An Examination of Quality Assurance Impact on Student Satisfaction in Online Teaching

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Abstract

It has been postulated that quality assurance in instructor training should lead to enhancement of student satisfaction toward online education. In this study, Quality Matters standards are adopted to guide development of a student satisfaction survey. Online text boxes are employed to solicit student responses about their online learning experiences. The survey data are gathered from 222 students at CSU, Bakersfield to confirm the linkage between student satisfaction and online instructor training. In addition, student comments reveal different patterns of the positive responses. The qualitative data are employed to further assess sentiments and concerns embedded in the survey results. Triangulation of the research findings is supported by R scripts that can be re-used for similar projects in the future.

Purpose

In contrast to face-to-face instruction that dated back to over 2000 years ago, online teaching is relatively new. In an effort to support quality assurance (QA), California State University (CSU) adopted online education as "an important strategy for meeting students' needs and facilitating degree completion"[1]. In 2016, CSU received an Outstanding Impact Award from Quality Matters (QM) (Salvador, 2016). As the largest higher education system in the United States, CSU has nearly 3,000 faculty and staff completed at least one QA training, with over 150 faculty and staff certified as formal peer-reviewers of online courses. Over 130 fully online courses have been reviewed and formally certified as meeting or exceeding quality assurance standards.

In Academic Year (AY) 2018-2019, the CSU Chancellor's Office launched a Student Quality Assurance Impact Research (SQuAIR) project to demonstrate the impact of QA professional development on teaching performance and student success across 14 campuses. As part of the QA investigation, one hypothesis is stated as:

> Instructors completing QA professional development are better able (than non-trained peers) to design and deliver online courses while more effectively engaging students - resulting in higher grades, improved course completion rates, higher student satisfaction, and ultimately a reduction in equity gaps.[2]

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[1] https://www2.calstate.edu/csu-system/news/Pages/CSU-Students-Can-Now-Take-More-Fully-Online-Courses-Every-Term.aspx

[2] https://calstate.eventsair.com/QuickEventWebsitePortal/cal-state-tech-conference-2019/agenda/Agenda/AgendaItemDetail?id=2d028652-9024-41d9-a523-70fc086c1966

Following the systemwide QA initiative, CSU, Bakersfield (CSUB) subscribed to QM in 2012 (Wang & Hu, 2017). In the spring of 2013 the CSUB Academic Senate approved an Online and Hybrid Instruction Policy that required all faculty to receive QA training prior to teaching online courses. In partial fulfillment of the SQuAIR project requirement, a report has been developed to address four outcome measures, *higher grades, improved course completion rates*, and *reduction of equity gaps* (Wang & Hu, 2019). The **purpose** of this research is to examine the QA impact on *student satisfaction* at CSUB, a campus that needs online teaching to serve a vast region as large as the state of New Jersey.

Theoretical Framework

The QA task has dual aspects, *course design* and *instructor preparation*. From the course design perspective, "The QM Rubric contains a set of standards and examples of how to ensure quality online or blended courses" (Kunz & Cheek, 2016, p. 110). In supporting faculty professional development, CSU Chancellor's Office has been tracking the number of QA training courses completed by online instructors. In AY 2018-2019, efforts have been made in SQuAIR to collect student satisfaction data as an outcome measure.

Strong, Irby, Wynn, and McClure (2012) reported, "Literature indicated student satisfaction in online courses should be routinely assessed in order to potentially improve online course delivery" (p. 98). In reality, there has been little research to investigate learners' satisfaction in online learning environments (Anderson, 2013; Craig, Goold, Coldwell, & Mustard, 2008; Mykota & Duncan, 2007). To fill the void, the CSU team created a student satisfaction survey for data collection in the SQuAIR project.

In conforming to the professional practice, “Quality Matters is the national benchmark designed to certify the quality of online courses and online components” (Onodipe, Ayadi, & Marquez, 2016, p. 41). The rubrics are grounded on the latest research and best practice. On one hand, QM (2019) acknowledged its extensive review of research literature on online learning. As an ongoing process, QM periodically examines new literature for the improvement of its rubrics. On the other hand, “Quality Matters (QM) researchers have begun likewise investigating the relationship between course redesign and course outcomes” (Swan, Matthews, Bogle, Boles, & Day, 2012, p. 82). In particular, “Moving beyond what the research reveals, the QM Rubrics also incorporate best practices from those on the front lines: the course developers and instructors” (QM, 2019, p. 1). To guide the instrument design, the QM framework is needed to not only maintain the survey content alignment, but also support comprehensive data collection for quantitative and qualitative inquiries.

