate Quantext with their own student data as part of their studies. Two students report on their evaluations.
H. A visiting educator and learning analytics researcher from the University of British Columbia conducted a preliminary evaluation of Quantext as a tool to support curriculum mapping and graduate attribute alignment.
I. A research study explored the potential of Quantext to analyse free text student comments collected as part of student evaluations of teaching. This work is part of a larger study at Otago Polytechnic and the University of Otago to investigate student perceptions of student evaluations of teaching.
J. An exploration of the potential of Quantext to analyse free text comments from Occupational Therapy graduates at Otago Polytechnic. This work is part of a larger research project to understand graduate career paths and to inform curriculum design and fieldwork practice decisions. It was a late addition to the pilot study and we include a brief description of the aims and objectives.
K. A research study to explore the collaboration between automated tools and humans in understanding and analysing texts, and in search for meaning. This is a collaborative project at the University of Auckland between literacy teachers who use grammar checkers, researchers and the developers of Quantext. It is in progress at the time of writing.
L. Integration of the IMS Learning Tools Interoperability standard Quantext with a test Canvas (LMS) installation and a Moodle installation. We provide a brief description and evaluate potential.



Use Case A

(see page 9)

Exploratory use by Victoria University of Wellington teachers of 1) Philosophy, 2) Restorative Justice (a MOOC), and 3) Chemistry courses using shortform written work generated by their students.

All comments from use case participants related to specific Quantext functions and usability have been recorded and where feasible, within the scope of the pilot study, Quantext has been updated at http://pilot.quantext.org. Additional fixes and enhancements have been prioritised. A list of planned enhancements is provided in Appendix 1.

Please refer to the Quantext user guide at https://workbench.quantext.org for specific features available in the pilot version of Quantext.

Use case contexts, findings and recommendations

A. Quantext Pilot Observations in two undergraduate courses and a MOOC – Victoria University of Wellington

Background

Three teaching academics were selected to critically engage with Quantext over the timeframe of the pilot. Our three teacher participants used Quantext to explore text created by their own students as part of their taught courses. Text was drawn from short-form student writing in first-year undergraduate Chemistry and Philosophy courses and from a Massive Open Online Course (MOOC) on Restorative Justice. We asked each participant to reflect on their perception of the value of Quantext, what limitations or challenges they found, and what desires they had for improvements or changes that would better serve their needs. In addition, they were asked to reflect on requirements for operationalising the tools within their faculties at Victoria University of Wellington. Each participant was supported to format their text data so that it was easily uploaded to Quantext. In each case, teachers explored data from their own recent classes.

The issue/s or problem/s explored

Each teacher was interested to see if analysing student responses to questions or student discussion posts in Quantext provided insights or efficiency gains that were not already available to them in other ways.

How the teachers used Quantext

Teachers began by importing their data to Quantext. They were introduced to the overview or summary screen and then assisted to work through the range of options and settings available (Figure 1.). Thus, they could change how the summary analysis was presented. For example they could choose to include or exclude function words (e.g. articles, prepositions etc), punctuation, and numbers in order to focus the analysis. They could also change the number of commonly occurring words and word groups (ngrams) to display, search for terms of interest and identify words that commonly co-occurred (An example is depicted in Figure 2). At each point in this process, participants reflected on the summary text and data that they were presented with.

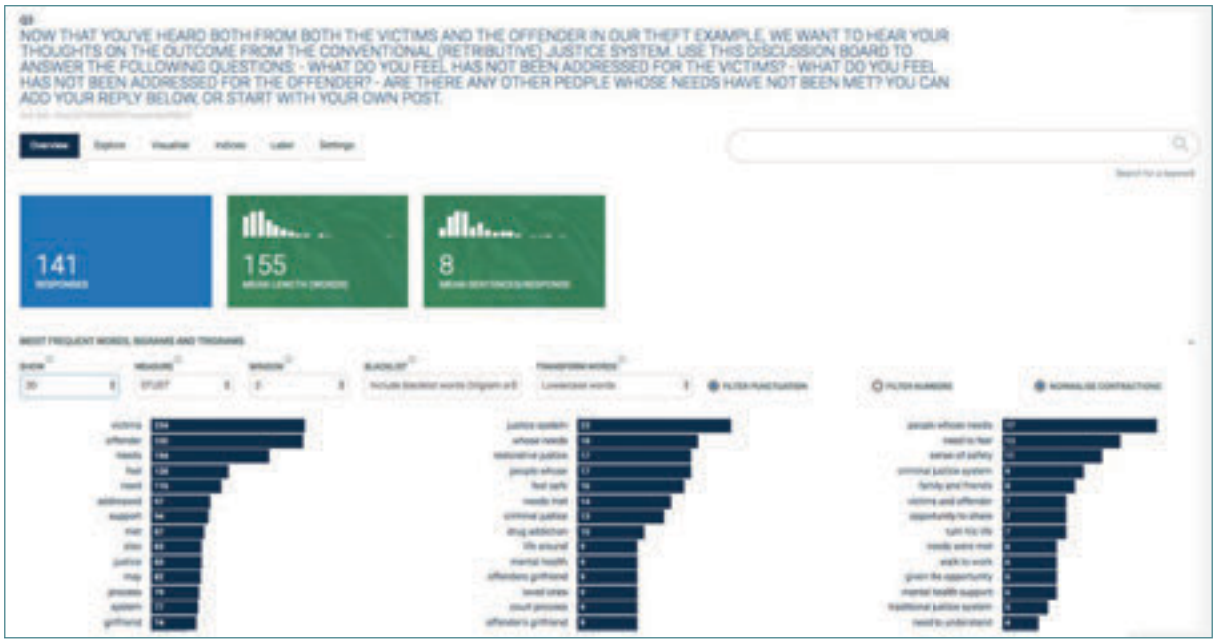


Figure 1. Quantext summary analysis for one question posed to discussion participants

Figure 2. Quantext search for words commonly co-occurring with the word 'opportunity'

Figure 3. Quantext wordtree for words commonly co-occurring with the word 'opportunity'

Participants could also dive deeper into the text to view all responses that contained particular terms, filter responses by length and identify specific parts of speech, such as nouns, verbs, or prepositions within each response. They could also generate wordtrees to get a summary overview of how students were using words in context (Figure 3).

What we found

Participants thought Quantext had the potential to offer new insights into how students learn in the course and their levels of understanding of subject-specific concepts and terms. For example, the chemistry lecturer was interested to see how some students conceptualised the structure of chemical molecules. A number of students referred to a 'bent tetrahedron' structure. This alerted the lecturer to a specific misconception and one that needed to be addressed. She noted that Quantext could be a powerful tool to identify specific issues especially where a large proportion of a class have a common misconception.

They also thought that the tool could provide useful feedback on the quality of assessment (questions and instructions) and teaching materials, and could help them improve the contents of lectures and tutorial. For example the philosophy lecturer particularly appreciated how Quantext drew attention to misunderstandings and misconceptions that he may not have predicted and thus provides useful formative feedback for him as a teacher.

Participants thought that there was value in using the Quantext analysis in real time during the course (for example, to adjust the content of the following lectures or to help students prepare for tests and examinations). They also thought that Quantext could be used as a tool to reflect on the course and consider how to improve its design and delivery for future iterations. One lecturer saw how students had been able to answer some questions by simply regurgitating lecture slides. This provided the impetus for him to review his assessments.

As an extension to the use of Quantext as a Learning Analytics tool, participants thought that it could support scholarship of teaching and learning (SoTL) research and discipline-specific teaching research, providing data for their scholarly SoTL publications. For example, one lecturer found that Quantext was helpful in identifying highly debated topics and suggested the tool may provide one approach to measuring attitudes.

Another potential use of Quantext that was recognised is for the analysis of open-ended comments in Student Course and Teaching Feedback. This could help course-coordinators, programme directors and associate deans identify common patterns in student comments on individual courses, or across sets of courses, or across the whole programme, in order to support future course, programme and teaching improvements.

The ability to track changes in responses over time and across different student cohorts was identified as a potentially useful enhancement.

Several limitations were identified for Quantext in its current form, although each of these presents an opportunity for improvement.

The main limitation that participants commented on was the time-consuming nature of the data analysis and its interpretation. They felt that one-on-one support would be needed, especially in the early adoption stages, in order to understand the available options and functionalities. They thought that the most effective way of using the tool would be in conjunction with an academic developer, who could help them with the interpretation of the results and suggestions on how to improve the course and teaching.

Another limitation was the type of analysis of student responses provided by Quantext. Some of the questions that the academics had in mind could not be answered using existing tool features. For example, what patterns of the language would indicate that a student is likely to complete the MOOC? Identify what patterns of language use are characteristic of students who receive high grades. In order to answer these kinds of questions, Quantext would need to support importing additional data fields such as course completion and grade data. At present, the way to achieve this would be to use Quantext to identify and label language patterns, export labelled data and then import to R, SPSS or Excel in order to identify relationships to other variables.

Participants also commented on aspects of the Quantext interface that they found clunky or that did not work as expected.

Indications for future use

All three participants indicated a desire to use Quantext again and saw considerable potential in the tool.

B. Quantext Pilot Observations in three undergraduate courses – University of Auckland

Similar to Use Case A, our three teacher participants used Quantext to explore text created by their own students as part of their taught courses. Text was drawn from short-form student writing in a first-year Philosophy course, second-year engineering and a first year human anatomy and physiology course. We asked each participant to reflect on their perception of the value of Quantext, what limitations or challenges they found, and what desires they had for improvements or changes that would better serve their needs. In addition, they were asked to reflect on requirements for operationalising the tools within their faculties at the University of Auckland. Each participant was supported to format their text data so that it was easily uploaded to Quantext. In each case, teachers explored data from their own recent classes.

The issue/s or problem/s explored

Each teacher was interested to see if analysing student responses to questions or student discussion posts in Quantext provided insights or efficiency gains that were not already available to them in other ways.

How the teachers used Quantext

We illustrate how teachers used Quantext with an example from a question posed to undergraduate engineering students. Teachers began by importing their data to Quantext. They were introduced to the overview or summary screen (Figure 1.) and then assisted to work through the range of options and settings available. Thus, they could change how the summary analysis was presented. For example they could choose to include or exclude function words (e.g. articles, prepositions etc), punctuation, and numbers in order to focus the analysis. They could also change the number of commonly occurring words and word groups (ngrams) to display, search for terms of interest and identify words that commonly co-occurred (Figure 2). At each point in this process, participants reflected on the summary text and data that they were presented with.

Participants could also dive deeper into the text to view all responses that contained particular terms, filter responses by length and identify specific parts of speech, such as nouns, verbs, or prepositions within each response (Figure 3). They could also generate wordtrees to get a summary overview of how students were using words in context (Figure 4).

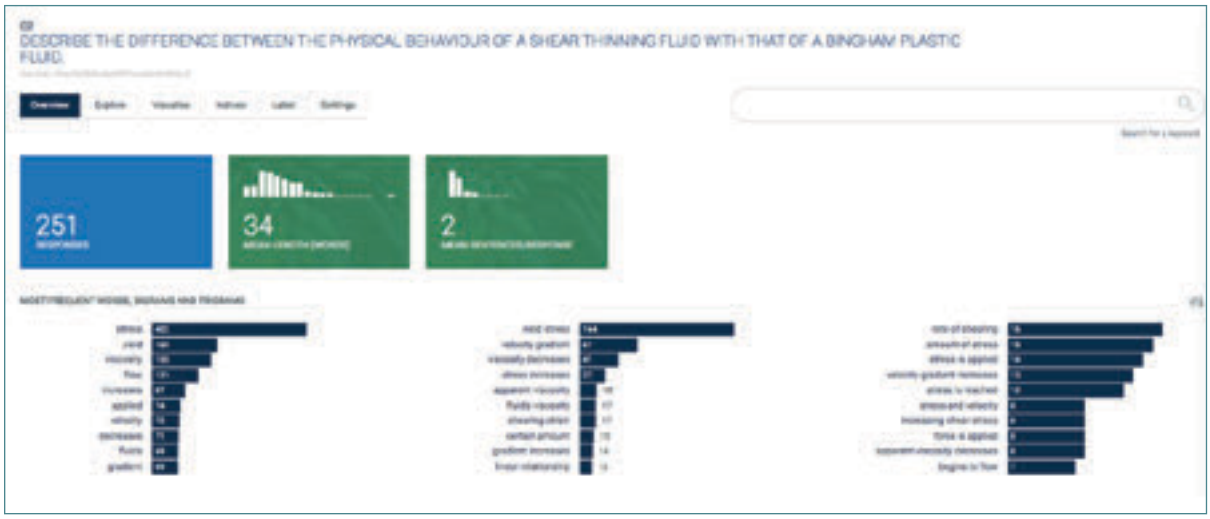


Figure 1. Quantext summary analysis for one question posed to undergraduate engineering students

Figure 2. Quantext search for words commonly co-occurring with the word increases

Figure 3. Quantext explore view showing individual responses

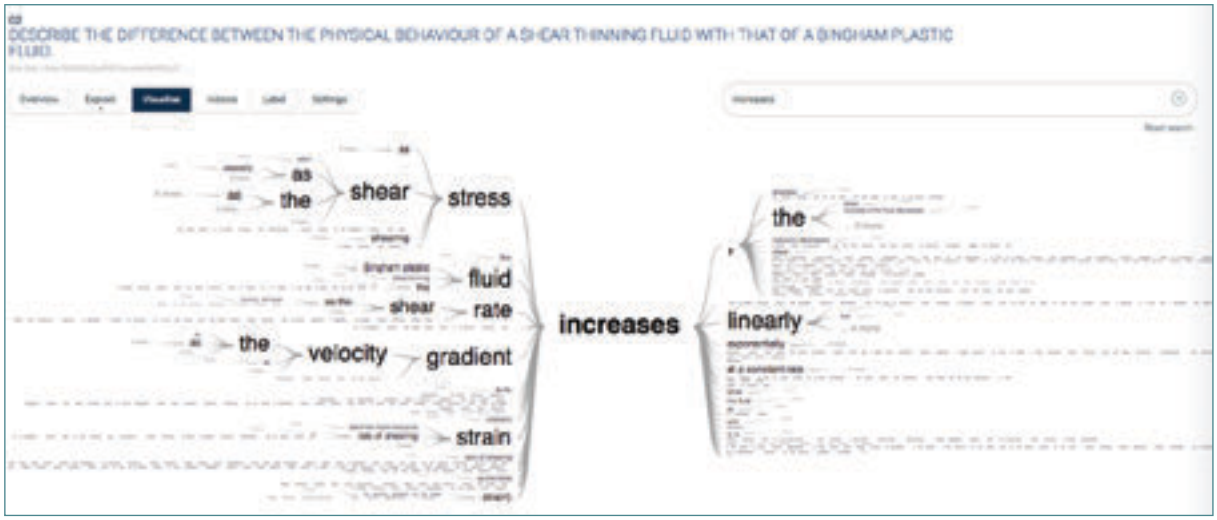


Figure 4. Quantext wordtree visualisation with a focus on the word increases

Through the ability to share Quantext aggregated reports (an example report is provided in Appendix 2), one participant noted the potential for supporting students so they,

"can see that they're not the only ones struggling with the concepts, which can be reassuring".

What we found

Consistent with similar observation sessions with teachers at Victoria University of Wellington, two participants thought Quantext had the potential to offer new insights into how students learn in the course and their levels of understanding of subject-specific concepts and terms. They also thought that the tool could provide useful feedback on the quality of assessment (questions and instructions) and teaching materials, and could help them improve the contents of lectures and tutorials.

One teacher felt there would be value in using Quantext during the course to identify difficult concepts through exploration of students' responses to formative/summative questions. He noted it would be valuable to compare this to feedback expressed by students on aspects of the course they found difficult. He also felt Quantext used in this way would promote a clear and immediate benefit for teachers; to support them to engage in reflective teaching practice.

The third participant felt that his context was a bit different. His students' writing was longer and tended to be more open-ended and reflective – the key terms identified by Quantext were not necessarily illuminating and a key concern for him was improving the efficiency of grading student discussion posts as he had a large number of students (~1500) in his course.

> "Longer-term possible semi-automated marking seems interesting. But the tool is primarily about formative feedback, while I already have a team doing that to a higher quality than software can currently do, so this is more about reducing the repetitive work of triage marking, which is emotionally draining and time-consuming."

Through the ability to share Quantext aggregated reports (an example report is provided in Appendix 2), one participant noted the potential for supporting students so they,

> "can see that they're not the only ones struggling with the concepts, which can be reassuring".

Several limitations were identified for Quantext in its current form, although each of these presents an opportunity for improvement.

Consistent with findings from Victoria University observations, the main limitations that participants commented on was the time-consuming nature of the exploratory data analysis and the support required to get data into Quantext.

Integration with Canvas to support direct import of quiz or discussion forum data was identified as a potential enhancement.

Another limitation, as already noted, was the desire for better support for triage marking in more open contexts.

C. Weekly analysis of short-form student writing as part of an undergraduate education paper – University of Auckland

Background

This use case is part of a wider, year-long project involving a first year undergraduate, general education paper with an enrolment of 80 students. The project was conducted by Professor Toni Bruce with support from colleagues at the Centre for Learning and Research in Higher Education (CLeaR) at the University of Auckland and the Quantext team. The principles underlying the project were that what teachers do affects learning outcomes, that feedback is a key influence on learning and effort, and that students better remember information if they generate all or part of an answer rather than just read it.

Feedback is a key influence on learning and student effort (Hattie & Yates, 2014): around 25% of the variance in university student learning outcomes is attributed to what the teacher does (Hattie, 2015). Timely and specific feedback to students and rapid, actionable feedforward on student understandings for the lecturer are likely to enhance teaching quality and student learning.

