

## **AC 2010-675: IMPROVING WRITING IN CIVIL AND ENVIRONMENTAL ENGINEERING COURSES USING CLAQWA, AN ONLINE TOOL FOR WRITING IMPROVEMENT**

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Dr. Jeffrey Cunningham is an Assistant Professor in the Department of Civil and Environmental Engineering at the University of South Florida (USF). He previously has held appointments on the faculty at Texas A&M University and on the research staff at Stanford University. Dr. Cunningham's research and teaching interests are related to the fate, transport, and remediation of contaminants in the environment. His current students are working on projects related to the clean-up of soil contaminated by hazardous chemicals, the fate of trace organic contaminants during reclamation of treated municipal wastewater, and the storage of carbon dioxide in deep saline aquifers as a method of mitigating global climate change. Several previous research projects focused on the transport and biodegradation of hazardous chemicals in groundwater. Dr. Cunningham regularly teaches an introductory Environmental Engineering class for undergraduate Civil Engineering students, as well as graduate classes on physical and chemical processes in natural and engineered environmental systems. Dr. Cunningham earned his BS degree in Chemical Engineering from Rice University, his MS degree in Civil Engineering from Stanford University, and his PhD in Civil & Environmental Engineering from Stanford University. He has authored over a dozen papers in peer-reviewed scientific journals.

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# Improving writing in civil and environmental engineering courses using CLAQWA, an online tool for writing improvement

## Abstract

A required ABET student outcome of engineering programs is “communication” which, according to the American Society of Civil Engineers BOK means that a student can “Plan, compose, and integrate the verbal, written, virtual, and graphical communication of a project to technical and non-technical audiences.” The Civil and Environmental Engineering program at the University of South Florida, addresses this outcome over a student’s undergraduate career, however, tools for student improvement are typically not directly linked with the course syllabus and the actual assessment of skills. The Cognitive Level and Quality Writing Assessment (CLAQWA) instrument is a computer based assessment and feedback tool designed to improve the writing skills and raise cognitive levels necessary for a given writing assignment. It also allows faculty to assess, diagnose and grade a writing assignment and student peers to provide feedback to each other. CLAQWA provides guided, interactive examples for self instruction on writing improvement and is flexibly designed to emphasize the particular instructor’s grading priorities.

CLAQWA was integrated into an upper level Environmental Engineering Systems course where it was used for a student term paper in both Fall 2008, the pilot, and Spring 2009. Working in groups of three (in Fall 2008 - 17 groups; Spring 2009 – 13 groups), students selected a topic relevant to environmental engineering and worked closely with the two course instructors in outlining the paper’s theme. A writing teaching assistant familiar with CLAQWA was assigned to the class and specially scheduled training sessions were provided to train students on the use of CLAQWA. Each group’s first paper draft received at least three peer reviews, all of which were compared for the purposes of this paper to determine any common issues amongst the class. The faculty and teaching assistant compared their own grading using CLAQWA in an effort to calibrate the process for the grading of the final term paper. For the Spring 2009 offering of the class the entire CLAQWA process was undertaken without the online component. This was done to determine whether the tool can be successful by use of traditional teaching techniques i.e. as a paper based tool. Student surveys were used to gain feedback on whether students felt CLAQWA was useful and helped them to improve their writing skills. CLAQWA provides effective tools that actually improve student writing skills and enables data collection to demonstrate this improvement.

## Introduction

According to Flateby and Fehr<sup>1</sup>, “the inability to communicate effectively in writing seems to be a common deficiency amongst engineers. One can debate over the root cause of this deficiency, but most people agree that strengthening communication skills will increase the effectiveness of the engineer.” To address this issue amongst engineering graduates, ABET now requires BS graduates to be able to effectively communicate their ideas verbally and through writing<sup>1</sup>. This concept has been incorporated into the Civil Engineering Body of Knowledge (BOK)<sup>2</sup>.