Appendix A shows the alignment of 25 survey items with the major objectives of QM rubrics. The latest version of QM rubrics (i.e., Version 6) is included in Appendix B for verification. While the item ratings on a Likert-type scale generate quantitative data for statistical analyses, Khalid (2014) observed, “Students in an online environment are similar to customers or consumers” (p. 2). In designing customer satisfaction surveys, Sharma (2019) recommends inclusion of online text boxes to solicit open-ended responses. “While they can sometimes be time-consuming to analyze, these questions encourage the participant to be honest and give them the freedom to address any topic” (Sharma, 2019, p. 1). With the CSU survey data released on 4/17/2019, open-ended comments are analyzed in this report by a quanteda package in R.

The name "quanteda" stands for *quantitative analyses of text data*. According to Benoit et al. (2018), "it provides highly efficient methods for compiling document-feature matrices … Using C++ and multithreading extensively, quanteda is also considerably faster and more efficient than other R and Python packages in processing large textual data" (p. 774). Furthermore, "Its capabilities match or exceed those provided in many end-user software applications, many of which are expensive and not open source" (Benoit, 218, p. 774).

In summary, this study is grounded on a comprehensive framework to support analyses of quantitative and qualitative data from a well-designed student satisfaction survey. Besides the content alignment with QM, technological supports, such as the online text box setting and the quanteda package application, are incorporated to facilitate the data gathering and analyses.

Research Questions

Based on the student satisfaction data, three questions have been adduced in this study:

1. Does online instructor training relate to better student satisfaction ratings?
2. Do student comments reveal different patterns of positive responses across different parts of the student satisfaction survey?
3. What are the top keywords that indicate the sentiments and concerns at the student level?

Methods

In coding the student satisfaction data, responses to the 25 items (see Appendix A) are scaled in six categories: (1) Strongly Disagree, (2) Disagree, (3) Somewhat Disagree, (4) Somewhat Agree, (5) Agree, (6) Strongly Agree. The even number of response categories is designed to avoid neutral responses (see Johnson & Morgan, 2016). The student data are merged with the number of QA trainings taken by online instructors. In the quantitative aspect of this

study, χ^2 tests are conducted to examine the association between instructor training and student satisfaction rating (Question 1).

To summarize the qualitative information, R scripts are developed to create a Lexical Dispersion Plot to depict student mentioning of positive words ("great", "enjoy", "appreciate", "good", "helpful", "clear") in three parts:

- Part 1: Course Overview/Introduction (Items 1-4) and Assessment/Evaluation of Student Learning (Items 5-9)
- Part 2: Instructional Materials/Resources Utilized (Items 10-13), Student Interaction/Community (Items 14-16), and Facilitation/Instruction (Items 17-18)
- Part 3: Technology for Teaching/Learning (Items 19-20), Student Support/Resources (Items 21-22), and Accessibility/Universal Design (Items 23-25)

Cluster dendrogram is drawn to confirm similarities of the student feedback across these parts (Question 2). The quanteda package is used to plot top keyword frequencies and word clouds to show sentiments and concerns in Question 3.

In summary, content validity of the survey design is justified by the item alignment with QM standards (Appendix A). Because reliability refers to survey outcomes (instead of the instrument itself), Cronbach's alpha index is computed on the survey data from CSUB. R scripts are provided in Appendix C to generate the text analytical findings.

Results

Among the 222 survey respondents, 103 were taught by instructors with one QA course training, 63 were taught by instructors with two QA course trainings, and 53 were taught by instructors with three QA course trainings. Despite the university requirement of QA training for

online teaching, three respondents were taught by an instructor without QA training. Figure 1 shows the satisfaction ratings *at or above* 4.54, corroborating an overall positive response.

With the "Strongly Agree" response representing an *Excellent* rating, χ^2 test results are produced in Table 1 to examine the association of *faculty QA training* with *the reporting of an Excellent satisfaction outcome*. Because χ^2 test requires an adequate frequency count, the category with three respondents is excluded this analysis. The findings reconfirmed an optimal number of two QA trainings for generating high satisfaction responses from students (Table 1 & Figure 1). Presentation of the quantitative findings conforms to a report guideline from the Chancellor's Office[3].

Insert Figure 1 & Table 1 around here

With over 98.5% of the respondents taught by QA-trained instructors, one may expect frequent appearances of positive words, such as "great", "enjoy", "appreciate", "good", "helpful", and "clear", in the satisfaction survey. Lexical dispersion plots in Table 2 depicted the relative density of these keywords across the three parts. In comparison, student comments were more positive in Part 2 than Parts 1 and 3 (see Table 2).

In Figure 2, a vertical scale on the dendrogram represents the distance or dissimilarity of qualitative responses across different parts. Similar to Table 2 that shows more positive words in Part 2 than the other parts, student satisfaction is more focused on the topics surveyed by Items 10-18 of the instrument (see Appendix A). In this context, Figure 2 shows more similarities of student comments in Parts 1 and 3.