The issue/s or problem/s explored

The course represents first exposure to sociocultural perspectives in sport for many students. The focus has been on tools and strategies to enhance students' initial knowledge acquisition, through developing basic knowledge and vocabulary, and intermediate learning (Hattie & Yates, 2014), through supporting students to apply their new knowledge to more deeply understand and place their individual experiences into a bigger social world. In previous iterations, students were encouraged and incentivised to complete weekly, low-stakes, formative quizzes that tested their initial knowledge acquisition (9 multiple-choice questions) and apply that knowledge to their own experiences (1 short-answer).

The Canvas quiz tool personalises learning by providing immediate, individualised automated feedback on multiple choice answers, feedforward 24 hours later on overall class performance, and knowledge about question style/content relevant for later assessments. The lecturer used them to identify concepts/content that needed more explanation and, after reading all short answers, providing feedforward examples that exemplify expectations for later assessments. Multiple-choice questions typically evaluate recognition rather than recall and integration of concepts (McDaniel, Roediger & McDermott, 2007); this somewhat limits their utility to inform immediate course delivery and design. In addition, some students 'game' the multiple-choice component by just pushing buttons, which further limits their value for student learning and the lecturer's ability to assess which topics or concepts really need further explanation.

This project takes the course development in a new direction, drawing on findings about the generation effect, in which students asked to generate all or part of a stimulus item almost always remember information better than if they only read about it (Bertsch, Pesta, Wiscott & McDaniel, 2007). However, it is crucial that student receive at least some feedback on what they write. A key goal therefore, was to evaluate whether using Quantext to aggregate or summarise free-text responses would allow misconceptions to be identified and raised with students during the next lecture or tutorial.

How Quantext was used
Most weeks throughout the course, two or three short-form, free-text 'quiz' questions were presented to students together with seven or eight multiple-choice type questions. The exact make up of each quiz varied according to specific teaching and learning goals. The free-text questions were designed to focus on students' understandings of main concepts and provide actionable insights for the lecturer.

Quantext was used to rapidly summarise student responses to free-text questions and to identify key patterns through automatic extraction of key words, collocations (groups of words that commonly occur together) and syntactic constructions (e.g., noun phrases).

What we found
Overall, we found that Quantext provides the ability to quickly generate summary data from student free-text. In addition, response rates, length of responses and readability indices (e.g. Reading ease score) were helpful to get a sense of the level students were operating at.

In terms of opportunities to utilise summary data to address misconceptions, initially Professor Bruce found it hard to identify opportunities to enhance student learning of particular concepts from summary word patterns. But, she persisted and experimented with sharing visualisations of word patterns with students:

> "I provided visualisations of their attempts to define [terms or concepts] in their own words, and also summarised the main patterns as a way to [discuss specific ideas] in more detail, and to connect them directly to the lecture and reading content."

The most adventurous use was to actively solicit student input into the lecture content by asking them to identify concepts or ideas that confused or excited them in the readings or lectures. Professor Bruce then responded to their comments by revising the following lectures or material to address issues raised. This responsive approach was well received by students and while it added to the teaching workload, Professor Bruce commented:

> "I was able to expand, explain, address confusions and excitement in an immediate way—while the ideas were fresh in their minds —as well as integrate their own personal examples to show how the concepts were playing out in their own and their peers' lives. Their stories brought the concepts to life while often showing the similarities and differences in their experiences."

For some questions, students were provided with aggregated summaries of their responses. Prof. Bruce noted:

> "Value for me is to be able to provide students with feedback so they can further develop their own skills and get a sense of where they sit versus the class as a whole and in relation to lecturer expectations."

Informal student feedback throughout the course and the formal course evaluation suggest the new structure and feedback/feedforward approach creates a sense of conversation between the teacher and students, and between students, as they regularly read and heard each other's stories.

Specific student feedback was sought via focus groups. This revealed that while [visualisations] were interesting and a useful aid for explanation, they were not vital to most students. One student commented:

> "When Toni used it [summary visualisation] to explain ..., I found it helpful."

In addition, student feedback suggested that metrics such as reading ease scores needed to be personalised in order to be more directly useful to students.

While not conclusive, the final student evaluations of the course provide evidence of the value of increased opportunities for students to engage with the course implementation via feedback/feedforward. Results are summarised and compared to results for the previous year in Table 1. below.

Our goal, as the developers of Quantext, was to enable teachers to engage with the language their students are using; reflect on it in the context of the language they as teachers use; and to use those insights to adapt teaching accordingly.

While noting that learning how Quantext works and remembering how to use it presented challenges, Professor Bruce concludes:

> "Quantext is both pedagogically and technologically enabling, although I still feel I have only scratched the surface of what is possible.
>
> Quantext doesn't do everything I want nor may it be able to: with the feedback the development team has received from all of us experimenting with it, who knows what might be possible?"

	2018		2019	
	Mean	% Agree	Mean	% Agree
Overall satisfaction with the quality of the course	4.00	75	4.53	96
Overall satisfaction with the quality of the teacher	4.08	75	4.75	96

Table 1. Overall satisfaction scores 2018-2019, which increased from below to above the University average. Note that the response rate more than doubled from 15.2% (12/79) in 2018 to 37.5% (30/80) in 2019.

"Our goal, as the developers of Quantext, was to enable teachers to engage with the language their students are using; reflect on it in the context of the language they as teachers use; and to use those insights to adapt teaching accordingly."

D. Exploratory analysis of Statistics MOOC discussion forum data – The University of Auckland

Background

In 2014, a member of the Quantext pilot research team was the learning designer and supported teachers and moderators of the University of Auckland's first MOOC; Data to Insight. The course uses a novel way to teach statistical concepts through creation and interpretation of visual representations of data. It was delivered through Futurelearn, an online learning provider owned by the UK Open University and set up to attract large numbers of students to enrol in open online courses. Seven successive runs of Data to Insight attracted enrolments between 4,218 and 19,610.

All Futurelearn courses use a standard design template and are delivered through an online learning platform that captures data on learner activity, including discussion posts. Ongoing dialogue among teachers and students was a key feature of the learning design. The largest number of discussion posts in one run was more than 16,000.

We assumed that this large dataset would provide useful feedback on the course team's investment in teaching and learning design, and insights into learning using the novel approach. Working with a world leader in statistics education in a completely new learning environment (the Futurelearn platform), we made a lot of conjectures about design features and teaching strategies. A central assumption was that analysing data generated by the large, diverse student body would provide insights into the overall success of the initiative.

In 2018, a colleague with prior experience in learning analytics research joined the learning designer to use Quantext to analyse and present the discussion data in ways that would be useful to the course team.

The issues/problems explored

The problem was how to evaluate the effectiveness of novel course design features and teaching strategies used with large, diverse cohorts of students with no incentive to 'complete' the course in the conventional sense of that term. No formal accreditation was offered, though students who completed summative assessment tasks could choose to pay for a certificate of completion. Formative assessment was a common feature of the course.

The questions we wanted to explore using Quantext were:

- What could we learn from the data and the experience about the effectiveness of the course design, teaching methods and student learning in general?
- Where were problems occurring for learners?
- Which features and learning activities were most helpful and which were most challenging, (e.g. the pre-questions to the videos, the design of the glossary of statistical terms, the activity design)?
- Were the teachers sufficiently responsive to the students in the comments sections?
- What level of conversation and support was appropriate for this style of teaching and these learners?
- What level of teacher support is required when the course is running?

While the large volume of data generated from student comments and discussion posts was assumed to be useful, gaining insights was a labour intensive and time-consuming analysis task during an eight-week course. We were interested to know if Quantext analysis of student posts would provide teachers with an efficient way to respond to their questions.

The lack of time and tools to analyse student writing for formative assessment is a long-standing problem. Mason (1992) noted that the most valuable source of data to monitor what students are actually doing in computer conferences (now known as online discussions) was, paradoxically, the least used. While insights from students' writing could inform and focus teaching where analysis is feasible, simple tools and methods to analyse this kind of data are still not available for the average teacher to use while running a course.

An analytic approach

Discussions are one of four activity types available in the Futurelearn platform (along with videos, articles and quizzes) and were included for reflection at the end of each week. However, a comments feature included with all other activity types was also framed as a discussion by the platform. Being responsive to student comments was a core teaching aim, so we wanted to accommodate this in the learning design as well as in day-to-day teaching. Once the data was there, we were curious to know what insights it might provide. Quantext offered an opportunity to explore that question.

We acquired the discussion data from Futurelearn and asked the Quantext developer to prepare data files for analysis. This was a tricky process, as we had a larger volume of data than Quantext had been initially designed to handle. It proved impossible to analyse files larger than 1Mb, so we had to divide them into smaller sizes. We also had to learn how to format Excel files for upload to Quantext. The process of preparing the data, deciding what to use, and wrangling it to answer our questions was difficult for people with basic data literacy skills, and we called on the developer for support. Once the files were uploaded and analysed in Quantext, it was easy for us to see and search for commonly occurring terms.

As we began to refine and deepen our research questions, we found that the pilot version of Quantext would not allow us to reshape data on the fly, for example, to analyse discussion posts across, rather than within, a particular run. The interim solution was for the Quantext developer to support a Research Assistant working on the project to reshape data outside of Quantext. This process provided a clear indication of the data handling features that are desirable to include as standard within Quantext.

We began the analysis with questions about the learning design and use of a glossary of statistical terms. This simple task would allow us to familiarise ourselves with the software and the data that had been captured. Introduction and use of statistical terms throughout the course was a feature designed for students to build disciplinary knowledge. The Quantext analysis allowed us to see when, how often and how students used the key terms in their discussion posts. We then referred back to the course teachers to see if this was as they expected, and whether there was anything about the glossary they wanted to change. This preliminary analysis was also a useful trigger for further questions we will use Quantext to investigate, to better understand how students learn about and apply key concepts, e.g. variance, confidence interval, sampling error.

Describe what you found

Our findings fall into two categories: a) data formatting requirements and the types of research questions we can explore (process), b) glossary terms use by learners (product).

Data formatting and research questions

It is possible to analyse a large dataset once files are of a suitable size and format for use in Quantext. This was something we learned through experience rather than being able to plan from the outset. It was part of an iterative process.

Making sense of the data was not always easy, though this was nothing to do with Quantext. As researchers, we are unfamiliar with the subject matter and do not teach the course. We held preliminary discussions about the pilot study with Statistics educators. Once we've had the first proper research meeting with them to discuss our findings about glossary use, we expect to have a different set of research questions – some we can answer with Quantext alone, and some that will require triangulation with other data, e.g. quiz scores and activity logs. This is definitely an evolving process, and the learning curve has been steep at times.

Glossary use

Students used glossary terms most often in the weeks they were introduced, occasionally in earlier weeks, but not so much in later weeks. Some terms were hardly used or not used at all, which helps to answer questions about what needs to be included in the glossary. Teachers can make immediate sense of this analysis, as they know what to expect.

Quantext analysis allowed us to view the data in various ways, as the following examples show.

Figure 1 shows one of the most frequently used glossary terms from 15 introduced in week 4 across all 7 runs of the course.

Figure 2 shows the most commonly occurring words and word pairs in the discussions from the same week but only for the 4th iteration of the course, while Figure 3 shows the use of the glossary term 'correlation' in context.

Finally, Figure 4 shows the keyword in context using the word tree feature of Quantext.

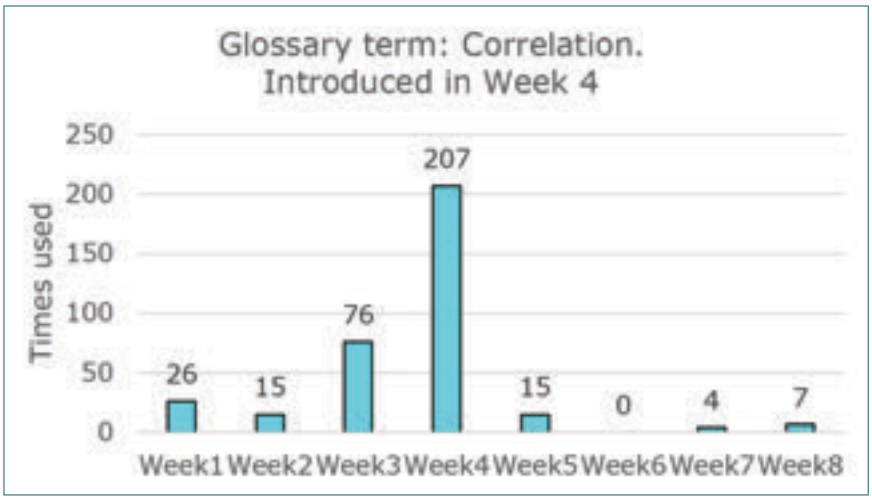


Figure 1: Course runs 1–7 week 4: students' use of glossary terms introduced that week

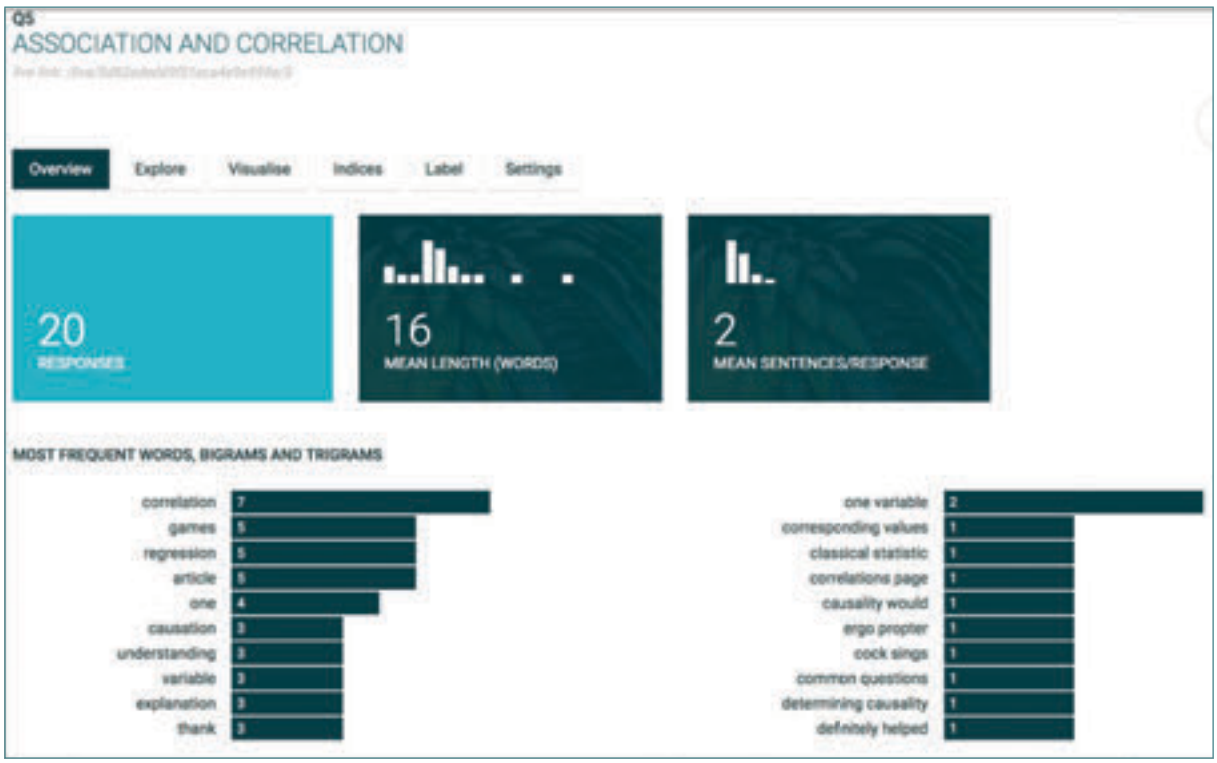


Figure 2: Frequency of use of glossary term 'correlation' in preliminary Quantext analysis