Outcome 16 of the Civil Engineering BOK<sup>2</sup> states that undergraduates should be able to organize and deliver effective verbal, written, virtual, and graphical communications by the end of their bachelor's degree. The Civil and Environmental Engineering program at the University of South Florida, addresses this outcome in different classes over a student's undergraduate career, however, tools for student improvement are not directly linked with the course syllabus and the actual assessment of skills, e.g. writing, is difficult. For written communication, especially in the form of technical papers, students are directed to college or university wide help centers which many times means meeting with a writing tutor. At the University of South Florida this question is being addressed through a tool to assess written communication skills based on an assignment given in an Environmental Engineering Systems class that is required of all Civil and Environmental Engineering undergraduates. The departmental vision is to institute this tool in all writing assessments and possibly expanding to first year courses that are not housed in the department.

These training sessions included both classroom type settings in both Fall 2008 and Spring 2009, and a virtual training environment using Elluminate<sup>TM</sup> software for the Fall 2008 offering. Using a cross-disciplinary example, students examined sixteen different writing and thinking elements that fell into the following five categories: assignment parameters, structural integrity, reasoning and development of ideas, language, and grammar and mechanics. A writing teaching assistant familiar with CLAQWA was assigned to the class and specially scheduled training sessions were provided to train students on the use of CLAQWA.

#### *About ENV4001 Environmental Systems Engineering*

This course is a senior level mandatory course for all students attempting a BS Civil & Environmental Engineering degree. Most students take this course in their senior year often in the semester of graduation. The writing intensive term paper provide a crash-course in written communication before heading out into the world of work. This was deemed essential since most of the students would have had their only communication skills acquired in their freshman year during Gordon Rule 6A Communications and General Education English composition requirements. The term papers are done in groups of three to further foster the development of non-written communications skills, which is also important according to Outcome 16 of the Civil Engineering BOK<sup>2</sup>. The enrollment in this class is usually above 65 students.

The term project is worth 15% of each student's final course grade and it is broken into four parts. The first part is worth 10% of the project grade and is based on a group selection of topic and delivery of a list of 25 journal references for the paper in APA format. In about a month from then the rough drafts are due from all groups which are mainly graded on effort in contributing a possible 20% to the project grade. Each group has their rough drafts evaluated by at least three other groups constituting a peer review while the drafts are graded by the instructor and teaching assistant to give the students more insights into where their effort should be focused in the production of their final draft. Peers have two weeks to complete their reviews and their own review is worth 20% of the grade. Final drafts are due at the end of the semester and is worth 50% of the

project grade. It is evaluated by only the instructing faculty and the teaching assistant. The process implements an iterative review and assessment process which is considered to be instrumental in making assessment of writing successful<sup>3,4</sup>. Held<sup>3</sup> and Yin<sup>4</sup> corroborate that student participation in the assessment process is paramount to meeting the written communication objectives of any assignment. Hence, the incorporation or peer reviews into the term paper exercise; an experience that is not common among most engineering curricula.

### *Background on CLAQWA*

Designed to help university instructors assess, diagnose, and grade student writing, Cognitive Level and Quality Writing Assessment (CLAQWA) conveys the writing skills and cognitive level necessary for a given writing assignment. CLAQWA is useful for the full range of writing and thinking assessment activities (from course to the institution), and helps guide the student peer review process. CLAQWA provides guided, interactive examples for self instruction on writing improvement and is flexibly designed to emphasize the particular instructor's grading priorities.

The root of CLAQWA stems from assessment at a defined cognitive level based on Bloom's taxonomy of cognition<sup>5</sup>. Cognitive levels range from 1-5 hierarchically and are described below:

Level 1: Knowledge. Accurately recalls or describes, identifies information which was presented in class or reading. Involves memorization.

Level 2: Comprehension. Translates or rephrases known words, interprets or explains in a way that demonstrates understanding of the material.

Level 3: Application. Uses what is learned in the assignment or in class.

Level 4: Analysis, Synthesis. Evaluation. Makes a judgment of a work or plan based upon a given constructed set of specific criteria, not opinion. Organizes or reorganizes ideas or combines elements to make a whole. Distinguishes between fact and fiction. Compares and contrasts or deduces. Identifies relationships of parts to a whole.

Level 5: Level 4 with superior, effective presentation style. Proper placement of material for greatest impact.

Higher cognitive levels may include characteristics of lower levels and so half and quarter level points may be allocated.

According to the creators of the CLAQWA system, any instructor that uses CLAQWA can determine prior the expected cognitive level of students. This needs to be selected depending on the complexity of the subject matter as well as the academic level of the class. Nevertheless, whatever the level, the assessment of writing with CLAQWA takes place under five distinct categories (i.e. assignment parameters, structural integrity, reasoning and development of ideas, language, and grammar and mechanics). Each category has particular analytical elements or traits for assessment (see Table 1).