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[3] See page 3 of https://docs.google.com/document/d/1cqtFZ4MxBY0aOcOZNm_2-i92IAnvPH_lMfk-_HSICqU/edit#

Insert Figure 2 & Table 2 around here

The respondent sentiments are reflected by a plot of the top keywords in student comments. Figure 3 shows a list of keywords that are mentioned by the respondents for more than 10 times. Using a function of word-stem truncation, Figure 3 indicates inclusion of *great, help(ful), time(ly), enjoy*, and *clear* that convey a strong sentiment of satisfaction. Meanwhile, the word cloud plot in Figure 4 displays concentration of student comments on the feature of *cours(es), assign(ments)*, and *class(es)* that appear more often in the survey responses. The qualitative data also show the focus of student comments on the essential components of online learning (Figure 4). The use of quanteda software in R has facilitated the incorporation of quantitative and qualitative inquiries in this investigation.

Insert Figures 3 & 4 around here

Significance of this Study

QM (2019) anticipated that "When online courses are well-designed, organizations are more likely to see an increase in student engagement, learning, and overall satisfaction" (p. 1). Levy (2007) also considered student satisfaction as an indicator of retention and dropout rates in eLearning courses. To address the importance of QA instructor training on student satisfaction, alignment has been made between a theoretical framework and the instrument design to justify the content validity. Meanwhile, reliability of the survey outcomes, as measured by Cronbach's

alpha, has reached .96 to confirm strong consistency of the student responses across 25 survey items.

Based on the mechanism of data gathering, two major takeaways are revealed from quantitative and qualitative inquiries:

- From the quantitative investigation, significant differences are found in student satisfaction from two online instruction scenarios: (1) instructors who completed 1 versus 2 QA trainings, and (2) instructors who finished 2 versus 3 QA trainings (Table 1).
- To support the qualitative text analyses, quanteda scripts were developed in R to tokenize student comments and use the results for triangulating the pattern of student comments across different parts of the student satisfaction survey (Table 2). Cluster Dendrogram, Lexical Dispersion Plot, and Frequent Keyword Plot were used to partition the pattern of positive survey responses, and thus, reveal sentiments and concerns of the respondents.

While the SQuAIR data are delimited to CSUB student responses in AY 2018-2019, the mixture of quantitative and qualitative inquiries is accomplished by R scripts that can be employed by other researchers, such as the sister campuses of SQuAIR, for the result reconfirmation.

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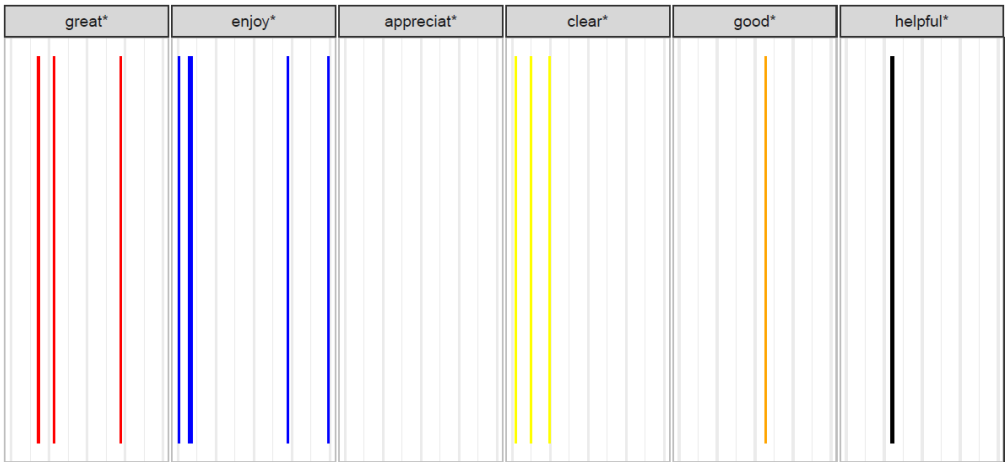
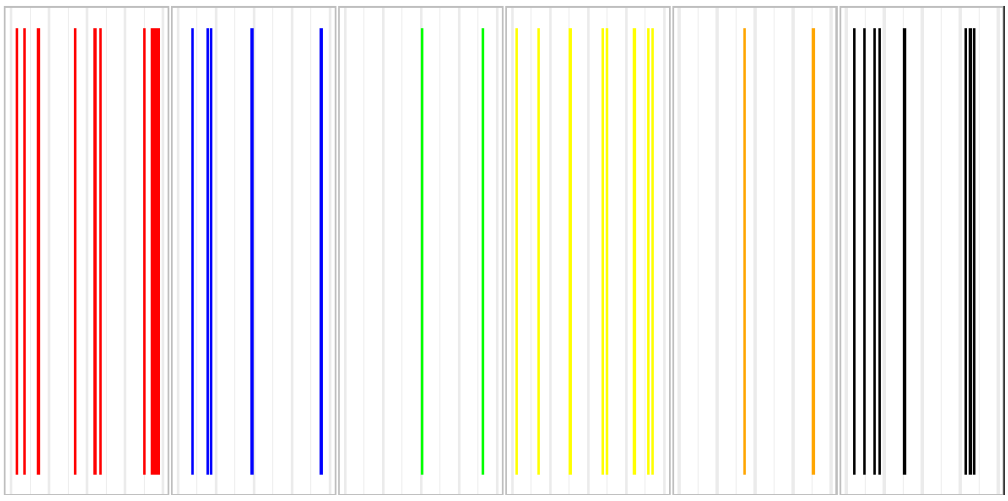
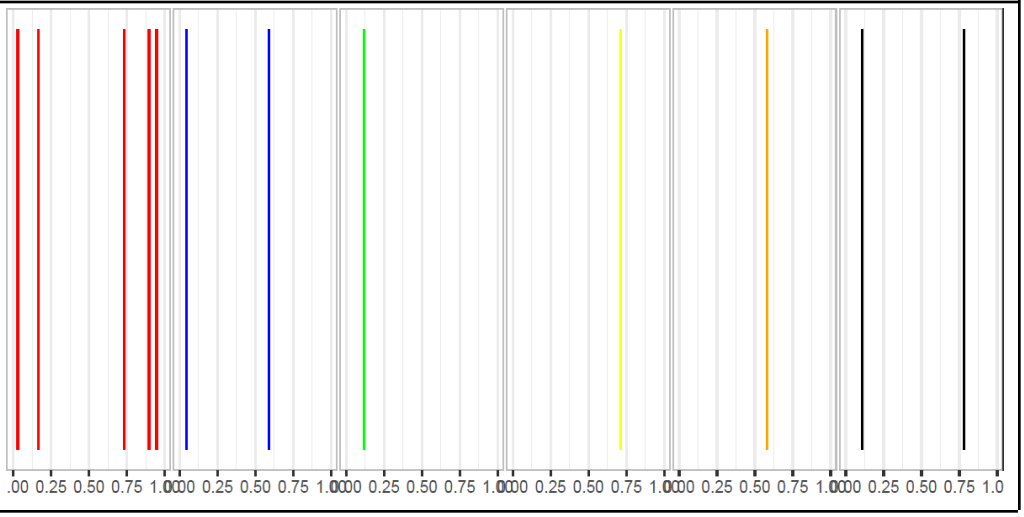
Table 1