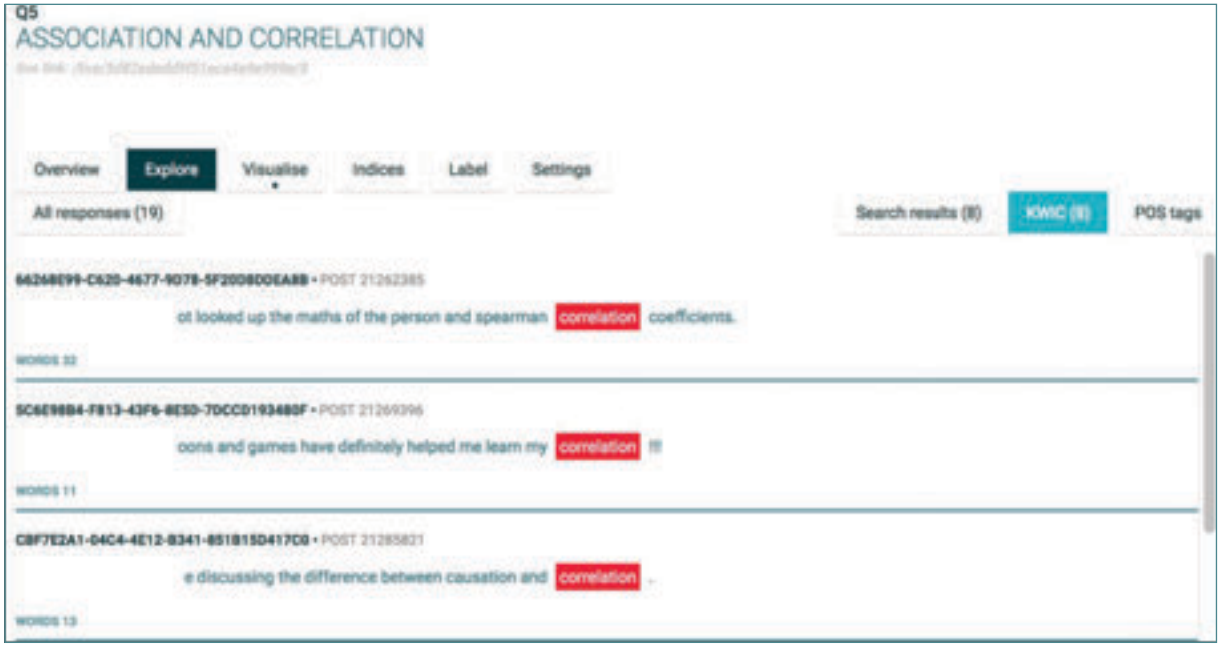


Figure 3: Use of the keyword 'correlation' in context

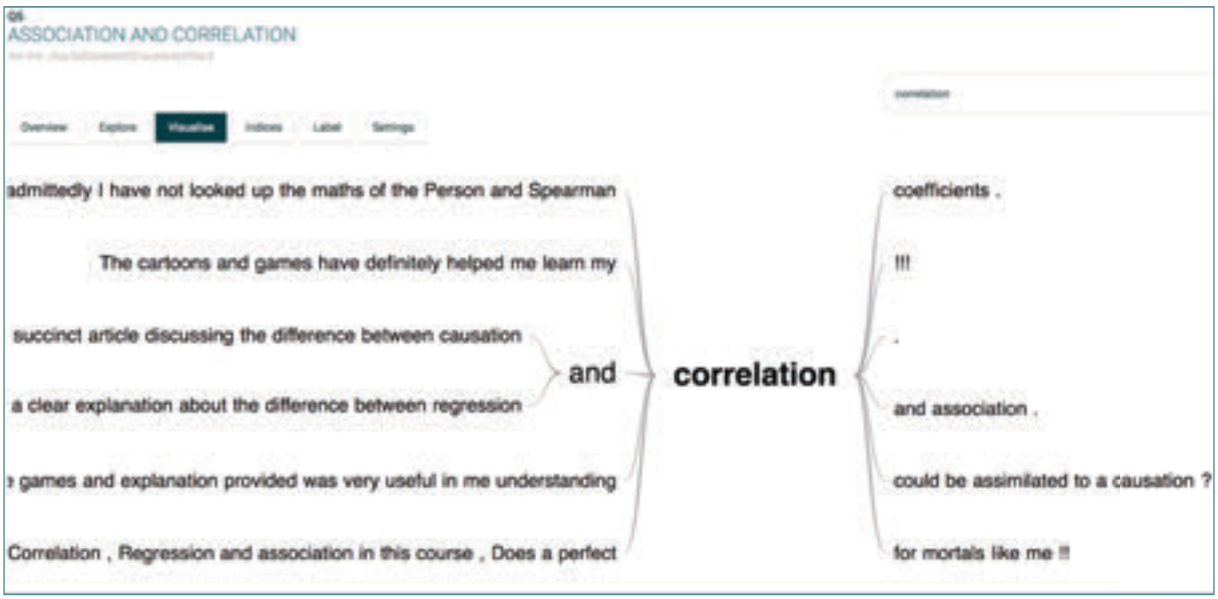


Figure 4: Using the word tree feature to visualise key word used in context

We believe that the ability to analyse and visualise a large dataset of this kind has potential to increase understanding of student learning, and to allow teachers to give timely feedback regardless of student numbers. So far, we have a starting point for further inquiry based on frequency and timing of students' use of glossary terms. Beginning with this quantitative output, we will use the keyword-in-context and word tree visualisation features of Quantext for qualitative analysis of students' use of glossary terms. If we were Statistics educators, we would have specific questions to start with. As researchers, we had research design, rather than content related questions, so e.g. can Quantext analysis identify which activities or concepts students find challenging, where a teacher might look at how they build disciplinary knowledge and apply concepts in use.

As a learning designer working with researchers, answering basic questions through the analysis has given us the confidence to have better-informed conversations with teachers about their teaching, and how students responded to it. We have preliminary findings that suggest teachers can gain insights from Quantext analysis. We are currently looking at how students and teachers used the glossary terms with separate data sets for each. We are also ready to explore how discussion analysis triangulated with other analytics data provided by Futurelearn might offer further insights into learning. This is still a work in progress.

Reflections on the experience

It was not possible for us to use Quantext unsupported because we weren't the course teachers, and we didn't have the data analysis experience to work alone. It might be difficult for other teachers to use Quantext without initial guidance, depending on their goal. It's not that the tool is difficult to use, but we lacked the data literacy required to understand text analysis, the capabilities of an analysis tool of this kind, and the expertise needed to prepare the data. Our data literacy skills have developed as a result of participation in the pilot study and the generous support of the Quantext developer. If we had chosen something simpler, for example a test in one of our own courses, rather than the MOOC dataset to work with, we might have been able to do this independently.

So far, we have only scratched the surface of our research goal and it's a taken a lot of work (iterative software development, data processing) to get there for reasons outlined above.

We will continue using Quantext, and are more confident now to explore the possibilities and make sense of the data, e.g. using visualisations to understand how glossary terms are used in context, and to compare teacher and learner 'talk' on key topics. We also want to compare transcripts of the teaching materials with student discussion posts.

We are optimistic about the potential to use student discussion data and the analysis tools provided by Quantext to gain insights into teaching and learning. The learning technology community has not yet been able to simply and systematically analyse student talk. The tools were too complex, and discourse analysis and language processing knowledge too specialised. We haven't found a miracle cure, but we do see Quantext as a useful step towards student data informed teaching and learning practice that could be widely adopted.

Recommendations

We will use Quantext again if we have specific teaching, learning design or research questions that can be answered through analysis of student writing. We would recommend Quantext for independent use by technically able colleagues and with research support for others. We have shown Quantext to a number of colleagues in different departments. Many see potential to use it for various tasks. The online support website has been updated, and should help to guide them through the process.

E. Exploratory analysis of discussion forum data from a MOOC on Antarctica – Victoria University of Wellington

This use case was completed just before the pilot study was funded. Nonetheless, findings from this work have directly contributed to Quantext development and we feel it is useful to include it as a detailed use case.

The use case is detailed in a paper presented at the Learning Analytics and Knowledge Conference (LAK) 2018 in Sydney, Australia (Elgort, Lundqvist, McDonald & Moskal, 2018). The full paper is included in the appendix (Appendix 3) and is also available online at: https://www.researchgate.net/publication/324417971_Analysis_of_student_discussion_posts_in_a_MOOC_Proof_of_concept

Abstract

Students' communications in a Massive Open Online Course (MOOC) may offer unique insights into their thinking and engagement with course topics. Is it possible for MOOC instructors to access such insights, short of reading individual posts? This proof of concept study used an online text analysis tool for teachers, Quantext, to examine key topics and ideas expressed by students in discussion forums, in a science MOOC about Antarctica. Outputs of the basic text analysis were scrutinised, in order to identify key topics of interest in the introductory MOOC forum and trace them to in-course topic discussions. We found that the analysis was, at the very least, minimally adequate to quickly observe lexical patterns in students' writing, linking their pre-course interests and aspirations to some aspect of their in-course communications.

F. In-class evaluation of Quantext in a foundation studies class

This use case was presented at the FABENZ conference in Wellington, November, 2018 (Stokes & McDonald, 2018).

Learning analytics to promote deep learning: framing information literacy assessment around student interests in enabling education

Abstract

As the Post-Millennial generation enters university, the promise of carefully implemented learning analytics is that educators can effectively connect with student interests and promote deep learning outcomes (Corrin, Kennedy & Mulder 2013). Understanding diverse cohort needs is particularly important for students in enabling programs, who are characterised by 'extreme heterogeneity' (Hodges et al. 2013, p. 32). New technology provides opportunities to extend enabling pedagogy (Stokes 2014) and further connect with the rich life-worlds of students to engage them with university education through meaningful learning experiences (Stokes 2018).

This use case was collaborative study undertaken by an Australian and New Zealand academic in Semester 2, 2018. We embedded Quantext learning analytics in the course, *Future Ideas: Information and the Internet to better understand student interests and concerns.* Future Ideas: Information and the Internet is an innovative information literacy course offered as an elective to 160+ students each year in enabling programs at UniSA College (University of South Australia). The course is designed to encourage deep learning approaches by supporting students to investigate real-world problems and identify evidence-based solutions. Quantext summarises key concepts from student text input in real-time during lectures. This allowed the teacher to shape the learning environment in response to student input.

Implementing this approach provided benefits for learners and educators. Embedding Quantext real-time learning analytics in lecture and online environments allowed us to capture and summarise student responses to key course questions. This extends the dialogic approach (Shor & Freire 1987) from the classroom to lecture and online spaces, opening further dialogue between students and academics. Quantext provided a practical solution to help tailor learning experiences to student needs. Student responses were summarised as themes to generate course assignment topics. Our hope/expectation was that this would resonate with this new generation of learners. Themes of global, environmental, sociocultural, and individual issues emerged, which reflect Post-Millennial interests. Through connecting with student passions and exploring these topics in a supportive learning environment, our aim was to encourage students in an enabling programme to adopt deep approaches to learning (Ramsden 2003). In other words, to reflect on and apply key course concepts in direct relation to their own experiences.

G. Reflections on Quantext use from two students undertaking a Master in Educational Technology programme – University of British Columbia, Canada

Reports for these use cases are included, in full, in appendices (Appendix 4 and 5) to this report with the kind permission of their authors and the Masters programme instructor, Dr Leah McFadyen. Brief report outlines are provided below.

Text Analysis of Student Surveys by Ryan Day

Ryan explored Quantext understand how it might be applied to the analysis of evaluation data. He analysed two questions from student evaluation of teaching (SET) data. He describes his use of Quantext and provides a basic SWOT analysis.

Ryan's main recommendation was to seek permission to analyse text data from existing class surveys using Quantext.

Analysing Learning Writing by Trevor Smitna

Trevor wanted to see if he could use Quantext to answer two practical teaching questions:

1. Is Quantext an accurate and meaningful tool to analyse learner writing at the Middle School level?
2. Can Quantext be used to guide teaching practice to target areas of lagging writing skill?

He notes that Quantext is still under development but could see it as meaningful tool to examine whole class writing (readability score) averages. He notes it is not currently possible to identify individual students and specific writing needs; however he thinks it may be useful to guide teaching practice through determination of the general level of writing for an entire class or group of writing samples.

H. Evaluation of Quantext as a tool to support curriculum mapping – University of British Columbia, Canada

This use case was very kindly contributed by Dr Leah McFadyen as part of broader curriculum mapping and review project in the Master of Education Technology programme at UBC. She experimented with Quantext, as a accessible text analysis tool that could be used to explore course content and applied relatively easily by educators and educational leaders who are not data science specialists. Leah notes that,

> "Although Quantext was not designed for 'curriculum analysis', when I learned of its analytic potential I was curious to discover whether it might be usefully co-opted for my purposes."
> Overall, Leah found that Quantext output was,
>
> "meaningful and useful (and more useful than findings from a previous effort to analyse course content using topic modelling which generated difficult-to-interpret thematic clusters)."

She has made a number of useful general recommendations and suggestions as well as more specific ideas if Quantext is to support curriculum mapping.

Leah's full report is provided in Appendix 6.

I. Potential of Quantext to summarise free text comments from Student Evaluations of Teaching

This use case is detailed in a paper published in Assessment & Evaluation in 2019 (McDonald, Moskal, Goodchild, Stein & Terry, 2019). The full paper is available online at:
https://doi.org/10.1080/02602938.2019.1614524

Abstract
Student evaluations of teaching and courses (SETs) are part of the fabric of tertiary education and quantitative ratings derived from SETs are highly valued by tertiary institutions. However, many staff do not engage meaningfully with SETs, especially if the process of analysing student feedback is cumbersome or time-consuming. To address this issue, we describe a proof-of-concept study to automate aspects of analysing student free text responses to questions. Using Quantext text analysis software, we summarise and categorise student free text responses to two questions posed as part of a larger research project which explored student perceptions of SETs. We compare human analysis of student responses with automated methods and identify some key reasons why students do not complete SETs. We conclude that the text analytic tools in Quantext have an important role in assisting teaching staff with the rigorous analysis and interpretation of SETs and that keeping teachers and students at the centre of the evaluation process is key.

J. Exploring the potential of Quantext to summarise free text comments from a course experience survey of Occupational Therapy graduates – Otago Polytechnic

This use case was a late addition to the pilot study and work is ongoing at the time of writing this report.

Background

A survey of Occupational Therapy graduates from Otago Polytechnic was undertaken to better understand their career paths and to inform curriculum design and fieldwork practice decisions. A survey of 90 questions was sent to 1,000 graduates of the Occupational Therapy degree; 514 responses were received.

The issue/s or problem/s explored

The potential of Quantext to synthesise free text comments from this survey data is being explored. The aim is to extract meaningful insights into the perceptions of past students about what was most valuable in their degree, both for personal development and career prospects. It is hoped that the insights from this analysis will inform development of the Occupational Therapy course in the years to come.

What we found

A preliminary analysis of the survey data has been undertaken and initial analysis of the free text comments is in progress. To date, one potential enhancement to Quantext has been identified: the ability to identify word and word group synonyms.

K. A research study to explore the collaboration between automated tools and humans in understanding and analysing texts, and in search for meaning – University of Auckland

There have been significant delays to this use case due to circumstances beyond the control of the project team. Nevertheless, this use case is still in progress and is being written up as a chapter in a forthcoming book to be published by Springer in 2020/21.

L. Integration of the IMS Learning Tools Interoperability (LTI) standard with Quantext – University of Auckland and Otago Polytechnic

We successfully completed LTI integration with Quantext within the first few months of the pilot study at the University of Auckland and at Otago Polytechnic. However, while this was a useful practical learning exercise it did not deliver the benefits we had hoped for. This is not a reflection of either the LTI standard or of Quantext. It was more that the LTI standard is designed for tools which are directly accessed by students. With the exception of one feature, this is not the case with Quantext; it is a tool primarily designed for teachers.

Use case F, above, illustrates the exception and provides a proof of concept. We provided a basic feature where teachers can create a web page for students to respond to a single free text question. Quantext summarises the results in real-time as students post their responses. The teacher can choose whether or when to share the summary results with students.

However, substantial development work would have been required to develop the proof of concept to the point where it could work as a standalone LTI tool. In the absence of specific demand from teachers we could not justify this additional work. There is a range of tools already available for capturing real-time input from students. We feel a more productive approach may be to support data captured from those tools.

A key finding from this exercise and quite separate from LTI integration, is the need to work with institutional IT departments to use their institutional single sign-on capabilities (Quantext currently supports Google sign in) and to provide an accessible link to Quantext for teachers from within institutional portals and/or their LMS. We hope to progress this work with our project partners beyond the current pilot study.

Quantext enhancements identified through the pilot study

As noted previously, the form, function and usability of Quantext has evolved considerably over the course of this pilot study. Many small and large issues identified were addressed and the pilot version of Quantext has been regularly updated. Indeed, this has been essential in order to progress some of the use cases described. Nevertheless, regular updating also presented challenges and these are discussed further in the next section. The pilot version of Quantext as at 31st January, 2020 is available at https://pilot.quantext.org.

Additional enhancements not included in the pilot version of Quantext are prioritised on our development list according to anticipated utilisation of Quantext beyond the pilot study.

Conclusion

Teachers from many different disciplines came to the Quantext pilot study with a range of expectations and unanswered questions about their teaching and student learning. The majority of pilot participants gained some useful insights and saw potential for further benefits from continued use.

Teachers used Quantext to identify misconceptions, solicit certain types of responses, gain deeper understanding of particular aspects of student learning and knowledge, and to explore student attitudes to different aspects of their course. The potential to use the software as an aid to reflective practice and for Scholarship of Teaching and Learning (SoTL) research was noted by most pilot study participants. However, it was evident that, initially at least, support from educational or academic developers will likely be required to use Quantext in this way. In addition, effort will be required to support and promote a change in practice and culture which, while undoubtedly desired, may often seem to be at odds with the practical demands on busy teachers. As one teacher noted,

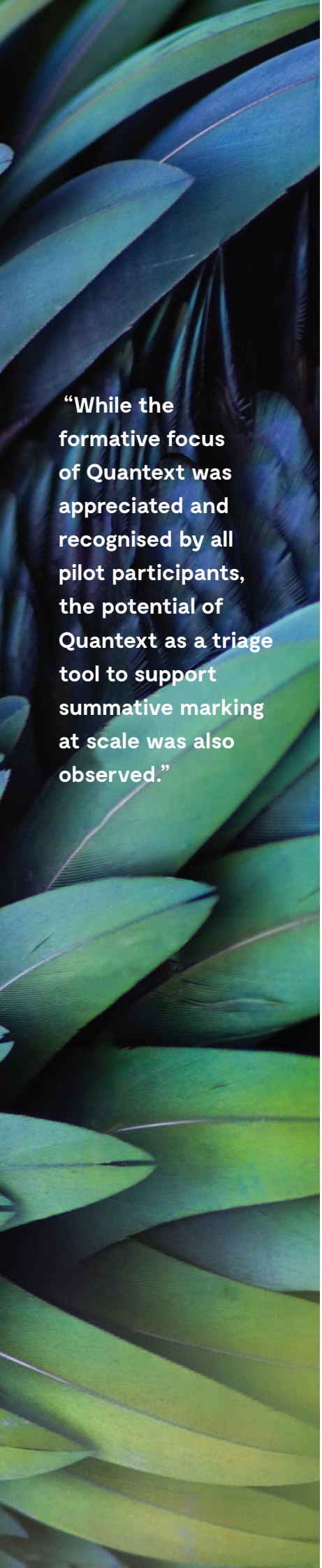
> To improve teaching is kind of what we should be doing but it's soft it's immeasurable while faster marking is something that ...people will say, it will save you 10 hours a week let's put some money in this.