Each trait or element can be assessed at the five levels. This means that the overall level of operation can be assessed based on the number of problematic traits contained in a

piece of writing. A generalized example of assessing a trait at the five cognitive levels is shown in Table 2.

**Table 1: CLAQWA analytical scale traits**

<b>A. Assignment Parameters</b>	<b>B. Organization and Development : Structural Integrity</b>	<b>C. Organizational Development: Reasoning &amp; Development of Ideas</b>	<b>D. Language: Contextual &amp; Audience Appropriateness</b>	<b>E. Observation of Standard Edited English: Grammar &amp; Mechanics</b>
1. Assignment Requirements 2. Main Idea 3. Audience 4. Purpose	5. Opening 6. Coherence Devices 7. Paragraph Construction	9. Reasoning 10. Quality of Details 11. Quantity of Details	12. Word Choice 13. Sentence Comprehensibility 14. Sentence Construction 15. Point of View	16. Grammar and Mechanics

**Table 2: Generalization for level differentiation for a single trait**

<b>Level</b>	<b>Trait 1: Assignment Requirements</b>
1	The writer is off topic or vaguely addresses the topic.
2	The writer addresses the appropriate topic, but omits most or all of the assignment requirements.
3	The writer addresses the appropriate topic and partially fulfills assignment requirements.
4	The writer addresses each aspect of the assignment.
5	The writer addresses and develops each aspect of the assignment and goes beyond the assignment prompt to address additional related material.

For each of the 16 traits listed in Table 1 a score of 1-5 is given according to the level of the writing. From Table 2 it shows that a score of 5 reflects writing that exhibits key understanding of the writing assignment while that of 1 is for work that does not address the requirements of the assignment. Thus the assigned level is the score for the trait and this is done in 0.5 level increments. This is the scoring used by instructors to obtain results shown below in Tables 4 and 5.

Flateby and Fehr<sup>1</sup> report that CLAQWA has been successfully used across several disciplines at the University of South Florida. These disciplines include electrical engineering, English composition, technical writing, anthropology, computer engineering, first-year experience and chemistry. Through studies of these success stories, Flateby and Fehr<sup>1</sup> concur that the chief benefits from the application of CLAQWA are that: (1) instructors are provided a clear framework to learn which allows them to assess writing consistently; (2) once the instructors explain the underlying

writing skills intertwined into CLAQWA and any given assignment then students have a clearer idea of instructor expectations and the key constituents of quality writing; and (3) since CLAQWA incorporates thinking, students are afforded the opportunity to understand the need for clear and well developed ideas through planning and revision.

**Peer Reviewing in CLAQWA**

According to Yin<sup>4</sup> and Swarts and Odell<sup>6</sup>, peer review and iterative revisions are two key factors in successful writing assessment. Peer review is able to provide an environment where students can share their experiences<sup>4</sup> while placing their insights within a framework acceptable for understanding by their peers. This allows for active student involvement in the academic writing process and which, according to Held<sup>3</sup> and Gruber et al.<sup>7</sup>, makes the students less likely to repeat their mistakes.