Chi-Square Test Results on the Association Between QA Training and Excellent Ratings

QA Training Contrast	χ^2	df	p
1 versus 2 QA trainings completed	11.81	1	.0006
2 versus 3 trainings completed	24.42	1	.0001
3 versus 1 QA trainings completed	2.40	1	.1215

Table 2

Appearance of Positive Words in Parts 1-3 of the Student Satisfaction Survey

Questions	Lexical Dispersion Plot
[Part 1] Q1-Q4 Course Overview and Introduction Q5-Q9 Assessment and Evaluation of Student Learning	
[Part 2] Q10-Q13 Instructional Materials and Resources Utilized Q14-Q16 Student Interaction and Community Q17-Q18 Facilitation and Instruction	
[Part 3] Q19-Q20 Technology for Teaching and Learning Q21-Q22 Learner Support and Resources Q23-Q25 Accessibility and Universal Design	

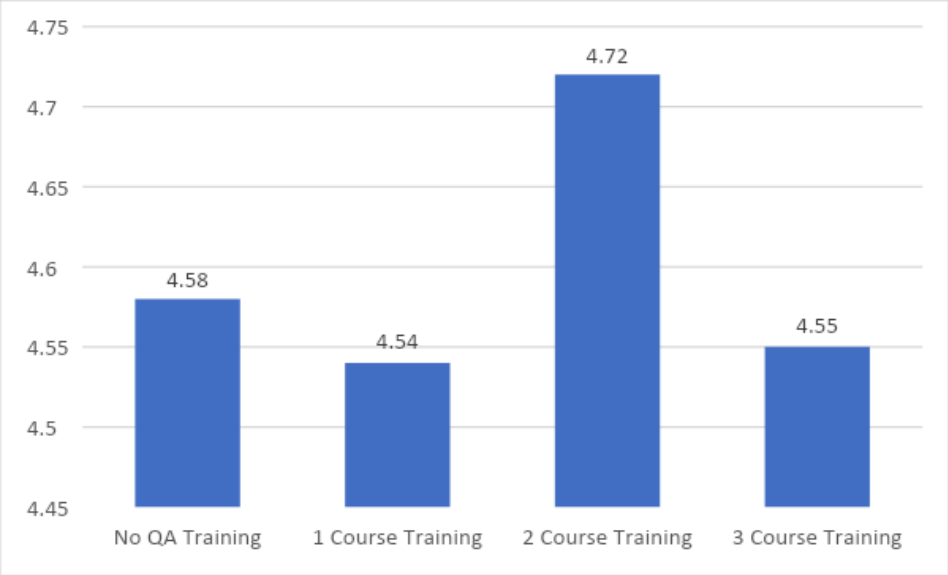


Figure 1. Average student satisfaction ratings by teachers with different QA training

