

Application of Plagiarism Screening Software in the Chemical Engineering Curriculum

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1. Introduction

Most chemical engineering (ChE) departments require coursework involving written laboratory and/or design reports, especially as students enter their junior and senior years. A drawback of written assignments is the potential for plagiarism of outside materials by students. Plagiarism is problematic from an academic perspective for two commonly-cited reasons: (1) the student(s) who plagiarize neither develop associated writing skills nor learn the intended lesson content¹, and (2) students within a class where other students are plagiarizing without knowledge of the instructor may receive comparatively poor grades even though they are learning and developing the intended skills.

Prior to word processing and the Internet, plagiarism required considerable effort: students must first locate a book, article or old report, then write or type the outside text. However, in recent years convenient access to text and other materials via the Internet has increased the ease with which plagiarism can be committed: cutting-and-pasting pages of text into a word processor can be completed in seconds. Additionally, students raised during the Internet Age likely have relaxed views on intellectual property rights since illegal downloads of music, movies and other media are more commonplace and difficult to police^{1,2}. These factors indicate that plagiarism is a growing concern in academic institutions. This concern is particularly relevant for engineering programs since previous research has suggested that engineering students may be especially likely to copy materials from textbooks, etc. for homework assignments³.

The most common method to identify plagiarism is the “I know it when I see it” approach, where faculty identify passage(s) of text they suspect are plagiarized during grading, typically by identifying text with quality exceeding that reasonably expected of the student, or targeting detailed descriptions with no citation. This method requires little effort on the part of the instructor, but it is not rigorous toward identifying plagiarism. An obvious drawback of this approach is that documents containing plagiarism that do not openly appear to be plagiarized can pass by faculty unnoticed, and students may then receive grades they did not earn. However, students who submit grossly plagiarized works can often be identified by this method, and these students typically face harsh academic penalties including failed assignments/courses or even expulsion. An underlying drawback of this method is that the first set of students (those who plagiarized unnoticed) receive no punishment, while the second set of students (who were caught) are penalized, even though they displayed the same behavior. Without vigilance in identifying plagiarism, some offending students are able to pass off plagiarized works as their own, while others committing similar infractions are punished; this is not an equitable approach.

A more insidious drawback of the “I know it when I see it” method of plagiarism screening is exemplified by the situation encountered by Michael McAdoo and the University of North Carolina (UNC). McAdoo, a UNC student-athlete, submitted a paper for a UNC course that was

later found to be footnoted and sourced by a tutor; the UNC honor court punished McAdoo by assigning him a grade of F on the paper and placing him on academic probation, removing him from the UNC football team⁴. As part of McAdoo's appeal of UNC's decision, the paper in question was made public. When processed by a third party using plagiarism screening software, the paper was found to contain plagiarized materials that were not previously identified. The discovery of plagiarism in McAdoo's paper eliminated his chances of reinstatement, raised questions about UNC's honor court, and "produced more embarrassment for [the] university"⁴.

McAdoo's plagiarism was missed not only by the initial professor, but also the UNC honor court, the athletic department and the NCAA⁴. Though the plagiarism was well hidden and not identified without assistance from a plagiarism screening program, the story quickly became national news, and the academic reputation of UNC was attacked. This unfortunate event exemplifies the likely ineffectiveness of the "I know it when I see it" method of plagiarism screening and highlights the larger responsibility universities must bear to prevent plagiarism by its students.

Use of plagiarism screening software has been shown to be effective in identifying plagiarism in student papers¹. However, a risk in the use of plagiarism screening software by instructors is the fostering of student distrust, due to students feeling that their instructor is "after them" or does not trust them^{5,6}. Literature studies have investigated student views on the use of plagiarism screening software by their instructors, generally concluding that the use of plagiarism screening software makes students uncomfortable and negatively impacts trust in student-instructor relationships⁶. However, current literature studies on the topic of student views on plagiarism screening software are often subjective in nature and tend to discuss anecdotal evidence, such as student comments alone, as an indication of student distrust. In contrast, a comparatively objective approach is attempted in this study. Current literature studies also tend to focus on the application of plagiarism screening software to humanities courses, rather than for engineering courses requiring technical writing skills. It is possible that student views will vary depending on the type of writing they are assigned. The objectives of this study are (1) to investigate the effectiveness of plagiarism screening software in identifying plagiarism in ChE papers and (2) to identify the attitudes of undergraduate ChE students toward their instructors using plagiarism screening software.

2. Description of study

Plagiarism screening software was applied to four courses in a university ChE curriculum during the Fall 2011 semester: a required junior-level unit operations laboratory course (CHE 330), an elective senior-level unit operations laboratory course (CHE 331), a required junior-level professional development seminar course (CHE 395), and a required senior process design course (CHE 450). Additional information on the courses and written deliverables assigned in each course is given in Table 1.