**Table 3: Example of comment sheet for student peer review in CLAQWA.**

<b>A. Assignment Parameters</b>
<ol style="list-style-type: none"> <li>1. The writer addresses and develops each aspect of the assignment.</li> <li>2. The writer clearly has and maintains a main idea throughout.</li> <li>3. The writer exhibits an awareness of the audience’s needs and expectations.</li> <li>4. The elements of the paper clearly contribute to the writer’s purpose, which is obvious, specific, maintained and appropriate for the assignment.</li> </ol>
<b>B. Organization &amp; Development: Structural Integrity</b>
<ol style="list-style-type: none"> <li>5. The writer uses the opening to introduce the main idea, capture the reader’s attention and prepare the reader for the body of the paper.</li> <li>6. Transitional words, phrases, sentences and paragraphs (coherence devices) smoothly connect the paper’s elements, ideas or details, allowing the reader to follow the writer’s points effortlessly.</li> <li>7. Each paragraph is unified around a topic that relates to the main idea. All paragraphs support the main idea and are ordered logically.</li> <li>8. Closing synthesizes the elements, supports the main idea and finalizes the paper.</li> </ol>
<b>C. Organization &amp; Development: Reasoning &amp; Development Ideas</b>
<ol style="list-style-type: none"> <li>9. The essay exhibits a logical progression of sophisticated ideas that support the focus of the paper.</li> <li>10. Details help to develop each element of the text and provide supporting statements, evidence or examples necessary to explain or persuade effectively.</li> <li>11. All points are supported by a sufficient number of details.</li> </ol>
<b>D. Language: Contextual &amp; Audience Appropriateness</b>
<ol style="list-style-type: none"> <li>12 (a). Vocabulary reflects a thorough grasp of the language appropriate to the audience.</li> <li>12 (b) Word choice is precise, creating a vivid image. Metaphors and other such devices may be used to create nuanced meaning.</li> <li>13. All sentences are understandable.</li> <li>14. Clear and concise sentences vary, with the degree of complexity reflecting the audience and purpose.</li> <li>15. Point of view is consistent and appropriate for the purpose and audience.</li> </ol>
<b>E. Observation of Standard Edited English: Grammar and Mechanics</b>
<ol style="list-style-type: none"> <li>16 (a). Sentences are grammatically and mechanically correct.</li> <li>16 (b). References are consistent, and citations reflect appropriate style.</li> </ol>

One of the extremely useful tools that CLAQWA possesses is its peer review facility. The online CLAQWA system allows groups to upload and assess each other's papers using the Elluminate™ software. In class as well as virtual time by the teaching assistant versed in CLAQWA was included. Each student reviewed one paper and each paper was reviewed by three separate students. The peer reviewed comments were available without identification of the reviewers. Instructors, however, can track which reviews were done by whom to effectively give individual scores to each student for the peer review component of the term paper.

To ensure consistency of peer review, the students were given a grading rubric. The first rule is that the reviewer must simply identify the errors without making corrections to the paper. The students had to put a CLAQWA categorical correspondence number (or a few of them if necessary) next to their suggestions and criticisms. They were as follows: A = assignment parameters, B = structural integrity, C = reasoning & focus consistency, D = language, E = standard English. The peer review findings are summarized put into a comment sheet as in Table 3. The basis of the peer review sheet consists of the 16 elements or traits of CLAQWA (as highlighted in Table 1). The CLAQWA developers used the 16 elements to formulate related questions that probe at the analysis at each of the traits.

After a review, the paper owner, instructors and teaching assistant can then log in and see the comments and scores left by a given reviewer. After the peer reviews, groups then work on preparing their final drafts in consideration of the comments and scores of their peers as well as the teaching assistant and instructors. The final report is only graded by the instructors and the teaching assistant.

### **Results and Lessons Learned**

The final assessment done by the teaching assistant and the instructors yielded the following results. The score by group represents the average of the instructor and the 'calibrated' teaching assistant. Scores of the instructor from that of the assistant varied by  $\pm 0.5$  levels for both semesters.

CLAQWA provides a quantifiable assessment by trait either in the online or paper-based form as shown with the results in Tables 4 and 5 above. To be most effective, instructors and teaching assistants should become familiar with the system and one teaching assistant with experience should calibrate the scoring for the entire assessment. More details and documentation on CLAQWA are available at <http://usfweb3.usf.edu/CLAQWA/Online/Cross/crossdisciplinary.htm>.

CLAQWA is rooted in Bloom's taxonomy and can for measure the overall cognition of our students. Table 6 shows the change in cognitive levels of operation of students in the Spring 2009 class. The results show that cognitive level increased over the course of the semester and it is highly likely that this was due to an increased use of the system by the students doing the draft submittal and peer review.

Surveys were used to assess student views on CLAQWA both online in Fall 2008 and paper-based in Spring 2009. The general consensus of the Fall 2008 students was that the CLAQWA system worked well for them in dealing with a group project and the online feature created great convenience of being able to do different components of the project while away from campus. Technical difficulties with the actual program that were beyond the control of the department led to many criticisms by the students and hence the online component was dropped in Spring 2009. More interesting to this study was the transferability of the online tool to a paper-based system. More detailed surveying data was collected in Spring 2009 and the results are summarized in Table 7.