While the formative focus of Quantext was appreciated and recognised by all pilot participants, the potential of Quantext as a triage tool to support summative marking at scale was also observed. One participant has confirmed their interest in being involved in further trials of features to support this use case and received a small internal grant to support the investigation.

It is clear that institutional imperatives and time constraints on teachers mean that tools that solve immediate problems, whether pedagogical or administrative are in demand. Use case I – a joint research project from Otago Polytechnic and the University of Otago provides a good example. Quantext was used to summarise free text comments from a questionnaire exploring student perceptions of student evaluations of teaching (SETs). It was clear that the technique could also be applied to summarising free text comments from SETs and we have further evidence of this from use case G provided by a practicing teacher and Masters Student in Educational Technology at the University of British Columbia. There is a firm proposal from Otago Polytechnic to implement Quantext as an innovative extension to their existing student survey systems currently under consideration. Interest in further exploring this application was also expressed by staff at Victoria University of Wellington.

Several use cases also revealed that text analysis is often required in association with related data such as student grades, attendance, assignment completions and so on. It has to be easy for teachers to visualise text analytic summaries in relation to other relevant data. Associated with this, across the board, it was clear that integration of Quantext with institutional single sign-on systems and teacher portals alongside supporting easy upload and/or integration of learner data will promote adoption and use.

A number of cases involved handling very large volumes of data, both in terms of numbers of students and in terms of the length of text responses. Earlier this year we substantially re-engineered Quantext in order to cope with larger data files, in particular, data from MOOCs, and to reduce processing times. We believe the issues are now largely resolved although we have limited file size on our pilot server due to cost considerations.



"While the formative focus of Quantext was appreciated and recognised by all pilot participants, the potential of Quantext as a triage tool to support summative marking at scale was also observed."

Functional limitations with the pilot version of Quantext were noted by all participants as they worked with the application in their own contexts. Where possible, within the scope of the pilot study, limitations were addressed as they arose. Where limitations or desired enhancements were judged to be out of scope for the pilot they were added to a list of potential improvements for future development.

While there were sometimes unexpected delays and changes to Quantext functionality throughout the course of the pilot, this was hard to avoid. Throughout, as the developers of Quantext, we tried to be as responsive to participant requirements and pedagogical aims as it was possible to be without losing sight of the core purpose and goals of the pilot study. Feedback from all our pilot participants suggests that in this respect we have largely succeeded.
Our sincere hope is that the interest and opportunities developed through this pilot study generate sufficient momentum for us to continue to develop and support Quantext as a truly pedagogically driven text analytic tool for teachers.

Beyond the Pilot Study

In this section, we itemise expressions of interest we have received in using Quantext beyond the pilot study and provide brief reflections from the project team relating to our private-public collaborative partnership.

Expressions of interest in use beyond the pilot study

The following expressions of interest in using Quantext beyond the pilot study have been received:

1. Otago Polytechnic have requested a proposal for consideration by their Executive Leadership Team for a trial implementation of Quantext specifically to analyse written learner feedback to inform institutional and college leadership (e.g. collected via student evaluations of teaching)
2. A group a five academic and teaching staff, who have been involved in the pilot study have obtained an internal University of Auckland grant for projects involving Quantext analysis in 2020. In particular, there is interest in automatic labelling of responses based on identified themes within student written assignment submissions.
3. There is interest among participants at Victoria University to continue with a second phase pilot study in partnership with academic developers.
4. The potential of Quantext as a research tool has been a theme throughout the pilot study. One academic at the University of Auckland is seeking to utilise Quantext as a research tool to analyse qualitative data and is currently applying for funding to support their project.

Reflections from the pilot team

Overall, the pilot study team believe the use cases presented here provide evidence that supports the value and potential of Quantext to illuminate the practice of teaching and learning in a range of tertiary education contexts.

Specific written reflections from Dr Elgort and A/Prof. Gunn in relation to the operation of the pilot and the private-public partnership are provided in full in Appendix 7.

From the perspective of Dr McDonald and Mr Moskal, the developers of Quantext, the partnership with Dr Elgort and A/Prof. Gunn was productive, valuable and essential. It made no sense to try to develop a tool for teachers in the absence of collaboration with teachers or external to the tertiary institutional context. While we each have different specialist skills, all members of the pilot team have extensive experience working in academic development and educational technology development or support roles. This likely provided the common ground that was vital for what we regard as a successful collaboration. We are confident that Quantext is a much more valuable and robust tool now than it was at the outset of the pilot study.

In terms of whether our private-public partnership mitigated against known issues of sustainability of educational technology innovations, the short answer is probably no. While we were able to operate in an agile and responsive manner in terms of supporting and developing Quantext we faced the same fundamental issues as any bottom-up internal innovation. Any development work had to be within the scale and scope of the available budget. Klobas, & Renzi (2014) provide a useful analysis of the issues from canvassing the views of leaders of both continued and discontinued innovations. Unsurprisingly, institutional support, especially financial support topped the list of issues. In addition, stable technology and marketing skill feature among initiatives that were sustained. Depressingly, teacher and student views had little effect on whether an initiative is sustained. All else being equal, McGill, Klobas & Renzi make the point that,

> Overall, the difference between sustainable and non-sustainable initiatives has more to do with conditions associated with gaining ongoing material support for the initiative and attracting others to become involved in adoption and development than factors associated with teachers' ability or willingness to participate, or with learning or student response to the initiative.

In terms of Quantext, it is important to consider the question of sustainability in the context of the current broader technology environment and the tertiary sector environment. At the time of writing, both are in considerable flux. While arguably it has ever been thus, the present rate of change, especially in relation to text analytics, seems greater than ever.

Since the inception of the Quantext pilot study less than 2 years ago, Microsoft, Google, Amazon and IBM have all stepped up their marketing of text analytics as part of their broader business analytics (BA) platforms. For example, automated sentiment analysis and the extraction of key people, places and organisational entities are becoming standard functions among business analytics tools. Basic text analytics are now commonly integrated into research tools such as NVivo as well as into survey tools, including those commonly used for student surveys, such as Qualtrics and Blue. Which is not to say, the use of these tools by teachers is either easy or self-evident. By and large, such tools remain inaccessible to tertiary teachers and they are certainly not routinely used to improve or develop teaching practice. Nor are they likely to be used in this way without substantial incentives and academic development effort. Nevertheless, a broader discourse around text analytics has become established and it is situated firmly in the realm of business analytics.

At the same time, both the ITP and university sectors in Aotearoa have undergone, or are undergoing, structural change. This change extends from the sweeping national review of vocational education (RoVE) at one end of the scale to the recent disestablishment of the Centre for Learning and Research in Higher Education, at the University of Auckland at the other. The latter, while a small-scale change in terms of the sector as a whole, has had a profound impact for colleagues working on and with the pilot study team. Furthermore, in relation to removing support for pedagogically informed educational technology innovation, the change at Auckland mirrors changes at the Higher Education Development Centre at the University of Otago a few years earlier.

It is disheartening that the painstaking and careful applied research work of small, dedicated educational technology and academic development units appears under-valued. Historically, these units are among the first casualties when the winds of change blow through the sector; academic institutions are by no means immune to broader economic, social and technological forces. Paradoxically, the critical role small educational technology units play in foregrounding the pedagogical affordances of technology and cautioning against the wholesale application of simplistic metrics, is not infrequently viewed with suspicion by some academic colleagues; colleagues who are themselves critical of technology developments and neoliberal reforms.

It is important to point out that the private sector side of the Quantext collaborative partnership was personally funded. It was not funded by big business or large commercial entities. It was funded by two former university staff who believed, and still do, in the value and benefit of supporting tertiary teachers to teach well rather than simply to teach larger numbers of students in more efficient ways. We embarked on a journey to build Quantext. But, to sustain Quantext as an educational technology business there has to be a sustainable business model. At the time of writing this report, we have not yet succeeded in creating that model. Depending on the outcomes of ongoing work, that position may change; time will tell.

Yet perhaps the reason we have not yet succeeded is the same reason that small internal educational technology units are so often disposed of, re-organised, and re-structured; it is hard to measure and point to the value that they (and we) add in terms that business imperatives and analytics recognise.

Final remarks

The Quantext Pilot Study sought to expose and illuminate the value inherent in teaching and learning conversations. Quantext is predicated on the belief that by making aggregated summaries of student and teacher language accessible to teachers, teachers and students will gain practical insights that will help teachers to teach and improve outcomes for students.

We have described examples, across a wide range of contexts, where teachers gained insight and either changed, or indicated that they would change, some aspect of their teaching as a result. In one case, which extended across a whole semester, the changes were positively correlated with substantial gains in student evaluation of teaching (SET) scores. Such gains cost time, effort and energy – they were not magically produced by Quantext, although Quantext demonstrably helped and validation will take time and additional use cases. What is clear from our account of this pilot study as a whole is that, in general, iterative and collaborative development and validation takes time, effort and energy. This is the reality of learning analytics writ large.

As Ferguson, Clow, Griffiths & Brasher (2020) write in a recent issue of the Journal of Learning Analytics:

> ...the evidence that learning analytics delivers benefits is not yet convincing to the experts in the field. Much more technical and research work is required, which is challenging but achievable.

Yet, this begs the question why tertiary education institutions across Aotearoa and many institutions globally are implementing analytics initiatives if the evidence to support them is not there?

An important follow-up question to ask, is whether it is learning analytics that institutions are implementing or something else? Ferguson et al. (2020) also note:

> ...it is still rare to involve educators throughout the process of developing and implementing learning analytics, and even rarer to involve the learners who will be end users, except as participants in trials.

We are proud that the Quantext Pilot Study is a *rare example* which has actively involved educators and learners in the development and implementation process. Perhaps the thing that distinguishes learning analytics from business analytics is the involvement of educators and students in the development and implementation process?

The sustainability of Quantext depends on making a business case. Quantext has been developed in close collaboration with teachers and with students. But as yet, we have no business case. We cannot point to 'bums on seats', or increased retention or higher grades and conveniently draw a line between those metrics and our innovation.

What we can point to is a story. A story told through a series of cases, unrelated except for their relation to Quantext and to this pilot study. A story that has unfolded, first with one teacher, then another and then with a student and then another and so on. From there we have pointed to one context dependent insight and then another ... step by step. And each step taken, has been modified and informed by a previous step or misstep. Sometimes we had to keep making the same mistake in order to fix a problem. Sometimes, it took us a while to recognise an issue. We have not been making a business case. We have not just been developing and implementing a learning analytics tool. *We have been doing teaching and learning.*

At the recent Australasian Learning Analytics Summer Institute (ALASI2019), in Wollongong, Australia, some of the leaders in the field of Learning Analytics sought suggestions from conference attendees about how to reach institutional leaders. How could we position the field of Learning Analytics to better inform institutional practice? If a room full of world-ranking professors struggle with this question, what hope is there for the rest of us?

The breathless adoption of business rhetoric by many of our universities and polytechnics belies the evisceration of thoughtful, applied educational research (and that includes learning analytics research) in favour of out-of-the-box business analytics products that produce easily countable evidence. If the evidence most valued is that which falls within the capacity of out-of-the-box products to count, we will fail to count much valuable work. Worse, we will be doing little more than offering valueless templates for 'student success'.

As Cathy Gunn observed a decade ago,

> "The challenges of turning funded projects from elearning innovations into sustainable products and services have featured in the higher education literature for more than forty years." (Gunn, 2010)

At 50 years now, the challenges remain.

Perhaps at heart, the issue is not whether we can make a business case but whether we should.

We have provided evidence that surfacing patterns in student and teacher text can support teachers to teach and to teach directly to the specific issues that students face. Being able to do this with classes of up to 1500 students is no trivial achievement. Quantext helps teachers to identify relevant patterns and to think through what is going on for their students. *It specifically, does not do the thinking for the teacher.*

As Margaret Heffernan (2019) has eloquently observed, there is real danger when we offload thinking to machines:

> "Every time we use technology to nudge us through a decision or a choice or to interpret how somebody's feeling or to guide us through a conversation, we outsource to a machine what we could … can do ourselves, and it's an expensive trade-off. The more we let machines think for us, the less we can think for ourselves."

If making a business case requires co-opting learning analytics in the service of business analytics, with a focus on efficiency gains, nudging students toward goals and producing widget-like *work-ready graduates,* what does that say about what we value in higher education? That is a much bigger question and one which is well beyond the scope of this small pilot study to answer.

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Appendix 1: Planned Quantext updates and enhancements

Updates

Fixes for known issues and smaller enhancements. Items in green have been fixed ready for testing and update to pilot site.

1. Fix login issues.
2. Confirm current file size limits and document (issue with pilot site, dealt with on dev site).
3. Confirm fixed timeout errors when analysing larger files.
4. Add links to 'new analysis' and 'file upload' boxes on control panel.
5. Debug 'run again' button (odd behaviour when running most recent analysis).
6. Restore rollover values on summary histogram bins.
7. Restore Quantext Live.
8. Restore switch between files - list is there but only default file available.
9. Restore custom blacklist.
10. Whitelist options to set words for Quantext to include in summary analysis.
11. Include a shortcut to add question words to blacklist.
12. Consider adding words to blacklist using a checkbox in summary view of keywords.
13. Consider extending/filter by count and optional reverse ordering the number of ngrams to display.
14. Consider hiding default display of livelink.
15. Debug KWIC count and response count [odd values with some datafiles].
16. Consider moving location of POS tag function or adding to KWIC/Search selection.
17. Restore readability indices.
18. Restore report function.
    a. Document how to add specific questions to report.
    b. Fix select number of ngrams to display or remove – currently reports number set in analysis screen.
19. Complete basic label screen. In particular:
    a. Restore ability to filter responses in labelling screen. Specifically:
        i. Sort/filter by similarity to selected response or entered response/phrase*.
        ii. Sort/filter by length.
    b. Check assigned labels save to analysis.
    c. Check assigned labels are included in report.
    d. Check labels correctly exported.
20. Add responsive tooltips to main interface elements.
21. Document/tool tip any remaining stub functions (e.g. validation) as placeholders.
22. Review sentence segmentation, lemmatisation and lowercase functions and update user docs.

* Add to enhancements – we will include this as part of a revised labelling tool.

Enhancements

Additions and enhancements for consideration to include as part of pilot. Items in black have been developed ready for testing and update prior to soft launch - early 2020.

1. Re-engineer file format for upload.
    a. Choose any CSV/XLSX file (specify sheet/s?).
    b. Select columns for import.
    c. ? Option to rename selected columns.
    d. Include option to add or upload list of questions/topics.
    e. ? Option to upload m/any text file – [generate autoid and provide ability to name question/topic.
2. Add validation function to label screen.
3. Complete and bug check analysis sharing option (to share analysis across teaching teams).
4. Re-engineer wordtree. ?Mosaic.
5. Corpus comparison and aggregation. Specifically, summarise data across all questions/topic in current file.
    a. Compare overview summaries for same question by cohort.
    b. Compare overview summaries for any question to any other question or text summary.
    c. Select text for analysis/export based on data column and/or label values.
6. Identify keywords (i.e. not just top word count) by TextRank (or similar) or by corpus comparison.
7. Add synonym search (vector based and/or wordnet lookup based).
8. Consider rethinking search – KWIC-based, regex tec – to discuss.
9. Enhance readability indices. Specifically:
    a. Only include where average text length > 50 words.
    b. Warning where some text responses < 50 words.
    c. ? Assist users with selection of indices.

Appendix 2

Quantext

Sample report from an undergraduate engineering course

OVERVIEW
3 questions analysed
17,597 total words
1,207 total sentences

Sample report from an undergraduate engineering course | 5 pages

Prepared by Jenny McDonald
29.9.2019

Quantext

Q1 QUIZ1_1

Explain the physical meaning of the "viscosity" term in the following equation: tau = mu*du/dy

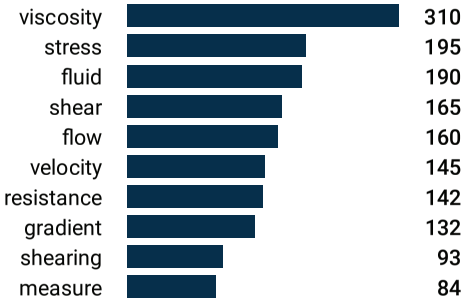
SUMMARY STATISTICS

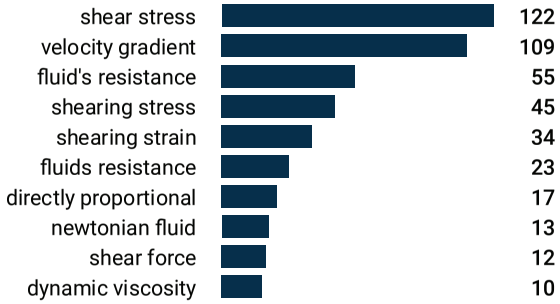
256 responses

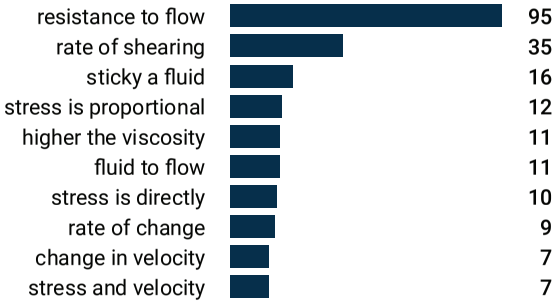
26 mean response length in words

2 mean sentences per response

MOST FREQUENT WORDS, BIGRAMS & TRIGRAMS







Quantext

Q2 QUIZ1_2

Describe the difference between the physical behaviour of a shear thinning fluid with that of a Bingham plastic fluid.