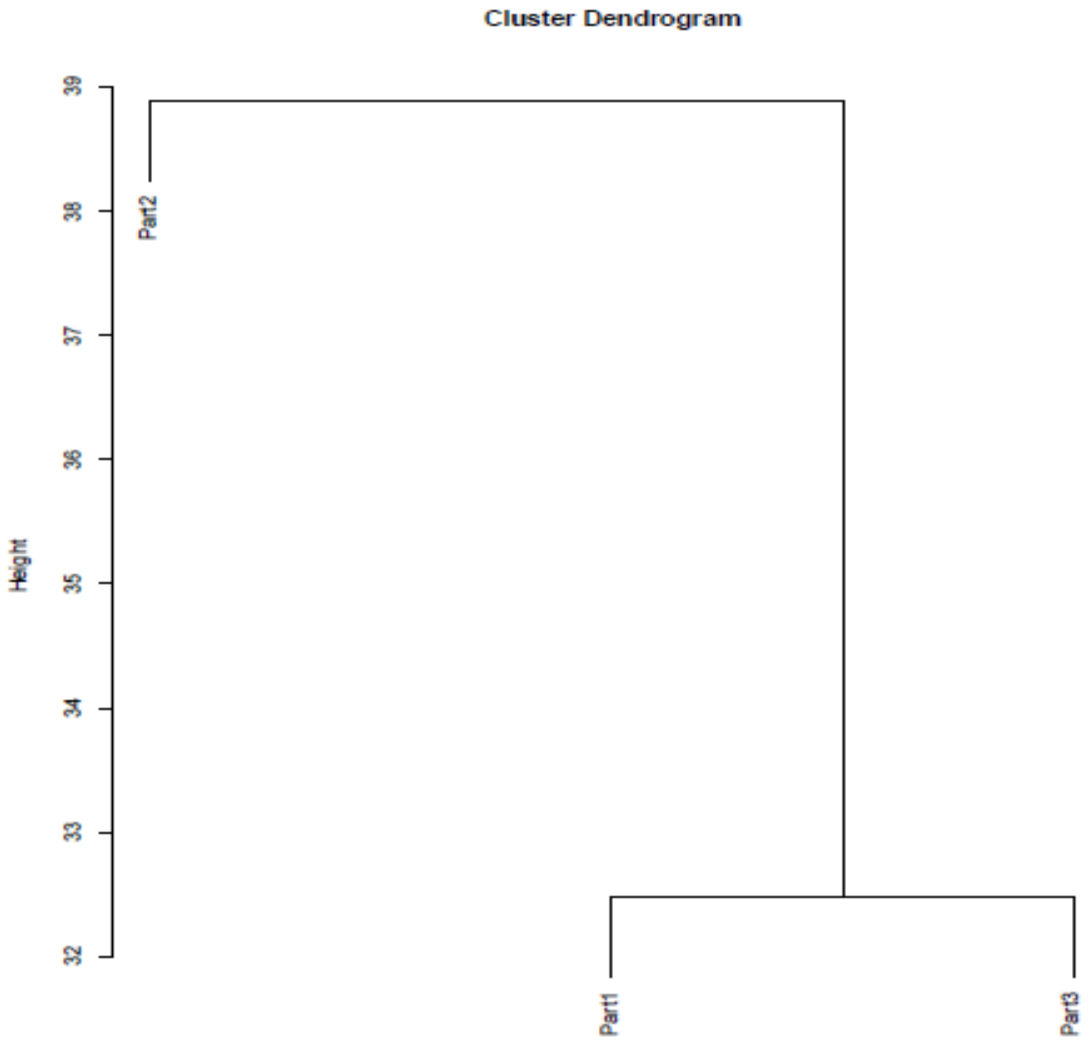


Figure 2. Cluster pattern of student satisfaction responses.