**Table 4: Fall 2008 CLAQWA level assessment findings by trait (for Section 001)**

CLAQWA Scale Trait	Trait	Gp 1	Gp 2	Gp 3	Gp 4	Gp 5	Gp 6	Gp 7	Gp 8	Gp 9	AVG
Assignment Parameters	1: Assignment Requirement	4.3	4.0	3.8	3.5	3.8	3.8	3.8	3.3	3.0	3.7
	2: Main Idea	4.0	4.3	3.0	2.8	3.8	3.0	4.3	4.3	3.0	3.6
	3: Audience	3.3	4.3	3.3	3.3	3.0	3.5	4.5	3.5	2.5	3.4
	4: Purpose	4.0	4.0	3.5	3.3	3.3	3.5	3.5	3.5	2.8	3.5
Organization & Development: Structural Integrity	5: Opening	3.8	3.3	3.0	3.5	3.5	2.8	3.0	3.3	2.8	3.2
	6: Coherence Devices	3.0	3.5	3.0	2.5	3.0	3.0	3.8	3.5	2.8	3.1
	7: Paragraph Construction	3.0	3.5	3.0	3.3	2.8	3.0	3.5	3.3	2.5	3.1
	8: Closing	3.3	3.3	2.3	2.8	2.8	2.3	3.3	2.5	1.5	2.6
Organizational Development: Reasoning & Development of Ideas	9: Reasoning	3.8	3.5	3.0	3.0	3.3	3.0	3.8	3.5	3.0	3.3
	10: Quality of Details	3.8	3.5	3.0	3.0	3.0	3.3	3.8	3.5	3.5	3.4
	11: Quantity of Details	4.0	3.8	2.8	2.5	3.8	3.5	3.8	3.8	3.8	3.5
Language: Contextual & Audience Appropriateness	12: Word Choice	3.8	3.5	3.3	2.8	3.0	3.0	4.0	3.5	3.3	3.3
	13: Comprehensibility	3.3	3.3	3.3	3.3	2.5	2.8	3.3	3.3	3.0	3.1
	14: Sentence Construction	3.0	2.5	2.8	3.0	2.3	2.8	3.3	3.3	3.0	2.9
	15: Point of View	4.8	3.5	3.5	3.3	3.3	3.5	4.3	3.8	3.5	3.7
Observation of Standard Edited English: Grammar & Mechanics	16: Grammar and Mechanics	3.3	3.0	2.5	2.5	2.5	2.5	3.0	3.5	2.3	2.8



**Table 5: Spring 2009 CLAQWA level assessment findings by trait (for Section 901)**

CLAQWA Scale Trait	Trait	Gp 1	Gp 2	Gp 3	Gp 4	Gp 5	Gp 6	Gp 7	Gp 8	Gp 9	Gp 10	Gp 11	Gp 12	Gp 13	AVG
Assignment Parameters	1	4.5	4.5	3.0	3.0	4.0	3.5	3.5	4.5	4.0	4.0	4.5	4.0	4.0	3.9
	2	4.5	4.0	3.0	2.5	4.0	3.0	3.5	4.0	4.0	3.5	4.5	4.5	4.0	3.8
	3	4.0	4.0	2.5	2.5	4.0	2.5	3.0	4.5	4.0	4.0	4.0	4.5	4.5	3.7
	4	3.5	3.5	2.5	2.0	3.5	2.0	2.5	3.5	2.5	3.0	3.0	3.0	3.5	2.9
Organization & Development: Structural Integrity	5	3.0	3.0	2.5	2.0	3.5	2.0	2.5	3.5	2.5	4.0	3.0	2.0	3.5	2.8
	6	2.0	4.0	2.0	2.5	4.0	2.0	2.5	4.0	3.5	2.5	5.0	3.5	3.0	3.1
	7	2.5	3.5	2.0	2.5	3.5	2.0	3.0	4.5	4.0	3.5	4.5	4.0	3.5	3.3
	8	2.5	3.5	2.5	3.0	2.5	1.0	2.0	2.5	4.5	3.0	2.0	2.5	2.5	2.6
Organizational Development: Reasoning & Development of Ideas	9	3.5	4.0	2.5	2.5	2.0	3.0	3.5	4.0	4.0	4.0	4.5	5.0	4.0	3.6
	10	2.5	4.5	2.0	1.5	2.5	2.0	3.0	4.5	4.5	4.0	4.5	4.5	4.5	3.4
	11	3.0	4.0	3.0	3.5	3.0	2.5	3.0	4.5	4.5	4.5	4.5	4.5	4.5	3.8
Language: Contextual & Audience Appropriateness	12	3.0	3.5	2.0	2.0	3.5	3.0	3.0	3.5	4.0	3.5	4.5	4.0	4.0	3.3
	13	3.0	4.0	2.0	2.0	3.5	2.5	3.5	4.0	4.0	4.0	4.0	4.5	4.0	3.5
	14	2.0	3.5	2.5	2.5	3.5	2.0	3.0	4.0	3.5	3.0	4.0	4.0	4.5	3.2
	15	2.5	4.0	3.0	3.0	3.5	3.0	4.0	4.5	4.5	4.0	4.5	4.0	4.0	3.7
Observation of Standard Edited English: Grammar & Mechanics	16	3.0	3.5	2.5	3.0	3.5	3.0	3.5	4.0	4.5	3.5	4.5	4.5	4.5	3.7