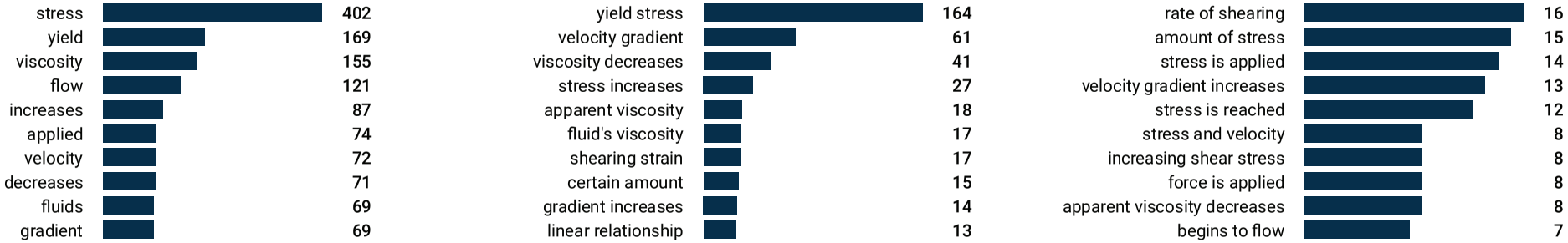
SUMMARY STATISTICS

251 responses

34 mean response length in words

2 mean sentences per response

MOST FREQUENT WORDS, BIGRAMS & TRIGRAMS



Quantext

Q3 QUIZ1_3

Please describe any concept that you have found particularly difficult from this week's teaching, or leave this question blank if you have not struggled with any concepts this week.

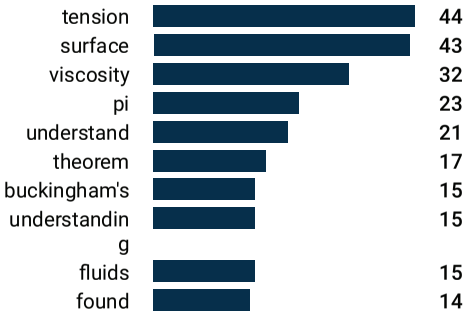
SUMMARY STATISTICS

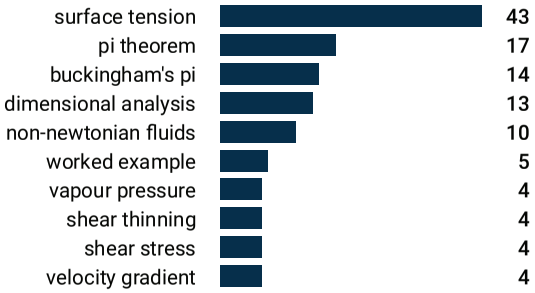
175 responses

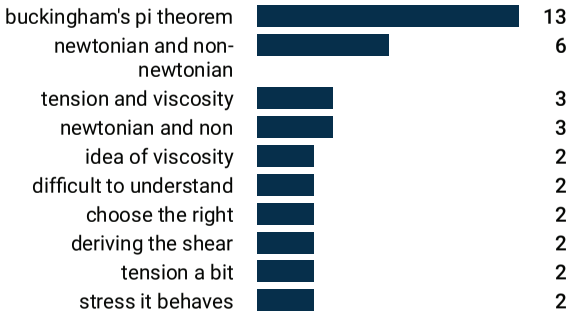
13 mean response length in words

1 mean sentences per response

MOST FREQUENT WORDS, BIGRAMS & TRIGRAMS







Appendix 3

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Analysis of student discussion posts in a MOOC: Proof of concept

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Analysis of student discussion posts in a MOOC: Proof of concept

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ABSTRACT: Students' communications in a Massive Open Online Course (MOOC) may offer unique insights into their thinking and engagement with course topics. Is it possible for MOOC instructors to access such insights, short of reading individual posts? This proof of concept study used an online text analysis tool for teachers, *Quantext,* to examine key topics and ideas expressed by students in discussion forums, in a science MOOC about Antarctica. Outputs of the basic text analysis were scrutinized, in order to identify key topics of interest in the introductory MOOC forum and trace them to in-course topic discussions. We found that the analysis was, at the very least, minimally adequate to quickly observe lexical patterns in students' writing, linking their pre-course interests and aspirations to some aspect of their in-course communications.

Keywords: text analytics, MOOC discussion forums, student-generated text

1 Introduction

As numbers of Massive Open Online Course (MOOC) offerings continue to grow, education researchers investigate this novel learning environment in order to understand factors that could improve its effectiveness. Because of the sheer scale of MOOCs, their student populations are much more diverse than in traditional online courses, making it challenging for instructors to understand learning expectations and motivations of their students and keep their finger on the learning pulse throughout the course.

These issues are being addressed by using learning analytics to identify and understand patterns in students' course behaviour, aiming to reinforce those that are associated with successful learning outcomes and counter those that lead to disengagement and dropping out. The types of data used in education research and interventions are generally either clickstream data providing a detailed account of students' interactions with different components of the course (Balakrishnan & Coetzee, 2013; Boyer & Veeramachaneni, 2015; Sharma, Jermann, & Dillenbourg, 2015) or participation and achievement data from formative and summative assessment activities (Beheshtiha, Hatala, Gašević, & Joksimović, 2016). Another relevant type of data is students' interactions with peers and instructors, usually, in discussion forums or through peer assessment (Jiang, Williams, Schenke, Warschauer, & O'Dowd, 2014; Reich, Tingley, Lede-Luis, Roberts, & Stewart, 2015; Wang, Wen, & Rose, 2016). Peer interactions are often examined using social-network analysis (Jimoyiannis & Angelaina, 2012; Piech et al., 2013) identifying the degree of social interactions and centrality of individual students in online learning communities (Joksimović et al., 2016; Poquet & Dawson, 2016). There are fewer examples of learning analytics tools that support the examination of qualitative data generated by students as part of the learning process, such as answers to open-ended questions or course discussion posts. And yet, this data might provide insights into cognitive and metacognitive processes that underpin student engagement, motivation and, ultimately, their learning (Crossley, Paquette, Dascalu, McNamara, & Baker, 2016; Kovanović et al., 2016, McNamara, Allen, Crossley, Dascalu, & Perret, 2017; Wen, Yang, & Rosé, 2014).

It is unreasonable to expect instructors to read and engage with individual posts from hundreds or even thousands of students participating in a MOOC, therefore, tools and approaches are needed to allow MOOC instructors to engage with this rich and complex text data in a meaningful, effective and efficient way. Natural language processing (NLP) has been a key approach to this challenging issue. NLP tools use computational analyses of linguistic properties of student-generated text for topic modelling, generating computational indices associated with topic comprehension, high-order thinking, engagement, emotional state and motivations. Together with student behaviour and achievement data, these indices may be used to improve the quality of learning in MOOCs (Crossley et al., 2016, Wang et al., 2016).

NLP-based learning analytic tools, however, are still relatively new and more research is needed to interpret indices they generate with confidence (McNamara et al., 2017). One approach to overcome this limitation, while taking advantage of the affordances of automated text analysis, is to reveal patterns of student language use to their MOOC instructors, leaving the final interpretation and categorisation of these patterns to them. In this paper, we explore the potential of a new text analysis tool for teachers, Quantext (McDonald & Moskal, 2017), featuring a simple and intuitive online user interface to serve as such a tool.

2 Present study

2.1 Quantext

The initial Quantext analysis is conducted in three simple steps by uploading a spreadsheet containing prompts and responses, selecting a prompt to analyse, and running the analysis. This displays basic descriptive statistics and charts for each question-based dataset, including number of responses, mean response length in words and sentences, most frequent words and multi-word units (bigrams or trigrams), and readability indices (Figure 1). By selecting a frequent word or multi-word unit, users can quickly access student original texts in the worksheet view.

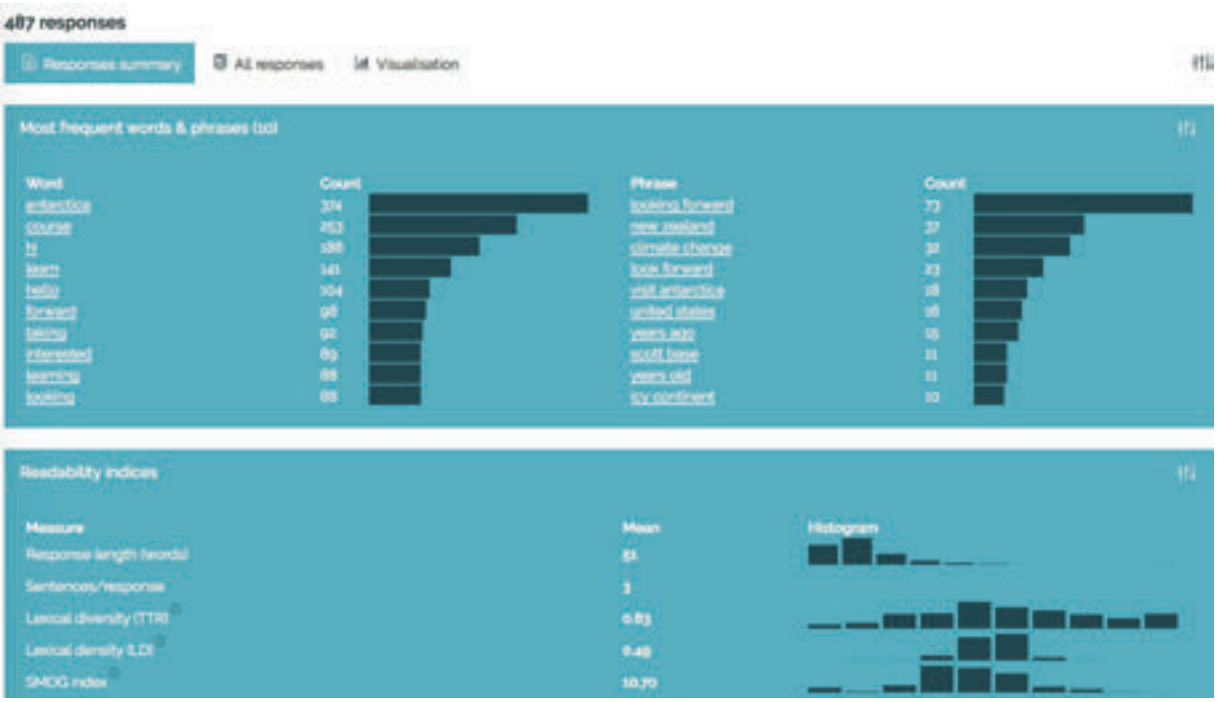

Figure 1: Quantext analysis: Responses summary

2.2 Proof of concept

We report on outcomes of a proof of concept study that evaluated whether the basic Quantext analysis is sufficient to quickly engage with student-generated textual outputs in a MOOC. Two sets of student-generated data are considered: (1) posts in a pre-course introductory forum, and (2) discussion forum posts generated in response to instructor questions linked to specific course topics. By examining students' text, framed by the Quantext analysis, we investigate whether a non-linguist would be able to identify meaningful patterns that can inform teaching.

2.3 The MOOC

We used an inaugural Victoria University of Wellington MOOC, *ICE101x Antarctica: From Geology to Human History,* hosted on the edX platform. The MOOC was launched in April 2017 as a 5-week course. First two weeks are focused on the human history of Antarctica including exploration and the science done in Antarctica. The topic of weeks three and four is Antarctic geology, including research into Antarctica's historical climate change. The final week is about modern Antarctica, in which students meet science and humanities researchers studying the icy continent.

Course content is delivered primarily via video lectures broken into 3-8 minutes segments some of which are followed by non-assessed knowledge-check questions. At several points in the course, students are invited to respond to questions related to the topic they are studying, using discussion forums. It is explained that the forums are an opportunity to discuss and explore course topics in more depth. The forums are moderated but instructors do not engage with students in the forums. Instead, they address some of the topics raised in the forums in their weekly blog posts. There were 2161 students who signed into the course, of which 2020 went beyond the entry page. The number of active MOOC participants changed from 1757 in the first week to 510 students in week five.

3 Analysis

3.1 A pre-course forum case

Our first question is what can be learned from the analysis of students' posts to the pre-course introductory forum. In this forum, students were invited to introduce themselves, share reasons for taking the course and elaborate on their connections with Antarctica. There were 487 posts in this forum from 437 students - about one fifth of those enrolled in the course (21.6%). The results of the basic Quantext analysis show a number of themes immediately identifiable by eyeballing the most frequently-used words and multi-word units. The main overall focus of the students' interest was Antarctica - the most frequently-used content word in this forum (n=374). Among the frequently-used bigrams we see: *Scott base; icy continent; South Pole; polar regions; Ross Sea; Antarctic peninsula* and *amazing continent.* These bigrams are aligned with the main topic of the course. *Visit Antarctica* was the fifth most frequent bigram, while *bucket list* also appeared among the 30 most frequent bigrams, pointing to a possible source of intrinsic motivation for enrolling in the course. Frequently-used trigrams were indicative of the students' attitudes to the topic and their intention to learn: *fascinated by/with Antarctica; interest/ed in Antarctica; connection with/to Antarctica; learn/ing about Antarctica; knowledge of Antarctica.* Another prominent point of interest for students enrolled in *ICE101x* was *climate change* - the third most frequently-used bigram. The analysis also suggests that students taking the course were interested in geology. The word, *geology,* was among the first 20 most frequently-used words (n=76), and the analysis identified other frequently-used language chunks *(earth science/s and interest in geology)* related to the topic. To confirm this deduction, we used the search option in the worksheet view to examine in what contexts the word, *geology,* was used (Figure 2). This examination showed that students were, indeed, interested in learning about the geology of Antarctica; moreover, many of them already had solid backgrounds in geology, including undergraduate and graduate qualifications, and some were geology teachers.

Response	Words	Sentences
Hello I'm [redacted] I'm from Missouri in the US and I teach high school science. I'm taking this class to further my education in geology and find new exciting content to share with my students.	39	3
Hello everyone, my name is [redacted] and I'm a textbook writer and editor. I live in Boynton Beach, Florida, and I'm taking the course because I'm interested in geology and seeing places I've never been.	39	2
Hi, I'm from Guatemala. I'm interested in geology since I can remember. I don't really have a direct connection with Antarctica but I really would like to be part of an study there. Good luck everyone!	39	4
Hello! My name is [redacted] I am a recent university graduate in geological engineering. I live just outside of Toronto and am taking this course because I have a passion for both geology and history!	36	3
Hi everybody! My name is [redacted] IÃ¡m Geologist and IÃ¡m from Colombia. I am keen to know more about AntarticaÃ¡s geology and evolution as well as all the implications it has with global change. See you!	36	4
Hi everyone I'm [redacted] I study Antarctica at university from a climate change perspective but its been a while since I did geology so I'm hoping for a refresher from this course!	34	1
Hi! My background is in human physiology, biochemistry and nutrition. Intrigued with geology, especially after touring and learning about the Grand Tetons and Yellowstone Park in Wyoming USA. Plate tectonics fascinate me.	31	3
I'm from South Brazil living in Rio de Janeiro. I just finished my PhD in analysis of Antarctic ice core samples, and I would like to learn about Antarctic geology.	31	2
Hi, I'm [redacted] living in London, UK. I've read so much about Antarctic exploration - real and fictional and am looking forward to finding out more, especially the geology.	30	2
Hi, I'm [redacted] from Wellington, New Zealand. I visited Antarctica on holiday in January and am looking forward to finding out more about its history and geology.	28	2

Figure 2: Quantext analysis: A worksheet view

Although *history* was not among the 30 most frequent words, we also searched for it in the worksheet view because historical thinking was another important aspect of the course. The search returned 50 hits, which showed that about 11% of the students acknowledged history of Antarctic exploration as a content area of interest. However, they did not show prior knowledge of this topic.

The basic Quantext analysis also revealed a theme of personal learning goals. *Course*, was the second most frequently-used word (n=253) and *learn* was the fourth (n=141), with *learning* (n=88), *know* (n=62) and *knowledge* (n=53) among the 30 most frequent words. The bigram and trigram analyses showed both general interest in learning (*forward to learning*; *like to learn*; *learn new things*; *keen to learn*; *hope to learn*; *like to know*; *broaden my knowledge*; *love to learn*) and a more specific interest in geology, earth and environmental sciences. High-frequency bigrams displayed students' enthusiasm about the course (*look/ing forward*; *learn new*; *new things*; *'d like*; *'d love*). Other frequent vocabulary was indicative of sharing personal details (*currently living*; *years ago*; *years old*; *high school*; *long time*). *New Zealand* was the second most frequently-used bigram and *United Sates* the sixth. The social function of the introductory forum was apparent in the frequent use of greetings; the words *Hi* and *Hello* were the third and fifth most frequently-used in the forum.

In summary, the first finding of this analysis is that students followed the suggested topics in their introductory posts. It is notable that climate change was shown to be a key area of students' interest in this course. Knowing this, we now move to the second part of the analysis – students' posts in topic related course discussion forums.

3.2 A discussion forums' case

We found that, in topic-related discussions, students actively engaged with the prompts and questions related to the topic of climate change, which they identified as a key point of interest in the introductory forum. Although the overall number of posts in the discussion forums reduced gradually throughout the course, and was paralleled by active student numbers in the course by week, an examination of the descriptive statistic for the number of words per post showed a different picture.