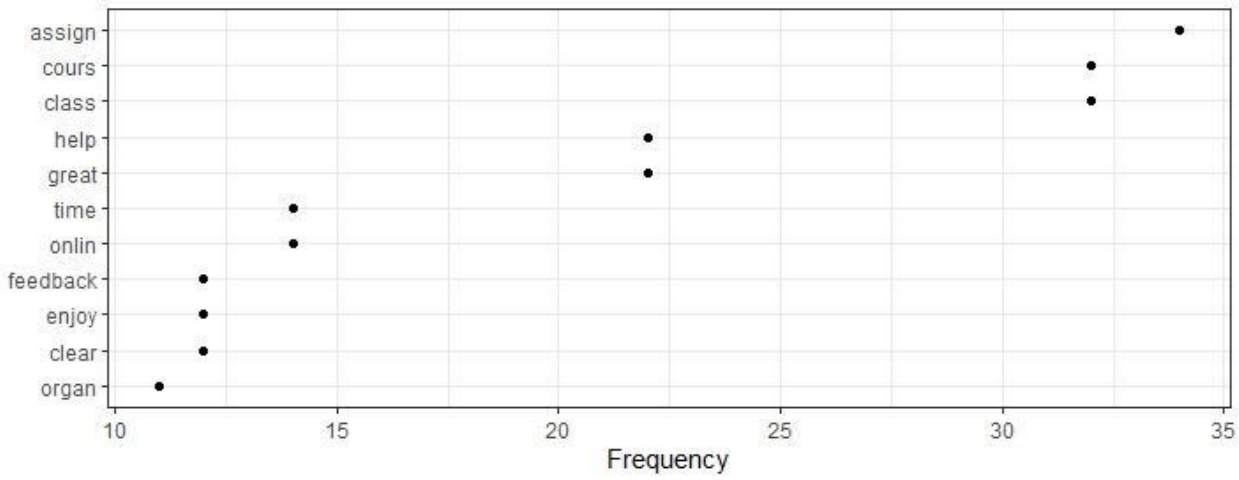


Figure 3. Plot of frequently-used keywords in responses of the student satisfaction survey

Figure 4. Word choices surfaced from the student satisfaction survey

Appendix A. Alignment of the Survey Items with Key Components of QM Standards

Categories	Standards	Survey Items
Course Overview and Introduction	QM 1.1	1. The instructor provided clear and detailed instructions for how to begin accessing all course components, such as syllabus, course calendar, and assignments.
	QM 1.8	2. Detailed information about the instructor was available and included multiple ways to contact him/her, times s/he was available, a brief biography, and a picture or welcome video.
	QM 1.2	3. The course description included the purpose and format (e.g. fully online, blended; schedule/calendar with specific dates/times) of the course, as well as any applicable prerequisite knowledge (e.g., prerequisite course).
	QM 1.4	4. The instructor clearly defined academic integrity and/or provided a "code of ethics" and provided institutional policies and/or links to those policies (e.g, academic dishonesty, cheating, and plagiarism).
Assessment and Evaluation of Student Learning	QM 2.1 QM 2.2 QM 2.3 QM 2.4 QM 5.1	5. The instructor provided specific, well-defined, and measurable learning objectives. I understood what I was supposed to accomplish both weekly and by the end of the course. For example, each week there were specific learning goals and I knew exactly what I was supposed to learn/accomplish (e.g, there were bulleted list of activities to complete each week).
	QM 3.1 QM 3.3 QM 3.2 QM 3.3	6. I understood how the learning activities (including the assignments and ungraded activities) helped me achieve the learning objectives each week. For example, I understood how a discussion forum could help me prepare to develop a "reaction paper" on a topic.
		7. The instructor made it clear how individual papers, exams, projects, and/or group contributions would be evaluated. For example, I was given grading sheets or detailed descriptions of how points were distributed for major assignments.
		8. The instructor provided a course grading policy that clearly defined how much each assignment or category of assignments contributed to my overall course grade.
		9. I was given opportunities to receive feedback from my instructor and to self-check my progress in the course. For example, my instructor posted grades regularly, provided comments on my work, had us self-grade assignments, allowed us to submit drafts of projects for comments, and offered discussion forums for feedback and practice tests.
Instructional Materials and Resources Utilized	QM 4.3 QM 4.1 QM 4.2	10. The instructor gave me adequate notice and time to acquire course materials. For example, I received information on how to obtain the course textbook/materials prior to the start of the course via email, or the instructions for how to acquire the materials were in the syllabus or elsewhere in the course.
		11. The instructor offered a variety of course material types (such as audio, video, and readings) and perspectives. S/he did not over-rely on a single way to deliver content such as via text or from a single source/textbook or author.
		12. The materials supported the content of what I was learning in the course. For example, the textbook, articles, audio recordings, and videos were all tied to the course topics and objectives.
		13. The instructor provided a good explanation to show how the instructional materials (e.g., textbook, videos organized by topics) support the course objectives or competencies.
Student Interaction and Community	QM 5.2	14. The instructor provided an opportunity at the beginning of the course for students to introduce themselves. This created a sense of community among course participants.
		15. The learning activities (e.g., discussions and activities) encouraged me to log on and interact with my fellow classmates often.
		16. The course learning activities helped me understand fundamental concepts and build skills that will be useful in the real world. For example, the activities made connections with real-world problem solving, and involved real-world scenarios.