**Table 6: Change in cognitive level of students (Spring 2009 ENV4001) measured with CLAQWA**

Group	Cognitive level (1-4)		Change in cognitive level
	Draft Paper	Final Paper	
1	1	3	+2
2	2	3.5	+1.5
3	2	2.5	+0.5
4	2	2.5	+0.5
5	2	3.5	+1.5
6	1.5	2.5	+1
7	1	2.5	+1.5
8	3.5	3.5	0
9	3.25	3.5	+0.25
10	2	3	+1.5
11	2	3.5	+1.5
12	3.5	3.5	0
13	2	3.5	+1.5

**Table 7: Spring 2009 ENV4001 CLAQWA Student Survey Results (% of respondents) and Comments.**

Survey question with associated student comments (based on 27 respondents out of a possible 39)	Yes	No	*NR
<p><b>Did you think the CLAQWA system was appropriate for an engineering paper?</b> "CLAQWA allowed each student to know exactly what was expected....It also removed the uncertainty in the grading scale, which in my opinion is of great concern to students." "Being an engineering student, I sometimes forget about the grammar, punctuation, and sentence structure, The system helped assist me through writing a[n] in depth policy on the effects of greenhouse gas emissions."</p>	89	11	0
<p><b>Did you think the CLAQWA system worked well as a paper based tool?</b> "CLAQWA worked well as a paper based tool. It provided guidance for the peer reviews which allowed students to offer more useful feedback."</p>	78	11	11
<p><b>Is it advisable to use the CLAQWA method of assessment even in group work as you all did?</b> "In my opinion it forced all students to be more involved in each aspect of the paper." "Group writing is a challenging endeavor and having a general outline of the expectations is helpful in holding team members responsible. I found my group (as well as the group I peer reviewed) has varying abilities of writing and the CLAQWA system emphasized the differences."</p>	89	11	0
<p><b>Do you think the CLAQWA system is easy to follow?</b> "It was easy to follow and CLAQWA provided clear guidelines on what writing level was required to achieve the cognitive level expected..." "In my opinion it is easy to understand and follow it as long as you get familiarized with the steps."</p>	56	44	0
<p><b>Did you find the literature provided on CLAQWA helpful in grasping the grading system?</b> "It did a great job at explaining what was expected, and provided some benchmarks to help determine if the goals had been met or not. If a person is objective enough, the system provides a pretty good idea of what the final grade is going to be precisely because it sets specific goals to be met."</p>	78	11	11
<p><b>Would you recommend that we continue using the tool in the future offering of ENV4001?</b> "It eliminates the randomness of grading based on content or writing style." "It helps (especially engineers) us as developing writers and provides information to the scope of the paper as well as depth."</p>	89	11	0
<p><b>Do you think that this is a fair assessment tool that can be used across engineering disciplines to improve the written communication effectiveness of engineers?</b> "Having went [gone] through the process of writing a group paper using the system I personally witnessed fellow students['] writing improve. I personally believe this happened because of the [clear] expectations....and the grading scale provided by CLAQWA."</p>	100	0	0
<p><b>Term paper assessment required peer review. Do you think the information that you gathered from the peer review was extremely valuable?</b> "I personally found the peer review very helpful [as] the group that reviewed our paper provided insight into the subject that my group and I had not considered." "Extremely valuable - provided guidance and direction for a better final product."</p>	78	22	0

\*NR – No Response

Table 7 shows that students generally thought that the paper-based tool worked well in the production of their group term papers (78%) and that CLAQWA was appropriate for engineering assignments of a similar nature (89%). All of the respondents thought that CLAQWA can be used throughout engineering curricula to enhance the written communication effectiveness of budding engineers and 78% also saw the personal value of having the peer review as part of the assignment.