All written assignments submitted by students in each course were screened for plagiarism using the plagiarism screening service Turnitin.com, which compares submitted text against a database containing (1) current and archived internet pages, (2) periodicals, journals and other licensed publications and (3) assignments and papers submitted by other students to the Turnitin.com

service. Many plagiarism screening software packages are available for use. In particular, Turnitin.com has been shown to be effective in identifying text in written documents matching outside sources while being resistant to technical “tricks” intended to hide plagiarism from the software, such as using Cyrillic equivalents for certain characters to avoid detection⁷. It is assumed that the actual plagiarism screening software package chosen will not affect student views on use of the software by faculty.

Table 1. Courses utilizing plagiarism screening and typical student deliverables.

Course Number	Course Title	Level	Number of Students	Typical Writing Assignments
CHE 330	Unit Operations Laboratory I	Junior	38	Group laboratory reports
CHE 331	Unit Operations Laboratory II	Senior	20	Group laboratory reports
CHE 395	Professional Development Seminar	Junior	66	Individual technical writing assignments
CHE 450	Chemical Engineering Design I	Senior	112	Group design reports

The effectiveness of plagiarism screening software in identifying plagiarism in student reports was investigated by comparing the number of instances of plagiarism discovered in semesters prior to using the software compared to the number of instances of plagiarism found by the software during the semester the software was utilized. In order to investigate student attitudes toward faculty using plagiarism screening software, a brief questionnaire was given to students on the last day of class for each course. The questionnaire solicited student views on faculty use of plagiarism screening software to determine how ChE students view the use of such software and any resulting effects on student-instructor relationships. The questionnaire appears in Table 2. Students’ responses to Questions 1 – 3 used a Likert scale of 1 – 5, with 1 indicating a strongly negative response and 5 indicating a strongly positive response. Question 1 was directed toward students’ level of comfort with their instructor using plagiarism screening software. Questions 2 and 3 probed the feelings of students toward continued future use of the software in the class they were currently enrolled as well as other courses in the ChE curriculum. Question 4 was open-ended, asking for additional written comments on the use of plagiarism screening software by instructors; this question was used in part to determine additional factors or views not considered when constructing the study.

A limitation of this study is that the semester sample size was small, comparing only two semesters, but the total number of students for Fall 2011 (236) provided a reasonable number of responses for one semester’s study. Future testing of larger sample sizes will yield more conclusive results.

Table 2. Questions asked in student questionnaire.

Question	Text
1	How comfortable do you feel with your instructor using TurnItIn to screen written assignments for plagiarism?
2	Do you agree that the CBE Department should utilize TurnItIn to screen for plagiarism in future [course number] classes?
3	Do you agree that the CBE Department should utilize TurnItIn to screen for plagiarism in all future courses requiring written assignments (e.g. CHE 330/331, CHE 395, CHE 450, etc.)?
4	Please provide any additional comments on the use of TurnItIn in this course.

3. Results

3.1. Impact of plagiarism screening software on number of identified instances of plagiarism

This portion of the study compared the number of instances of plagiarism identified in the previous semester (i.e. when plagiarism screening software was not used) to the number of instances identified in the semester the software was used. Instances of plagiarism were placed into two categories: “malicious” and “non-malicious.” In brief, malicious plagiarism was characterized by use of a significant amount of text (e.g. multiple sentences) from outside sources with little or no paraphrasing, as well as a lack of citation; these were cases where it was deemed the student(s) were deliberately attempting to pass off another’s material as their own in a malicious fashion. All instances of malicious plagiarism were referred to the Office of Student Conduct for further investigation. Non-malicious plagiarism was characterized by comparatively minor citation problems, such as not paraphrasing to an acceptable extent or not including a citation for a small amount of text; these were cases where it was deemed the student(s) made an “honest” mistake or could benefit from additional instruction on proper citation protocol. Instances of non-malicious plagiarism resulted in a private conversation by faculty with the student(s) involved and further instruction on citing. These definitions of malicious and non-malicious plagiarism are the opinions of the authors. Non-malicious plagiarism as defined here (such as inaccurate or otherwise “sloppy” citations) can also be interpreted as a significant plagiarism issue depending on instructor perspective. Other faculty may espouse a more aggressive approach, considering even instances described here as non-malicious to be suitable for referral to the Office of Student Conduct, a grade of zero on the assignment, etc.

Instances of identified plagiarism in both studied semesters are summarized in Table 3. Data show that application of plagiarism screening software did not significantly increase the number of instances of malicious plagiarism identified in each course, indicating that the “I know it when I see it” approach may be suitable for identifying gross instances of plagiarism. A complicating factor is that during the semester plagiarism screening software was used, students were informed in the syllabus and on the first day of class that their papers were being screened for plagiarism prior to submission. This information likely provided additional encouragement for students to avoid malicious plagiarism in fear of penalty, which may in itself be a benefit of the use of plagiarism screening software.