The longest posts were in response to q10 (M = 93), q12 (M = 118) and q13 (M = 89) in week 4. Interestingly, these questions are all related to climate change. *Climate change* was the most frequent bigram in students' responses to q12 and q13, and among the first 10 bigrams for q10. Other frequent bigrams across the three questions were: *global warming*, *ice sheet/s*, *global temperature*, *greenhouse gases*, *climate system*, *carbon dioxide*, *fossil fuel/s*, *sea level*, *CO2 emissions*, and *renewable energy;* all of which are closely related to the topic of climate change. The

fourth longest post average (M = 87 words) was recorded in week 2 for q6, also related to the broader topic of climate change. Here, the most commonly-used bigrams were: *ozone depletion*, *UV radiation*, *ozone hole*, *ozone layer;* while *ozone depletion impact* was among most frequent trigrams. An additional analysis showed that the words, *climate* and *ozone,* had high keyness values (1162.045 and 957.496, respectively) across posts in all course forums, compared to the frequency of these words in general academic texts (in the COCA corpus), further confirming their prominence in the students' discourse. Responses to q10 and q12 were also characterised by the highest mean lexical density (.61-.62), a feature of academic writing indicating higher complexity.

The shortest responses (in words per post) were to q14 - week 5 (M = 54), q2 - week 1 (M = 60), q11 - week 4 (M = 62) and q4 - week 2 (M = 63). These questions focused on creating opportunities for students to share personal experiences, e.g., their favourite art or books about Antarctica, their interest in visiting Antarctica, or personal opinions about preservation of animals and birds in Antarctica. Ideas expressed by students' in q2 and q14 were also less complex, as indicated by their lower mean lexical density.

4 Implications and future work

Based on the results of our proof of concept study, we believe there is merit in using Quantext as a way of interrogating students' responses to open-ended questions in MOOC discussion forums. This is because even the basic text analysis (as the one we conducted) may offer MOOC instructors insights into students' interests in and engagement with course topics, at different points in the course. Our results suggest that instructors would do well to analyse introductory students' posts for main topics and areas of interest, and to adjust course discussion prompts to reflect these interests. This approach might lead to deeper thinking and higher levels of engagement in MOOC discussions.

The present study reports only on the basic text analysis of student posts in a MOOC. In our future analyses, we plan to (1) compare patterns of language use in student posts and reference corpora of the MOOC learning materials, (2) use automatically generated similarity indices to compare student responses to prompts with model answers, (3) explore the effect of question type on the nature of student responses, and (4) investigate links between students' contributions to MOOC discussions and their course assessment data.

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Appendix 4

Text Analysis of Student Surveys

Learner Analytics Choose Your Own Adventure By Ryan Day

This report for Extended Education (EE) at the University of Manitoba will provide a brief overview of student evaluation surveys and how they are currently being implemented in our online programs. The report will explore how the current surveys could be supplemented with learning analytics for a more robust evaluation of teaching and programming.

Introduction

A student survey delivered near the end or after the completion of a post-secondary course is standard practice in higher education. The ubiquity of the student survey has been driven by pressure for schools to be accountable, ensure quality, and encourage reflective practice among teaching staff (Moore & Kuol, 2005). This coincides with institutions increasingly viewing their learners as consumers (Lindahl & Unger, 2010) and consequently there is an expectation of quality assurance and customer experience. There is a lot of literature on this subject due to academics direct interest in this topic. Student feedback can be a source of anxiety for academics that find survey comments off-topic, non-constructive, or even cruel (Tucker, 2014). Student evaluations are a source of controversy that produce a number of opinion pieces and news stories (Peters, 2019) due to the impact they can have.

Technological advancements in the delivery of education have allowed institutions to easily collect information from learners not previously possible. This data could provide a more complete and balanced view of a learners experience than a student survey alone. Furthermore, new techniques and tools can provide advanced analysis of the traditional surveys.

Student Surveys in Higher Education

There are often political and philosophical debates that occur alongside any discussion on how student surveys should be interpreted. These surveys typically include questions about the instructor's performance and can include more comprehensive questions about the course, program, and institution. It is critical to remember that student ratings capture student perceptions but are not formal faculty evaluations and they do not measure student learning (Linse, 2017). Student evaluations are a valuable information source that provide context and understanding but they are not perfect or complete.

There is little consensus on the reliability and validity of student surveys. The survey response can vary widely but is typically low and this affects generalizability (Alhija, 2009). There are concerns regarding survey scores correlating with external variables including student course load, leniency in grading, student interest in subject, personality, physical attractiveness of the instructor (Lindahl & Unger, 2010), and even the time of day a course is offered (Peters, 2019). There also a concern that the biases that exist in society including sexism, homophobia, or racism can influence survey results. Researchers like Linse (2017) acknowledge the presence of these biases but asserts that the performance of faculty who consistently received poor ratings rarely could be fully attributed to this bias.

Although Tucker (2014) notes that the majority of students comments are not abusive and unprofessional these types of comments do occur. This is troubling when considering academics tend to focus more on negative comments and less on positive ones and this can potentially skew their consideration of the data (Moore & Kuol, 2005). Comments from students can also be general or viewed as off topic and unhelpful. Lindahl & Unger (2010) observed how dissatisfied students often cite not getting their money's worth for the cost of their tuition. This type of feedback might be easily dismissed as outside the control of the instructor and obfuscate useful information that could improve teaching of a course.

Despite the limitations of end of course surveys, the data they generate is being used to inform and defend important decisions. Student evaluations were initially intended to provide feedback to improve instruction but are now increasingly employed in determining promotion, tenure, performance funding, and awards (Lindahl & Unger, 2010) (Tucker, 2014). Jones, Gaffney-Rhys and Jones (2012) note that this data, if improperly used, can result in harming an academics reputation or even lead to their dismissal. This can be particularly troubling to academics that question the validity of student survey results.

Student rating data is an important tool for creating a well-functioning and quality learning environment within an institution, but only if it is being used appropriately. Linse (2017) notes that the misuse of this data leads to mistrust, inconsistencies, and inequities that demoralizes faculty. It is important that student surveys are used transparently and their results are interpreted fairly.

Student Surveys in Extended Education

Student end of course surveys in online EE courses are different from the more rigid and standardized surveys in the degree-credit faculties of the University. This allows for greater flexibility and the opportunity to adapt evaluation to meet our needs.

Currently EE provides an anonymous survey link to students during the final weeks of our online courses. There is a standard set of questions that are adapted by the assessment lead to include program-specific questions required for program evaluation plans. Questions in the survey are grouped into sections typically including course design, instructor, course administration, and student experience. The majority of questions are Likert-scale questions that produce quantitative data. Qualitative data is occasionally collected with open-ended general comment sections with text response boxes.

The results of the surveys provide important information to staff in EE. The delivery team reviews the feedback and discusses feedback with their instructors. Design and Production (D&P) review the feedback on an on-going basis to make minor adjustments to courses being delivered. D&P will review several years of feedback before completing a scheduled major redevelopment of a course.

A challenge with the surveys in general is the low-response rate. General comment questions are often skipped or are not answered in detail. Staff view surveys as a helpful tool but an incomplete picture.

Learning Analytics to Enhance

The emerging field of Learning Analytics is an opportunity to move beyond student surveys and gain a more holistic view of how our courses are functioning. Alderman, Towers, and Bannah (2012) recommend survey data is supplemented with information from other sources to achieve robust links to the the overall quality management regime of institutions.

There are a number of areas where the data captured by our LMS intersects with the survey topics we typically ask our students about including engagement, workload, and collaboration with peers. Data that could provide context to these evaluation topics include log-in information, progression through the course content, discussion logs, and assignment grades. For example an important pillar of our Program Development for Adult Learners (PDAL) certificate is collaboration between learners from different backgrounds. We ask students in the survey about this but can also explore the discussion forum logs. Learner analytics could visualize this data with an interactive web of connections.

Learning analytics like the traditional end of course student survey provide us with powerful insights but there are limitations to the conclusions we can draw from them. The human interpretation and analysis of findings is currently still important.

Text Analysis

The large number of students we serve each semester and the amount of information we are seeking has required us to limit the number of open-ended qualitative questions in our surveys.

Qualitative data collected via text-entry questions in our surveys can be valuable in creating a well-rounded view of a course offering. Santhanam, Lynch, & Jones (2018) Note that written comments in teaching and unit evaluations are an overlooked source of rich data. They can generate unique insights because students are free to explore what they perceive to be important in open-ended questions (Stupans, McGuren, & Babey (2016).

The implementation of an automated process can improve the efficiency of interpreting student comments and reduce the amount of human intervention required (Santhanam et al. 2018). Text-mining establishes relationships between texts to identify patterns, frequency, and connections between words (Tucker, 2014). Computer analysis of text data makes free-form text more accessible by extracting common themes and identifying issues that may be missed in a human-only analysis of results (Stupens et al., 2018). There are a number of tools available or in development that could perform this function. Santhanam et al. (2018) identify and review a number of text-mining tools including Word-Stat, Leximancer, SPSS Text Analytics, and QSR Nvivo. The features of these tools vary and the costs can range from free to several thousands of dollars for a license.

Quantext

I experimented with the text analysis tool Quantext to get a better understanding of how this technology might be applicable to evaluation. I used a data set from an edx-based UBC MOOC on climate change. I took the climate_exit_survey.xlsx file and formatted it for input into Quantext. I chose the two open-ended text entry questions from this file to analyse:

1. What did you like most about this course?
2. What did you like least about this course?

I created a new Excel file according to the Quantext documentation with an index sheet listing the questions and a separate sheet for the results of each question. It was incredibly easy to get the survey data into Quantext and this could be done for University of Manitoba survey data exported from our survey tool.

The tool was able to give me broad strokes impressions of the data that occasionally required further drilling down. When I clicked on a word for example that was popular it would show me the context it was used in. From the results I could see that students liked the videos and the instructor. One of the least liked aspect of the course was the assignments.

Strengths

- Inputting data was easy and could be implemented into our existing procedures. We currently use a professional survey monkey account that can output data into a .csv file that can be converted into Quantext-formatted .xlsx file.
- The tool has an intuitive layout that is relatively easy to navigate.
- There are advanced settings that allow for experimentation and fine-tuning of the analysis.

Weaknesses

- Staff would be required to format the data for entry into Quantext. This would have to be assigned to someone in EE to perform at the end of each semester.
- The output reports Quantext automatically generate are basic which is good for readability but may lead to additional questions from staff. Staff may request access to the tool and this could be difficult to manage.
- The analysis still requires human oversight. In the sample data I analysed I found some of the phrases highlighted were not relevant or unimportant.

Opportunities

- Implementing a tool like quantext would increase our ability to capture important qualitative data.
- Text-analysis could be helpful in other context. For example Quantext could analyse text from discussion forums, portfolios, or assignments. Assessment plans for programs could better explore abstract topics that require qualitative data.
- The literature reviewed for this report highlighted a problem of abusive or unprofessional language in text-entry survey responses. This has not been a major issue identified by EE but is still an important consideration. The blacklisted words feature in Quantext could filter our abusive language before instructors see the results.

Threats

- There is a risk of collecting less data than we currently do. Open-answered question are not always answered.
- Quantext is cloud-based and there may be an issue with data security and privacy. This would need to be further reviewed to ensure that the use of these types of tools fall within University policies and best practices.
- With any new assessment initiative staff worry about being assessed fairly and that there will be an increase in their workload.

Final Recommendations

Analyse our Current Surveys

The Assessment Lead should seek permission to analyse EE data from existing surveys using Quantext.

Faculty Buy-in /Training

Any changes to how EE currently collects and analyses end survey data will require staff buy-in. This will involve engaging stakeholders and listening to the concerns they might have. The ideal forum for this would be presenting the findings of this report to EE council and soliciting feedback for steps forward. This presentation should highlight how changes to end of course surveys could lead to improvements across EE. The current surveys are trying to collect feedback for many different aspects of the course and explaining how the course will be evaluated from a holistic perspective may help with anxiety of staff.

Ethics, Privacy, and University Policies

Ethical considerations should be documented and eventually presented to EE council. Any changes to the assessment of our programs should align with university policies.

Explore additional tools

Learner analytics could be used to supplement EE program evaluation. A review of the data we currently collect has been completed in a previous report. The Assessment lead should begin to explore connections to Program Assessment plans and quality assurance practices that are being developed. There are different tools available that can perform
text-analysis. A detailed review and comparison of tools should be conducted. This review should look at features, cost, conditions of the user-license agreement, privacy of EE data, and ease of integration.

Pilot Text-Analysis of Portfolios and Reflections

We have found that our surveys have a low-response rate. Text-analysis however opens up new sources of data that can aid in program evaluation. Due to the applied nature of continuing education many of our courses feature applied projects with portfolios and reflections. Useful insights about how a course is functioning could be pulled from this data.

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Appendix 5

CYOA Assignment 2: Analyzing Learning Writing

Trevor Smitna
ETEC565A Learning Analytics

Rationale for Exploring Quantext

As a teacher of Grade 6/7 students, I chose to focus this "Choose Your Own Analytics Adventure" assignment towards an analytics tool that may be of practical use in my own classroom setting. By the middle grades, students are writing a steadily increasing amount of content for assignments, essays, reports, and have moved away from straight spelling and grammar work for the most part. This can leave teachers in a position to read and evaluate large amounts of writing over multiple subjects in very short time periods as content learning proceeds at a fairly rapid pace. An important step in this process is to identify early the content areas that students struggled with before moving past it. Individual students or whole classes may need additional support with a specific assignment as well as areas within the writing curriculum that may need to be targeted. Additionally, early in the school year it is also important to identify students who will need more in depth support and development with their writing. Also important is the need to identify how students are thinking about and responding to teacher questions, text or assignments. To further these needs, I chose to examine Quantext and its potential to answer these two questions;

1. Is Quantext an accurate and meaningful tool to analyze learner writing at the Middle School level?
2. Can Quantext be used to guide teaching practice to target areas of lagging writing skill?

Quantext is a text analysis tool developed by Jenny McDonald, a guest lecturer at the University of Auckland New Zealand and educational technologist and Adon Moskal, an information technology lecturer at Otago Polytechnic. The Quantext system, currently in beta form is currently being developed for and piloted by post-secondary educators in New Zealand as a Learning Analytics (LA) tool to examine the way students respond to teacher questions with the identified purpose of helping the teacher better fine tune the questions. Quantext is also marketed as a tool to screen for plagiarism and to evaluate student writing (Quantext, n.d.).

In the version of Quantext that I had access to for this assignment there is the simple dashboard layout showing number of responses, mean number of words per response, and mean number of sentences in each response. Additionally, in the advanced mode, with the features available of the date of this assignment, there are a variety of measures to evaluate writing grade level and readability. The available tools on the advanced dashboard currently are (see Figure 1a and 1b for a view of the simple dashboard in blue panels, and the advanced dashboard in orange);

- Lexical Diversity: the range of different words used in a text, with a greater range indicating a higher diversity (McCarthy, Jarvis, 2010., p. 381).
- MLTD: another measure of lexical diversity (McCarthy, Jarvis, 2010.)
- HDD: another measure of lexical diversity (McCarthy, Jarvis, 2010.)
- Lexical Density: A measure of how informative a text passage is
- SMOG: or Simple Measure of Gobbledygook designed and used mainly in medical writing (The Flesch Reading Ease and Flesch-Kincaid Grade Level, 2019.)
- Gunning Fog: Aimed at business writing, designed to support targeted persuasive writing (The Flesch Reading Ease and Flesch-Kincaid Grade Level, 2019.)

- Flesch Reading Ease: Originates from education research. Measures the readability of a passage, with the higher score being the most easily readable (The Flesch Reading Ease and Flesch-Kincaid Grade Level, 2019.)
- Flesch-Kincaid: This is a conversion of the Flesch Reading Ease to US grade level, with Grade 8, or a score between 70 and 80 being readable to 80% of Americans (The Flesch Reading Ease and Flesch-Kincaid Grade Level, 2019.)

The advanced tools available through the Quantext platform allow the analytics tool to be used by multiple disciplines, and certainly fits the target pilot group of university level teachers and writers as described on the Quantext webpage. As an elementary school teacher of middle grade level students, I decided to narrow down and examine the measures that are most refined for my Grade 6/7 students, the Flesch Reading Ease scale and its associated Flesch-Kincaid grade level scale.

Description

To evaluate the ability of the Quantext platform to answer my research questions, I predicted that I would need a sample of student writing at the Grade 6/7 level where all the writing responded to the same questions and would contain a range of writing abilities. Though I was able to find numerous samples of writing at this level available online, it was not possible to find a complete response set to a single question or set of questions. Another concern that became apparent while searching for writing samples was my lack of knowledge of the context of the writing and the writing ability in general of the samples found online. I will discuss this more in my concluding remarks.

I decided to look for available samples from my own class. Using a sample much more familiar meant I would have a range of ability, all students would be answering the same set of questions, and I was intimately familiar with the writing instruction (teaching) over this and the previous school year that preceded this quiz. I had context.

My Grade 6/7 students recently completed a short quiz where they show their understanding of four characteristics of early civilizations that emerged during the transition from hunter gatherer to agricultural lifestyles (See Figure 2). Students completed this quiz and shared the document with me online for marking, so I had the writing samples available.

I input the 4 questions and a sample response and then proceeded to copy the student responses for each question into an Excel file in the format specified by the Quantext website. In all, I had 22 student documents available with a total of 88 responses in all. The breakdown of students in my class, 16 Grade 7 students and 9 Grade 6 students. I have 6 students who have ADHD (5 in Grade 7, 1 in Grade 6), 2 new English learners, and 2 different learning disabilities in the class. Material was presented and learned through written text, oral discussion, video, online, and through a multi-player group civilization game with the view to accessing multiple types of learning strengths. Three students did not write the quiz. Of the 22 students who did write, most completed the entire quiz in a single afternoon session on a Thursday, approximately one hour. A handful of students, including 4 of the students with ADHD also needed an extra period the next morning (Friday) to complete the questions, approximately 40 minutes. It is important to note that a common pattern in elementary school, particularly with a class makeup I described, Thursday afternoons and Friday's are challenging days to do any academics and typically I would not schedule any quiz, test, or important project work or lessons during those times. Constraints in the schedule and an imminent Spring Break holiday meant students needed to complete the quiz before the break. This timing may have had an impact on the quality of the quiz responses, particularly with the last questions, and among the identified students with ADHD. Indeed, when looking at those student's responses in particular, a clear and notable decrease in writing quality is noticeable between question 1 and question 4 (See Figure 4). These assertions are entirely anecdotal and I was not able to narrow down cognitive fatigue studies to the Grade 6/7 level. However, a conversation with any number of teachers will result in similar observations.