From the initial use of CLAQWA in the Environmental Systems Engineering class in Fall 2008, it continues to be adopted by the Department of Civil and Environmental Engineering. The goal is to introduce the tool into all classes. Given CLAQWA's versatility as either an online or paper format, it is easy to continue regardless of instructor preference. Also, the instructors of the Spring 2010 class have decided to attempt to raise the cognitive levels of individual students by having homework questions on each assignment that are totally qualitative and increasing in difficulty up the ladder of cognitive hierarchy. This idea stemmed from the deduction of the instructors and teaching assistant who found that many students were able to give good, critical peer reviews while having extremely weak papers themselves<sup>8</sup>. In this way the instructors hope that they will be able to track improvement in levels and persistence of trait mistakes before the final project to produce more effective writers and reports.

### **Risks and Limitations to the Application of CLAQWA**

The faculty involved agree that CLAQWA attempts to make a science or checklist out of something that is an art and that is difficult. Nevertheless, CLAQWA helps to demystify the differences between, for example, an A and a C paper. CLAQWA simply provides a tool or framework to assist faculty evaluate writing and help students to improve their writing but it does not pass or fail any paper that is put through the system. The decision to pass or fail any paper still relies on instructor judgment and if the assignment's rubric is developed appropriately, then use of CLAQWA will give an accurate indication of whether the paper is meeting the faculty's requirements.

The use of the CLAQWA system, inclusive of the peer review as required some level of in class teaching time. During the Fall 2008 course offering, one hour of teaching and demonstration was done during class time to acquaint students with CLAQWA, its inner workings and how to use the online facility. This was done by a Teaching Assistant from the Department of English at the University of South Florida that was experienced and familiar with CLAQWA. For the Spring 2009 the instructor, an engineering faculty, also devoted one hour to teaching about CLAQWA in class on his own after being trained in Fall 2008 and experienced with the use of the CLAQWA system. For both semesters the teaching assistant knowledgeable in CLAQWA was used to 'calibrate' the faculty scoring since the developers of CLAQWA suggests that each paper should be independently scored and discussed if there are any trait scores that are not within  $\pm 0.5$ . This calibration process further assisted faculty in understanding the CLAQWA system and its scoring scale.

Based on Table 7, some of the students are not happy with the application of CLAQWA. During Fall 2008 technical difficulties with the online environment frustrated students. In

Spring 2009, where the paper-based format was used students, were still uncomfortable with the system. Though in the minority, the same 11% of respondents gave comments along the lines of: “The CLAQWA system is repetitive and overly complicated....”; “I would have felt more comfortable with the teacher or TA grading them based on their opinion...that is the way we have been graded since elementary school so we are used to it, the CLAQWA system just made everything more confusing”; “...CLAQWA was still subjective.”

In order to meet Outcome 16 of the Civil Engineering BOK a department must show students are effective verbal and oral communicators. The linkage between CLAQWA assessments to a determination of whether a department meets this requirement will need some more integration efforts on the part of faculty. Are we trying to show a student’s change in levels as a function of time at the university? Are we trying to show that students meet a certain average across all cognitive levels? These are useful contexts to frame the evaluations of Outcome 16.

### **Conclusion**

The CLAQWA system is a beneficial tool for improving the development of undergraduate writing level. It provides an objective, quantifiable assessment framework for engineering written communication. The use of CLAQWA can indeed be beneficial across a wide array of disciplines once the scorers have been trained. It also encourages student participation in the assessment process through the peer review process which fosters more communication amongst our engineering students. This paper showed that CLAQWA can be successfully implemented as a more conventional paper-based tool or as the online version with the same beneficial effect on students. Hence this tool can be transferred to pilot studies in areas that do not have resources to acquire the online version.

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