Facilitation and Instruction	QM 5.3	17**.** The instructor was clear on how long it would take to receive feedback on assignments. I received feedback about my coursework and progress in a timely fashion.
		18. The instructor sent reminders of due dates (email, weekly announcements) and other information and instructions to help keep me on task.
Technology for Teaching and Learning	QM 6.1 QM 6.2	19. The instructor used a variety of online technology tools to engage me and encourage me to interact with others in the course and I felt the tools used supported the course objectives. Examples include, but are not limited to, web meetings, online discussions (e.g., VoiceThread), online collaboration tools (e.g., Google Docs), social media tools (e.g., Twitter).
		20. The instructor provided clear information about how to access or acquire the technologies required to successfully complete the course. Examples include, but are not limited to, web authoring software (web pages, blogs, wikis), proctoring software, printers, scanners, browser plug-ins or media players.
Student Support and Resources	QM7.1 QM7.3	21. The course syllabus listed and/or the course website linked to a clear explanation of the TECHNICAL support provided by my campus and provided information about when and how I can access it. For example, the syllabus had links to the technical support website, Help Desk contacts, and online tutorials.
		22. The course syllabus listed and/or the course website linked to ACADEMIC support services and resources, such as Supplemental Instruction, Writing Center, Math Center, Tutoring Center, testing services, and library resources.
Accessibility and Universal Design	QM 7.2	23**.** The course syllabus or course website provided or linked to the campus policy regarding accommodating students with disabilities.
	QM 8.3	24. The course materials (whether created by the instructor or from external sources) were in accessible formats (e.g., videos were captioned and/or had text transcripts).
	QM 8.1 QM 8.2	25. It was easy to navigate the online components of the course. For example, the module or weekly organization was easy to follow and course headings and links were clear and easy to understand. It was easy for me to locate respective course resources/components.

Appendix B: QM Review Standards

General Standards	Specific Review Standards	Points
Course Overview and Introduction	1.1 Instructions make clear how to get started and where to find various course components.	3
	1.2 Learners are introduced to the purpose and structure of the course.	3
	1.3 Communication expectations for online discussions, email, and other forms of interaction are clearly stated.	2
	1.4 Course and institutional policies with which the learner is expected to comply are clearly stated within the course, or a link to current policies is provided.	2
	1.5 Minimum technology requirements for the course are clearly stated, and information on how to obtain the technologies is provided.	2
	1.6 Computer skills and digital information literacy skills expected of the learner are clearly stated.	1
	1.7 Expectations for prerequisite knowledge in the discipline and/or any required competencies are clearly stated.	1
	1.8 The self-introduction by the instructor is professional and is available online.	1
	1.9 Learners are asked to introduce themselves to the class.	1
Learning Objectives (Competencies)	2.1 The course learning objectives, or course/program competencies, describe outcomes that are measurable.	3
	2.2 The module/unit-level learning objectives or competencies describe outcomes that are measurable and consistent with the course-level objectives or competencies.	3
	2.3 Learning objectives or competencies are stated clearly, are written from the learner's perspective, and are prominently located in the course.	3
	2.4 The relationship between learning objectives or competencies and learning activities is clearly stated.	3
	2.5 The learning objectives or competencies are suited to the level of the course.	3
Assessment and Measurement	3.1 The assessments measure the achievement of the stated learning objectives or competencies.	3
	3.2 The course grading policy is stated clearly at the beginning of the course.	3
	3.3 Specific and descriptive criteria are provided for the evaluation of learners' work, and their connection to the course grading policy is clearly explained.	3
	3.4 The assessments used are sequenced, varied, and suited to the level of the course.	2
	3.5 The course provides learners with multiple opportunities to track their learning progress with timely feedback.	2
Instructional Materials	4.1 The instructional materials contribute to the achievement of the stated learning objectives or competencies.	3
	4.2 The relationship between the use of instructional materials in the course and completing learning activities is clearly explained.	3
	4.3 The course models the academic integrity expected of learners by providing both source references and permissions for use of instructional materials.	2
	4.4 The instructional materials represent up-to-date theory and practice in the discipline.	2
	4.5 A variety of instructional materials is used in the course.	2
Learning Activities and Learner Interaction	5.1 The learning activities promote the achievement of the stated learning objectives or competencies.	3
	5.2 Learning activities provide opportunities for interaction that support active learning.	3
	5.3 The instructor's plan for interacting with learners during the course is clearly stated.	3
	5.4 The requirements for learner interaction are clearly stated.	2
Course Technology	6.1 The tools used in the course support the learning objectives or competencies.	3
	6.2 Course tools promote learner engagement and active learning.	3
	6.3 A variety of technology is used in the course.	1
	6.4 The course provides learners with information on protecting their data and privacy.	1
Learner Support	7.1 The course instructions articulate or link to a clear description of the technical support offered and how to obtain it.	3
	7.2 Course instructions articulate or link to the institution's accessibility policies and services.	3
	7.3 Course instructions articulate or link to the institution's academic support services and resources that can help learners succeed in the course.	3
	7.4 Course instructions articulate or link to the institution's student services and resources that can help learners succeed.	1
Accessibility* and Usability	8.1 Course navigation facilitates ease of use.	3
	8.2 The course design facilitates readability.	3
	8.3 The course provides accessible text and images in files, documents, LMS pages, and web pages to meet the needs of diverse learners.	3
	8.4 The course provides alternative means of access to multimedia content in formats that meet the needs of diverse learners.	2
	8.5 Course multimedia facilitate ease of use.	2
	8.6 Vendor accessibility statements are provided for all technologies required in the course.	2

* Meeting QM Specific Review Standards regarding accessibility does not guarantee or imply that the specific accessibility regulations of any country are met. Consult with an accessibility specialist to ensure that accessibility regulations are met.