Table 3. Number of instances of malicious and non-malicious plagiarism identified before and after using plagiarism screening software.

Course Number	Malicious instances of plagiarism		Non-malicious instances of plagiarism	
	Semester prior to using software	Semester using software	Semester prior to using software	Semester using software
CHE 330	1	0	2	6
CHE 331	0	0	0	2
CHE 395	0	0	0	7
CHE 450	0	1	0	3

While the number of identified instances of malicious plagiarism was similar regardless of whether plagiarism screening software was used, the number of instances of non-malicious plagiarism identified increased for each class. This was expected since non-malicious plagiarism is typically better hidden within the text and difficult to identify during reading, but is readily identified when using plagiarism screening software¹. Though non-malicious instances of plagiarism are not necessarily a severe problem on their own, their presence indicates a lack of attention or understanding by students on proper citation protocol. The identification of non-malicious plagiarism and the resulting private conversation between faculty and student is an important teaching opportunity which helps students avoid making a similar mistake in the future when the impact of plagiarism may be more severe.

3.2. Responses from student questionnaires

Data describing student responses to Question 1 of the questionnaire are given in Table 4. Analysis of variance (ANOVA) treatment of the data shown in Table 4 shows that the responses of students from each course are the same at a 99% confidence level considering data scatter. This finding implies that students had a similar comfort level with faculty using plagiarism screening software regardless of junior/senior class standing or whether the course was a laboratory, design or seminar course.

Table 4. Student responses to Question 1, indicating level of comfort with instructor using plagiarism screening software (scored on a scale of 1 – 5, with 1 being very uncomfortable and 5 being very comfortable).

Course Number	Mean	Standard Deviation	Median	Mode	% of Negative Responses (Score < 3)	% of Positive Responses (Score > 3) Accompanied by Concern
CHE 330	3.91	1.04	4	5	7.9	11.5
CHE 331	4.61	0.79	5	5	5.0	19.4
CHE 395	4.17	0.99	5	4	9.1	18.2
CHE 450	3.88	1.06	5	4	9.8	24.7

Based on data in Table 4, it can be inferred that students were generally comfortable with their instructor using plagiarism screening software to screen student documents for plagiarism. This is congruous with selected student responses to Question 4:

- “Please use this [software] to rid the [ChE] program of those who do not deserve the degree that so many work so hard for.”
- “Engineers are all about integrity right? So no one should have problems with this.”
- “Undetected plagiarism only hurts good students.”
- “I think it catches things that the professor might not and will help to make the grades more fair.”

Anecdotally, ChE students seemed to want “cheaters” to be caught, with the argument that honest students work hard for their degree and cheaters do not. However, there were also comments supporting uncomfortable views:

- “It is uncomfortable to feel like you’re getting analyzed for cheating even if you know that you did not. It makes the student worry that they may get in trouble even if they did nothing wrong and feel as if the department/instructor doesn’t trust them.”
- “This is just another example of the College of Engineering not trusting their students to have integrity.”
- “I don't want this to turn into some kind of witch-hunt where I have to defend myself for even writing a similar sentence.”

These comments reflect the views espoused in other literature on the use of Turnitin⁶. However, in the selected sample of ChE students, these views were in the minority as indicated by the small fraction (<10%) of negative responses from each class. It is suggested by the authors that the focus of this particular ChE department on ethics throughout the curriculum may inform the more tolerant nature of students’ views toward their instructor using plagiarism screening software. Similar views have also been described in other studies pertaining to non-engineering students^{8,9}.

A considerable fraction of students who gave an overall positive response to Questions 1, 2 and 3 (i.e. their mean score among the questions was greater than 3) also expressed concern in their responses to Question 4. These responses indicate a notable factor to be considered is the students’ confidence in the judgment and discretion of the faculty using plagiarism screening software:

- “I have no problem as long as those who require [the software] know how to interpret the results properly and understand not to just use the match percentage response.”
- “As long as the professors look beyond the match percentage response and look at what Turnitin actually flagged as a match I think the software is great.”
- “It is a good tool for spotting plagiarism but there is always a problem with common information such as dates and figures making the match percentage skewed higher than it should be.”
- “As long as the teacher uses proper judgment on the program I have no problem with the use of plagiarism screening software. I have faith in [this instructor’s] judgment.”