No identifying student information is included in the uploaded samples and the use of Quantext as a tool to evaluate their writing and relationship with the quiz questions falls within my role as their teacher.

Analysis

Interpreting the results of the Quantext analysis turned out to be different than I had anticipated. Initially, I thought I would be able to identify and target students with specific writing issues or in need of more support. The way results are presented and the data entered means that level of granularity is not possible, at least at this point. What the data did show though, when looking specifically at the two measures I chose, Flesch Reading Ease and the Flesch-Kincaid grade level is that overall, my students are writing approximately where they are supposed to be. When breaking down the 4 questions, students show the highest level of writing on question 1, with a grade level average of 8.85 and a reading ease of 64.47 (See Table 1). The first quality that stands out is the difference between the grade level of question 1 compared to the more similar grade level of questions 2 to 4. Being familiar with the teaching that lead up to this unit, including covering the evolution of other early hominid species and the heavy influence of climate and geography on those various evolutionary branches of the human family tree, I conclude the geographic conditions as an influence was much more familiar to the students in general than legal systems, cultural practices, and emergent writing systems. Those three were all covered for the first time in this unit. Taking the results here at face value, my students are writing at approximately grade level for 3 of the responses, and at least a grade level above for one of the questions. A consideration is the above mentioned challenge associated with the day of the week a quiz is scheduled may also be noted.

Table 1: Flesch Reading Ease score and Flesch-Kincaid grade levels per question

Question #	Flesch Reading Ease Score	Flesch-Kincaid Grade Level
1. Geographic conditions shaped the emergence of civilizations. How did geography and changes in climate help shape the change from hunter and gatherer to early farming societies? Use your notes, handouts, and your understanding from the videos to explain.	64.47	8.85
2. Increasingly complex societies required new systems of laws and government. Use your understanding of the videos, and your handouts. What types of governments and organization systems were most common among early societies? How were these organized? Who had the most and least power	59.74	6.53
3. Religious and cultural practices emerged during this time period that are still familiar today (though in very different forms). Describe one of these, why it is significant and what evidence is there for it? In ancient societies, what sorts of deities tended to be the most commonly worshipped?	69.57	6.82
4. As societies became more complex, and networks of trade emerged, systems were required to keep track and organize the goods being traded and who owned what. WHY did early writing systems develop and WHAT evidence is there for the earliest systems?	62.37	6.31

I also looked at the construction of the questions, and although questions 2 to 4 have multiple parts contained within, and the first question is a single question statement, my students are familiar with this technique. My questions are designed to access recall from different sources, and students do not need to answer each one, only demonstrate understanding in the question overall with enough unique information to cover the 3 points per question in this particular case. For example in question 2, "what types of governments and organization systems were most common among early societies" came from a printed handout that students highlighted key information on. "How were these organized", and "Who had the most and least power?" came from a video that outlined the pyramid of power, or typical hierarchy present in early societies.

I am interested if continued use of the Quantext platform could help me fine tune my questions and question formatting to elicit the most information dense and higher grade level responses. However, doing this may also shift my teaching to a style more similar to 'teaching to the test'. It also begs the question about the level of accuracy of the results. A study of the lexile and Flesch systems concluded that, "these results suggest that the two widely used tools, especially Lexile, may lack adequate validity for their current high-stakes uses in schools (Cunningham, Hiebert, & Mesmer, 2018. p. 829)." This same paper by Cunningham, Hiebert and Mesmer also discussed the more than 50 year old norms for the measures and that the measures are most accurate at the Grade 1-3 level and decrease in accuracy the older the age of the students being measured (2018, p. 830).

When thinking to the future, I predict if I arrange a similar quiz, covering a somewhat more recent ancient civilization, students exposed to similar questions would respond with higher grade level responses on average because they will have the same additional exposure to content by that point as they currently do with question 1; standard scaffolding.

Another feature of the advanced tools, one that I think I can make use of immediately and more often to identify areas for teaching is the deeper word analysis and visualization tool. Looking at the frequent words, bigrams, and trigrams it is clear that the terminology and lexicon students were exposed to and used during the short unit is reflected in the student responses. This helps me see the proportion of students who are using the language and terminology, though not with fidelity as again, individual student responses are amalgamated into the whole without identifying information. Specifically, this school year, the students have been practicing writing detailed, specific academic language that avoids generalizations. The use of some words are "banned", such as; *they, it, always, and everyone.* This is a deeper level of academic writing than students in Grade 6/7 are sometimes exposed to and is fairly new to them this year at my current school (Figure 1a and 1b).
Using the analytics in the Quantext system, I can tell there is still teaching and learning needed around this. Quantext breaks down the most frequent noun phrases and shows 32 *theys* occurred among the responses to question 1 (See Figure 3). Using the visualization tool, this is shown, along with two responses with *they* highlighted. The visual on the response itself and the general use of *they* on the right side visual shows generalizations still occurring much more frequently that I am comfortable with as their teacher. This data is certainly useful to me and will help guide upcoming writing practice and criteria for assignments.

Conclusion

Reflecting on the initial research questions I asked;

1. Is Quantext an accurate and meaningful tool to analyze learner writing at the Middle School level?
2. Can Quantext be used to guide teaching practice to target areas of lagging writing skill?

I recognize that Quantext is still in development and some of its tools and statistical analyses of readability are intended for a higher level of reading and writing ability than Grade 6/7, typically 11 to 13 year olds. In terms of the first question, I can see Quantext being a meaningful tool to examine whole class writing averages. My initial thoughts were that I could use the platform to identify individual students and specific writing needs; however, as Quantext is currently designed, this is not a possible use. I think there is still value in using Quantext with regards to the second question, even though the data that it provides is only a general level of writing for an entire class or group of writing samples. As a teacher, I can use this to assess the level of my class, but would find it difficult to parse out specific areas to target, particularly for my students with learning disabilities and ADHD. Without being able to identify who they are in the data, more general planning is all I can take away from the analysis. Whether this would be useful or not, I cannot say at this time. The added complexity is that in general, I have a strongly academic class, whose writing ability for the most part is already at or above grade level. The students who need the specific, targeted support and writing interventions need different strategies to be taught, something the Quantext data does not help with.

I would use Quantext in the future, but foresee the need for a more easily entered set of writing samples. Currently, the time it takes to format and enter all the data from the sample 4 question quiz I used is not something that is realistic more than once or twice a school year, and would still have to be done outside of working hours. Elementary age students write at a wide range of ability and and the context of their learning is varied, much more so than university level medical students or business students, where Quantext appears to be currently situated. To be useful at the Grade 6/7 level, the platform would need to be able to identify more than just average writing levels of the group because I already know that information. Helpful additions would be the most common grammar errors, or writing tone mismatches. At the elementary level, student writing is still developing, a much different circumstance than where Quantext is being piloted, where post-secondary student writing is already developed but being finely tuned for a particular discipline.

Figure 1a:

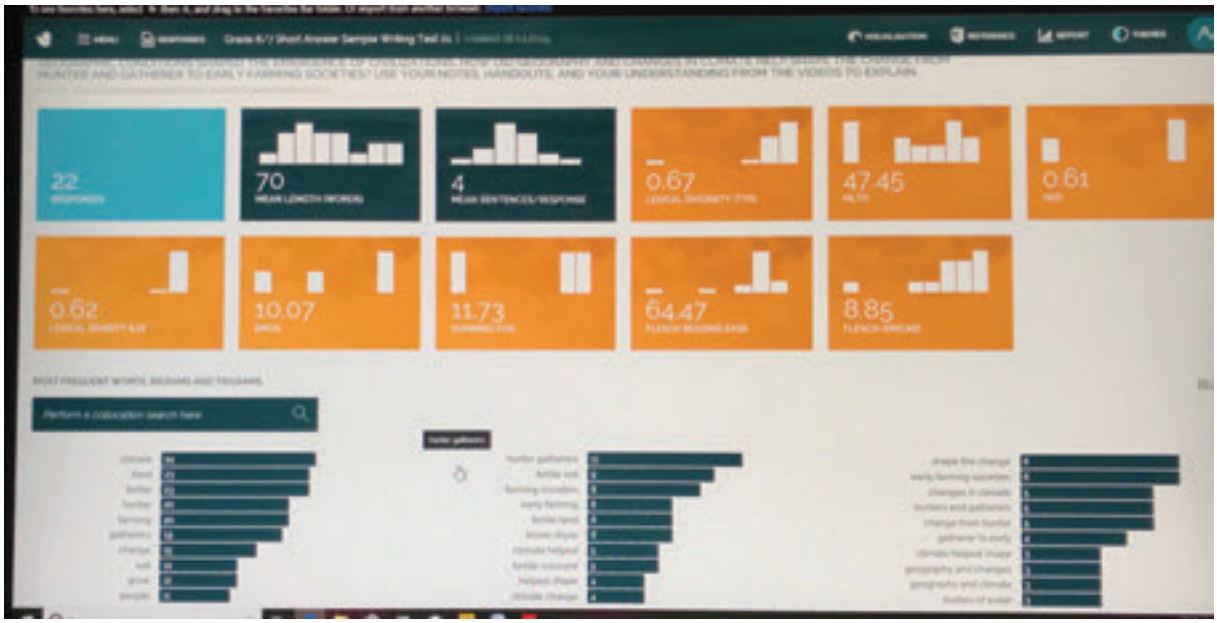

Figure 1b:

Figure 2

The Rise of Early Civilizations Showing Your Understanding

Name: _____

For this written work, you will show that you understand some of the bid ideas or competencies in Social Studies.
Read them carefully and then use evidence and reasoning from your handouts and notes to show you understand the significance. Be sure to keep track of how much information you need for each question. Answer in the boxes USING A DIFFERENT FONT AND FONT SIZE 14.

1.	Geographic conditions shaped the emergence of civilizations. How did geography and changes in climate help shape the change from hunter and gatherer to early farming societies? Use your notes, handouts, and your understanding from the videos to explain.	/3
2.	Increasingly complex societies required new systems of laws and government. Use your understanding of the videos, and your handouts. What types of governments and organization systems were most common among early societies? How were these organized? Who had the most and least power?	/3
3.	Religious and cultural practices emerged during this time period that are still familiar today (though in very different forms). Describe one of these, why it is significant and what evidence is there for it? In ancient societies, what sorts of deities tended to be the most commonly worshipped?	/3
4.	As societies became more complex, and networks of trade emerged, systems were required to keep track and organize the goods being traded and who owned what. WHY did early writing systems develop and WHAT evidence is there for the earliest systems?	/3

Figure 3:

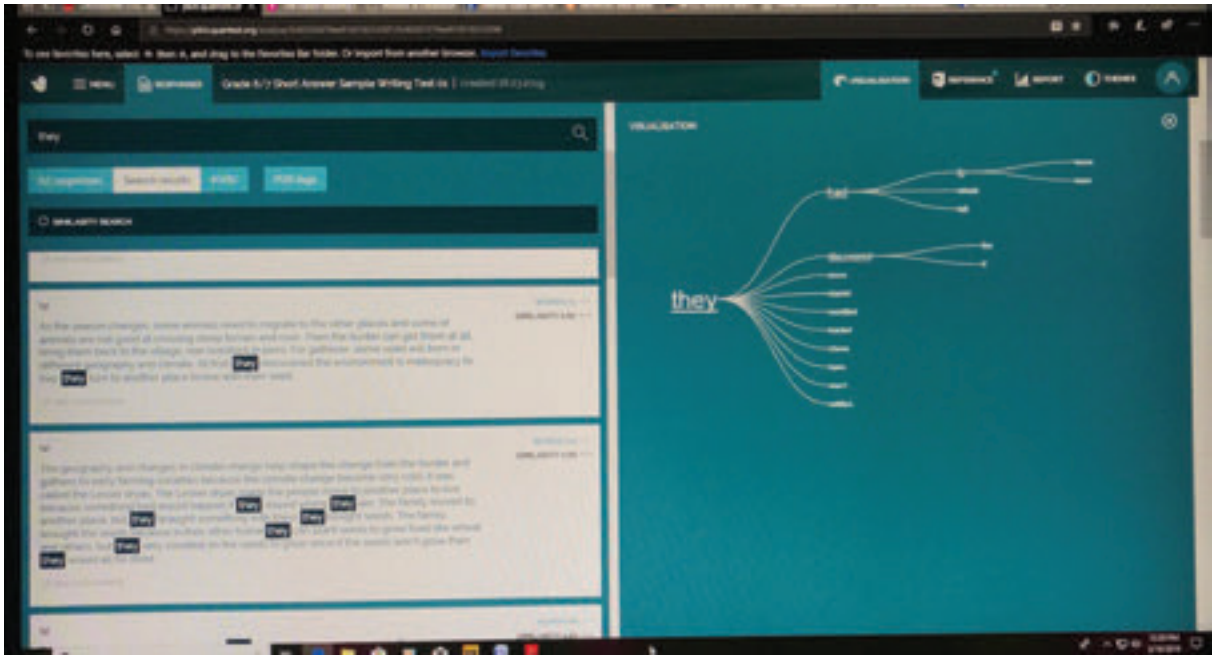

Figure 4:

Grade 7 response to question 2. Student is an English language learner, but on the higher end of writing ability.

> *"In every society, they always have a way to organize the social group. People begin to create economic, political, and religious institution, creating new hierarchies. Everyone all plays many special roles, but cities required diplomats, armies, and centralized rulers. A simple "pyramid of hierarchies" may be (in order from most to least power): 1. dictator, priest, king, or ruler 2. craftsman or trader 3. farmers and fishers 4. slaves. Most of the time king has the most powers and dictates or rules the city. Kings also as the role to solve arguments. The farmers' and fishers' goods were all sent to the king and sent back to every citizen."*

Grade 7 response to question 2. Student is diagnosed with ADHD and often struggles with written ideas and recall of concepts.

"Taxes on everything was a common law. Fhhfhdry. jtftfft"

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Appendix 6

Using Quantext for curriculum analysis

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I thank Alison Myers and Hootan Rashtian for assistance in developing necessary Python scripts for data extraction.

Context

As Associate Director of our Master of Educational Technology program (MET, met.ubc.ca) at The University of British Columbia in Canada, I have been charged with ongoing review and 'reimagining' of our curriculum. MET is the longest-running fully online graduate program at UBC, and at launch almost 20 years ago was an early leader in the field of online education. The MET program has since attracted more than 1800 adult professional learners from a range of professional backgrounds, including publishing, instructional design, business, higher education, K-12 education, healthcare, and the military; they live across Canada and around the world.

In 2015, a rigorous external review concluded that our program had "high enrolment, satisfactory completion rates, and overall good course evaluations," but recommended a review and updating of the MET curriculum including mapping "current course offerings to program goals and objectives… eliminating courses or content (in particular assignments and readings) that overlap." In response, we have embarked on an ongoing project of program review and renewal.

The challenge: Curriculum review of an online degree program

My challenge, then, is to map and review the curriculum of our online program, comprising seventeen online courses hosted in either our institutional learning management system (LMS; currently Canvas) or in an institutional instance of WordPress, or a combination of both. An additional interest is in development of a standardized approach to curriculum mapping for online programs that we might then share more widely across our faculty or institution.

Traditional curriculum analysis is manual, slow and subjective

Processes of curriculum review, analysis and mapping have become routine in curriculum renewal processes in higher education, and are usually undertaken to allow evaluation, analysis and/or improvement of the scope or quality of a unit's educational offerings (Richards & Ashbourne, n.d.). Curriculum mapping, in particular, calls for an examination of a program as a whole, and examination of individual courses to understand how/if each contributes to student learning outcomes. Does the curriculum continue to effectively represent the current state of the field? Do curricular gaps exist? Are there redundancies, with the same outcomes being taught in multiple courses? What is out of date, what is missing? Where might innovation be needed?

To support such undertakings, a variety of frameworks and guidelines for conducting curriculum analysis or curriculum mapping can now be found on university learning centre websites and in the educational literature (see, for example, Dyjur & Kenny, 2015; McNay, 2009; Richards & Ashbourne, n.d.; University of Saskatchewan, n.d.; Wolf, 2007). As Gottipatti & Shankararaman noted in 2014, however, "curriculum analysis has been mostly a manual process which is tedious and painstaking work". Perhaps more problematically, most established curriculum mapping and review processes rely solely on course *syllabi* for documentation of course content and learning outcomes, even though syllabus quality, accuracy and currency may be variable or limited.

Can text analysis support curriculum analysis?

Our courses are offered in fully online format and make heavy use of text to introduce concepts and structure learning activities. I therefore wondered whether it might be possible to use text analysis to support curriculum analysis, allowing exploration of actual course content rather than potentially inaccurate syllabi, and facilitating identification of dominant themes in each course, and features of course design or structure that may have educational implications. A bonus would be that application of such analytic methods might mitigate the risks of inadvertent 'reviewer subjectivity' observed in manual and qualitative approaches to curriculum analysis (Kawintiranon et al., 2016).