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Appendix C: R Script for Text Analytics

```
install.packages(c("ggplot2", "e1071", "caret", "quanteda", "irlba", "dplyr", "readtext",
"randomForest"))
library(readtext)
data1<-readtext("F:/QA/*.txt", docvarnames = c("title"))
colnames(data1)
names(data1) <- c("Label", "text")
library(quanteda)
d1.corpus<-corpus(data1)

textplot_xray(kwic(d1.corpus, pattern="great*"), kwic(d1.corpus, pattern="enjoy*"),
kwic(d1.corpus, pattern="appreciat*"),kwic(d1.corpus, pattern="clear*"), kwic(d1.corpus,
pattern="good*"), kwic(d1.corpus, pattern="helpful*"))

library(ggplot2)
theme_set(theme_bw())
tplot <- textplot_xray(kwic(d1.corpus, pattern="great*"), kwic(d1.corpus, pattern="enjoy*"),
kwic(d1.corpus, pattern="appreciat*"),kwic(d1.corpus, pattern="clear*"), kwic(d1.corpus,
pattern="good*"), kwic(d1.corpus, pattern="helpful*"))
tplot + aes(color = keyword) + scale_color_manual (values = c("red", "blue", "green", "yellow",
"orange", "black")) + theme(legend.position = "none")

d1_tokens <- tokens(d1.corpus)
d1_tokens <- tokens(d1_tokens, stopwords('english'), selection='remove')
d1_tokens <- tokens(d1_tokens, remove_punct = TRUE)
d1_tokens <- tokens(d1_tokens, remove_numbers = TRUE)
d1_tokens <- tokens_wordstem(d1_tokens)
d1_tokens <- tokens(d1_tokens, remove_symbols= TRUE)
d1_tokens <- tokens(d1_tokens, remove_url = TRUE)
d1_tokens <- tokens(d1_tokens, remove_hyphens= TRUE)
d1_tokens <- tokens_tolower(d1_tokens)
d1_tokens <- tokens_remove(d1_tokens, pattern =c('the', 'of', "and", "to"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('a', 'for', "her", "was"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('in', 'that', "their", "is"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('as', 'they', "have", "from"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('our', 'we', "tell", "up"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('were', 'she', "he", "has"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('which', 'an', "by", "on", "with"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('-', 'not', "be", "his", "at", "one", "are"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('i', 'this', "it", "veri", "professor"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('student', 'would', "me", "instructor", "my"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('but', 'other', "did", "about", "what"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('all', 'made', "when", "if", "us"))
d1_tokens <- tokens_remove(d1_tokens, pattern =c('how', 'dr', "there", "so", "each"))
```

```
d1_tokens <- tokens_remove(d1_tokens, pattern =c('them', 'email', "also", "more", "had"))
d_dfm<-dfm(d1_tokens)

topfeatures(d_dfm, 20)
rownames(d_dfm) <- c("Part1", "Part2", "Part3")

textplot_wordcloud(d_dfm, comparison=TRUE)
textplot_wordcloud(d_dfm, comparison=TRUE, rotation = 0.25,
                   color = rev(RColorBrewer::brewer.pal(10, "RdBu")))

textplot_xray(kwic(d1_tokens, pattern="great*"), kwic(d1_tokens, pattern="enjoy*"),
kwic(d1_tokens, pattern="appreciat*"),kwic(d1_tokens, pattern="clear*"), kwic(d1_tokens,
pattern="good*"), kwic(d1_tokens, pattern="helpful*"))

d1<-tokens(d_dfm)
library(ggplot2)
theme_set(theme_bw())
tplot <- textplot_xray(kwic(d1, pattern="great*"), kwic(d1, pattern="enjoy*"), kwic(d1,
pattern="appreciat*"),kwic(d1, pattern="clear*"), kwic(d1, pattern="good*"), kwic(d1,
pattern="helpful*"))
tplot + aes(color = keyword) + scale_color_manual (values = c("red", "blue", "green", "yellow",
"orange", "black")) + theme(legend.position = "none")

d <- dist(d_dfm, method = "euclidean")
hc1 <- hclust(d, method = "complete" )
plot(hc1)

textstat_frequency(d_dfm, n = 10)

tstat1 <- textstat_frequency(d_dfm)
head(tstat1, 20)

library(ggplot2)
ggplot(tstat1[1:11, ], aes(x = reorder(feature, frequency), y = frequency)) +
  geom_point() +
  coord_flip() +
  labs(x = NULL, y = "Frequency")
```