Quantext: A potential user-friendly tool for analysis of course content

Text analysis for curriculum review already has some support. Some published studies have demonstrated application of methods such as topic modelling and cluster analysis to course materials (Fiallos & Ochoa, 2019; Gottipatti & Shankararaman, 2014; Kawintiranon et al., 2016; West, 2017; Wu et al., 2018). On the other hand, all of these studies originated with scholars in computer science and data science programs – individuals whose area of expertise permits means they are confident in designing, implementing and interpreting output from highly technical analytic methods. After a decade of work introducing educators and academics to learning analytics, my experience is that unless the methods used are easy to apply, and the results generated easy to interpret, they will not be embraced.

I have therefore experimented with Quantext, as a potential user-friendly and accessible text analysis tool that could be used to explore course content, and that could be adopted and applied relatively easily by educators and educational leaders who are not data science specialists. Although Quantext was not designed for 'curriculum analysis', when I learned of its analytic potential I was curious to discover whether it might be usefully co-opted for my purposes.

Method

Data extraction

To undertake this analysis, I extracted a complete corpus of course content (text) from each course in our program. Note that this analysis is exclusive of the text-based content of courses themselves, as generated by the course author(s) – it does not include any written work contributed by students, or any additional text-based course resources (textbooks, linked websites, journal articles, etc.). And it naturally also does not account for ideas and activities presented using audio, images, video and new media. While this certainly means that it does not account for the full body of work that each student encounters as they work through one of our courses, I feel that it accurately spans the range of ideas and themes designed into each course by its author, and goes far beyond a simple syllabus.

For courses fully or partly hosted in the Canvas LMS, I generated a zipped 'course content export package' from a current copy of each course, and then employed a custom Python script to extract the text content from each course content package, which was saved to a csv. Similarly, for courses hosted partly or entirely in WordPress, I made use of a second custom Python script to scrape text from each WordPress course site, remove html code, and save to csv. For courses making use of both platforms, I then manually combined content extracted from each platform.

Data cleaning and formatting

As with most data analysis projects, 'preparation of the data' was the biggest challenge. The text extract from each online course presented one page of course content per row, with a number of additional identifying elements (page title, course page and module identifiers, page 'type', etc.). 'Pages' of content that contained only navigational headers or simple navigation instructions (e.g. "submit your essay here") and duplicate pages were removed. All course datasets were cleaned

by spell-checking and standardization of spelling, correction of any incorrectly transcribed international characters (é, ü, ø, etc.) and removal of any stray html code. Finally, a complete 'whole curriculum' dataset was compiled and formatted as per instructions given in the *Quantext Data File Format Guide* (Release v1.01 2018) resulting in a single 1.3MB Excel workbook which ultimately comprised a first qIndex sheet (listing course code in column 1 and full course title in column 2) and 17 subsequent tabbed sheets each labelled with the relevant course code.

Data loading

First attempts at loading my dataset into Quantext failed, and in consultation we discovered that although apparently 'within acceptable file size limits', the structure and scale of my complete data set was too much for Quantext to handle. The solution was to split the dataset in two, and run two separate uploads and analyses.

Analysis

My analytic process was guided by the *Quantext Quick Reference Guide* (Release V2.0 Beta 2018). For the corpus of page contents from each course (the 'Responses' from each 'Question', in Quantext-speak), I manually copied and compiled descriptive metrics (number of pages, average words per page, and average number of sentences per page) and the various readability indices computed by Quantext (lexical density, LD, TTR, SMOG, Gunning Fog, Flesch reading ease, Flesh-Kincaid, and MTLD).

Through a process of trial and I error I selected a standardized set of analytic parameters for analysis of the text from each course which I concluded would most meaningfully allow me to visualize, explore and compare dominant themes in course content. I elected to show 20 keywords and ngrams for each, to use the Students t-distribution (STUDT) statistical measure for calculation of the most common ngrams, to use a window of 4 words to identify bigrams and trigrams, and to exclude the standard blacklist of common words, filter punctuation, normalize contractions, filter numbers and lemmatize words. A significant additional analytic step for each set of course text was development and exclusion of a custom blacklist to remove words or ngrams that arose frequently but offered no insights into course themes (for example, textbook publisher names and locations, and generic course-related words such as 'course', 'module', 'page', 'quiz', etc.).

For each course I identified the top 20 set of course-specific keywords, and then drilled down to discover the top 20 bigrams and trigrams containing the most common keyword. I exported a PDF report for each analysis. Finally, I copy/pasted keyword and ngram counts from each histogram into an Excel spreadsheet, for later use.

I used Tableau desktop to analyze, visualize and compare descriptive metrics and readability indices for this group of courses. I used the web-based WordArt[1] application to develop word clouds for selected sets of keywords and ngrams.

[1] https://wordart.com

Results and discussion

Course-specific analysis

Active exploration of top keywords and ngrams (I found bigrams most consistently useful) in the text content of each course offered rich insights. Figure 1, for example, shows the top 20 keywords and bigrams for the content of the course *ETEC 500: Research methodology in education*, which was redesigned in 2018 with the goal of increasing the focus on critical thinking about educational research.

Figure 1. Top 20 keywords and ngrams in content of course ETEC 500: Research methodology in education

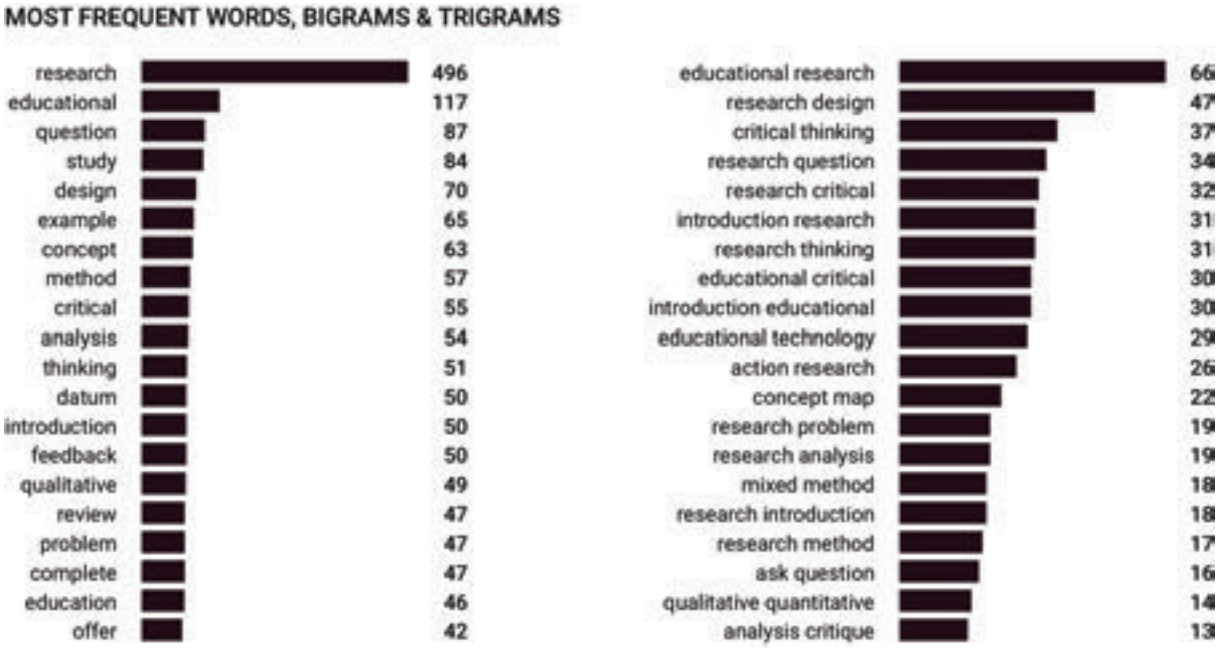

Figure 2. Word cloud of bigrams containing 'research' in content of course ETEC 500: Research methodology in education

Figure 2 meanwhile displays a word cloud generated from the top 20 'research' bigrams from this course content, with relative bigram size representing frequency of occurrence in course materials. Together, these findings tend to confirm that the desired focus on research and critical thinking in this course had been achieved.

Whole-program analysis

Compilation and comparison of course-specific metrics and bigrams goes some way to revealing programmatic areas of focus. Quantext also allowed me to compare aspects of our complete set of online courses in ways that permit critical reflection on overall program design, and expectations of our learners. For example, total word count per course ranges dramatically from ~12,000 to ~59,000 words. The size of each course would need to be considered in association with the size of associated reading requirements and course activities, but if the average reading speed of an adult is ~200 words per minute, this clearly has implications for learner workload (ranging from 5-25 hours/week) – particularly for an audience of working professionals such as ours.

The various readability indices computed for our courses meanwhile do not necessarily correlate with course size. Figure 3, for example, charts the SMOG index against word count per course. Since SMOG metrics are understood to indicate 'years of formal education needed for this reading level', it is evident that the language of our courses ranges from 'accessible to a high school student' (10.5) to 'requires university level education' (14.0). Findings like these should also prompt further reflection by our course authors and curriculum committee on the scholarly level of our courses.

Quantext for curriculum analysis?

Overall, I found this 'interim' Quantext output meaningful and useful (and more useful than findings from a previous effort to analyze course content using topic modelling which generated difficult-to-interpret thematic clusters). Per course results can be valuably compiled, compared and further analyzed (albeit manually and subjectively), to give a big picture overview of frequent curricular topics and networks of relationships between courses, in ways that both individual educators and curriculum committees can interpret and use for decision-making. I believe that these approaches to analyzing course and whole degree program content would also be valued by other units.

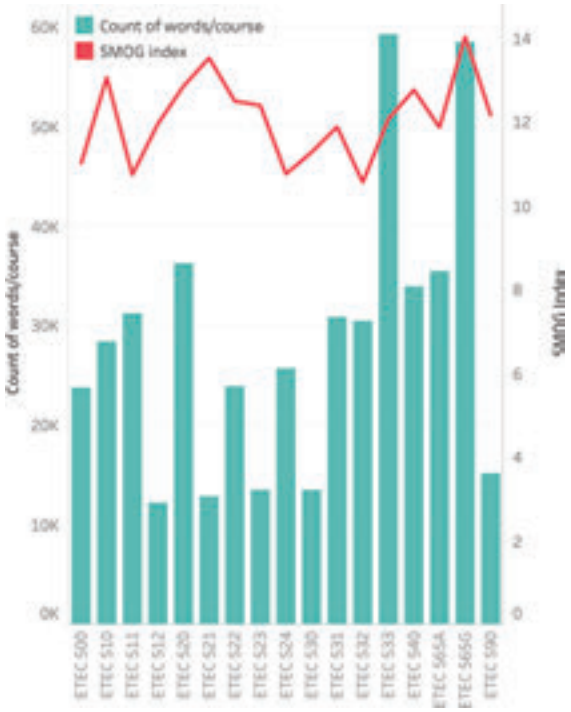

Figure 3. Word count and SMOG index per course

Three additional features would make Quantext an even more useful application for this purpose. It would be very useful to be able to collate all course content and undertake a keyword and ngram analysis of the entire corpus; to be able to do this, Quantext would need to be able to handle files of this size and complexity. It would be valuable to be able to undertake 'similarity analyses', to allow between-course comparison of content for redundancy. Most critically, the ability to analyze our course content against a contemporary reference corpus (for example, a definitive textbook in this field of study, or a compilation of published research articles in this field) would allow me to really achieve the goal of identifying curricular gaps in this rapidly evolving discipline.

Reflections and recommendations

As a pilot instance of an application actively under development, I did not expect Quantext to be trouble-free. I was also aware that I was using Quantext for a purpose not envisioned by its developers.

- I found the interface pleasing to look at, though occasionally confusing and a bit circuitous to navigate; the presentation of descriptive indices per course ('Question') in large boxes at top necessitated a lot of scrolling up and down to view analyses.
- Generally, I would suggest that user manuals need to be much more detailed and written for novice users who may have limited data skills and little or no knowledge of the fine details and meaning of text analysis terminology. Translation into meaningful terms and interpretations for educators is needed; diagrams and examples would help.
- If broader application of Quantext beyond simply question/response analysis is envisioned, I would recommend adopting different terminology than 'Questions' and 'Responses' to describe data items.
- Data formatting was certainly laborious, and I wonder if many educators have the skills or patience to compile data correctly.
- I occasionally found that lemmatization still failed to usefully combine terms: for example, Quantext presented 'constructivist' and 'constructivism' as separate keywords in a course focussed on that topic – I was forced to manually combine those terms in the source data and re-run analysis of that course dataset.
- To try to ensure that analyses applied both lower case settings and lemmatization (in the interface these appear to be mutually exclusive options) I experimented with analysis of a version of the data that had been transformed to lowercase before upload to Quantext. Strangely, this change file size and some of the descriptive metrics and readability indices, making me a little doubtful of accuracy.
- The ability to develop custom blacklists we critical and very useful. Thankyou!
- The absence of functionality to allow similarity analyses, or comparison of my data with a reference corpus, did limit current utility, and I will seek out other text analysis applications to complete this work.
- A final disappointment was the lack of output options for both data and visualizations. My workarounds involved manually transcribing and compiling indices for each course ('Question') and manually copy/pasting top n keyword and ngram counts. The ability to export data output easily, and to export image files easily seems an obvious need for anyone, researcher or educator, who may choose to use Quantext for text analysis.

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Appendix 7

Reflections

Dr Irina Elgort

The 2019 Quantext pilot at Victoria University of Wellington was conducted in partnership with McDonald & Moskal Ltd. Three university lecturers who took part in the pilot taught either a first-year undergraduate course or a MOOC. The goal of the pilot was to evaluate the usefulness of Quantext as a tool for analysing student responses, in order to facilitate insights into student learning in large classes.

Overall, our collaboration with McDonald & Moskal Ltd. has been (and continues to be) very productive and rewarding. At the start of the pilot, all participants got together for a full-day workshop in Dunedin that set the tone for the rest of the year. Jenny McDonald and Adon Moskal welcomed us, introduced the version of Quantext to be used in the pilot, and asked us to share our wish-list of software features, some of which were implemented almost immediately (for example, an option to lemmatise word lists, to avoid repetitions of the same word in different forms).

This spirit of cooperation and openness persisted throughout the pilot. The communication between the software development team and participants was excellent – we were always informed when larger updates were being performed and what features were being turned on or off. All technical questions or glitches received immediate response and attention from Jenny and Adon. Jenny visited the University a number of times during the year, providing in-person updates and helping out with the initial and final workshops for the teachers. Based on the feedback received from the lecturers, new important features (such as an option to exclude the text of the question from the data analysis) were added. The current version of Quantext made available to us towards the end of 2019 is a great improvement and includes many features that were recommended by the end users.

The continuous software development was also the main limitation of the Quantext pilot. It meant that some of the features that we initially had been planning to trial were unavailable during the time lecturers engaged with the software; for example, the comparison of the text submitted by students with that from lecture presentations and recordings (the teaching corpus) could not be tested. We were particularly interested in this feature because it could have revealed whether teaching materials and teaching delivery had an effect on student learning, and whether some of the misunderstanding identified in student responses could have been traced back to these materials. In hindsight, it might have been better to have two instances of Quantext, one stable, with all original features for undergraduate courses that took part on the pilot, and one development instance that would have been tweaked to accommodate the demands of high-volume text processing for the MOOC courses.

Overall, I think a continuation (phase 2) of the Quantext pilot would be extremely beneficial, because it would allow the lecturers to experience the full suite of Qunatext tools that are now available. On the positive note, in the final questionnaire, all pilot participants expressed their strong interest in continuing to pilot and/or use Qunatext in the future, ideally, with some assistance from academic developers, in most cases.

Assoc. Prof. Cathy Gunn

1. *Reflections on the pilot project - especially with respect to the public-private partnership.* To be honest, my overall experience of the pilot project was quite fragmented and frustrating. For the Stats MOOC case study, I was not familiar enough with the data to glean much meaning from it. A meeting with the teaching team suggested they found some interesting insights in our preliminary analysis, but this was an introductory meeting led by a colleague, so there was no opportunity to explore what those insights were or what, if any, actions the teaching team might take as a result. There were a number of operational issues that prevented us from progressing with the analysis while the software was still under development. At various times, I had trouble logging in, files that would not upload or the analysis did not run as expected. Having said that, we did make progress with a research assistant compiling the large data set into manageable size files for analysis in Quantext, and now have a 'clean' dataset for future analysis.

   Personal and organisational issues combined to make this a difficult time for us to progress with the case study. However, I believe that if the MOOC discussion analysis project continues with the latest version of the software now released, progress will be more even.

   The public – private partnership: It was most helpful to have Jenny and Adon available to assist with operational issues and to answer questions about useful approaches to analysis. There was no formal agreement around this relationship during the pilot study, but I do not believe the approach we used would be sustainable if McDonald & Moskal were to charge reasonable commercial, or even academic rates, for your essential contribution. Forward planning would be required to cost this into a research grant budget, and assistance required to make reasonable estimates of the time and work involved.

   The experience of our own and other University of Auckland case studies lead me to conclude that McDonald & Moskal would be better placed to offer text analysis on a fee for service basis. This need not necessarily be limited to academic users, as sectors e.g. health, public policy and tourism all require analysis of service user data, which you would be qualified and able to provide.

2. *Indication of ongoing/likely ongoing use/exploration of Quantext at your respective institutions* From my understanding, at least two of the case studies will continue and one of the case study leaders has a SEED Grant to bring Quantext users together in a community of interest or practice. I understand it is possible that Quantext code may be installed and managed locally. I am unable to comment on the likelihood of the Statistics MOOC case study continuing due to staff changes at the University. I think there is genuine interest, but cannot say if this will be followed up with a major restructure of teaching and learning support services scheduled for the first half of 2020.

Quantext

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VICTORIA UNIVERSITY OF WELLINGTON TE HERENGA WAKA NEW ZEALAND

OTAGO POLYTECHNIC Te Kura Matatini ki Otago