A lesson learned from responses to Question 4 is that many students were concerned about instructors using the software incorrectly, specifically that their instructor would look only at the percentage of matching words in a document, rather than reading the paper and examining the matched phrases individually to determine if plagiarism occurred. The authors posit that it is critical that plagiarism screening software be used as a tool to initially identify matching text and figures, but not to use the percentage of matching words in a document (a value automatically returned by the software) as the sole source of evidence when contemplating academic penalties. Words which match text in other documents but are not plagiarized, such as cited material or output from process simulation software, can raise the match percentage value even though plagiarism has not occurred. Interpretation of the output from plagiarism screening software should be the responsibility of the instructor¹⁰. It is recommended that when using plagiarism screening software in a ChE course, faculty should show the students at the onset of the course how the software is used and share examples of a writing sample that has a high match percentage but little actual plagiarism so that students understand they will not be accused of plagiarism without proper evidence.

Questions 2 and 3 of the questionnaire investigated whether students agreed that use of plagiarism screening software in ChE courses should be continued; Question 2 was specific to the course, while Question 3 referred to the future use of plagiarism screening software in all ChE courses requiring written assignments. Student responses to Questions 2 and 3 are summarized in Tables 5 and 6 respectively. Responses to Questions 2 and 3 indicate that the tested sample of ChE students agreed with continued use of plagiarism screening software in their courses. Pair-wise hypothesis testing indicates that there is no difference between student responses to Questions 2 and 3 on a per-class basis at a 95% confidence level. This finding indicates students in each course felt similarly about continued use of plagiarism screening software both in future offerings of their specific course and in the broader undergraduate ChE curriculum.

Table 5. Student responses to Question 2, regarding whether students agreed that plagiarism screening software should be used in future offerings of the course (scored on a scale of 1 – 5, with 1 being strongly agree and 5 being strongly disagree).

Course Number	Mean	Standard Deviation	Median	Mode	% of Negative Responses (Score < 3)
CHE 330	3.85	0.83	4	4	5.3
CHE 331	4.45	0.75	5	5	5.0
CHE 395	3.72	0.84	4	4	6.1
CHE 450	4.00	0.90	4	4	4.5

Table 6. Student responses to Question 3, regarding whether students agreed that plagiarism screening software should be used in future offerings of all ChE courses requiring written assignments (scored on a scale of 1 – 5, with 1 being strongly agree and 5 being strongly disagree).

Course Number	Mean	Standard Deviation	Median	Mode	% of Negative Responses (Score < 3)
CHE 330	3.82	1.04	4	4	7.9
CHE 331	4.33	0.78	5	4	5.0
CHE 395	3.64	0.87	4	4	9.1
CHE 450	3.84	0.94	4	4	7.1

4. Conclusions

A preliminary study investigating the application of plagiarism screening software in the ChE curriculum was completed. Written assignments from two laboratory courses, a professional development seminar course, and a design course were screened for plagiarism throughout the Fall 2011 semester using the plagiarism screening software Turnitin.com. When comparing the number of identified instances of plagiarism during the semester while using the software with a previous semester where no software was used, it was found that malicious (gross) plagiarism was identified with a similar frequency by faculty regardless of whether plagiarism screening software was used. However, the number of identified instances of non-malicious plagiarism (such as poor paraphrasing or missing citations for small amounts of text) rose during the semester using plagiarism screening software. Based on this analysis, it appears plagiarism screening software is an important tool to identify when students need additional instruction on paraphrasing and other citation protocol.

Responses to a questionnaire soliciting student views on the use of plagiarism screening software by their instructors were examined. The questionnaire inquired about how comfortable students were with faculty screening written assignments for plagiarism using software, as well as whether students felt plagiarism screening software should be used in ChE courses in the future. Responses showed that students were comfortable overall with instructors using plagiarism screening software and agreed that the software should be used in future offerings of the studied courses; these views were corroborated by written student comments. This finding is in contrast to other literature⁶ which argues students had negative views of faculty use of plagiarism screening software; it is possible this finding is due to the focus of this particular ChE department on ethics throughout the curriculum. A minority of students polled in the study (<10%) had negative views of faculty use of plagiarism screening software; written comments addressing these views centered on students' fear of being unfairly accused of plagiarism and feeling they were not trusted by faculty. ANOVA analysis suggests that student views were similar regardless of class standing or course type at a 99% confidence level.

Questionnaire responses also indicated that students were wary of faculty using plagiarism screening software incorrectly, using only the number indicating percentage of matching words in a document as the basis for plagiarism accusations, rather than by analysis of matched words and phrases. This finding indicates that effective communication of how faculty use the information supplied from plagiarism screening software to students would help resolve student anxiety toward use of the software in the ChE curriculum.

Planned future work involves the expanded use of Turnitin.com in additional undergraduate courses requiring writing assignments as well as graduate courses, such as the graduate proposition course. The authors plan to develop standard “scripts” for discussion of the use of Turnitin.com as well as examples illustrating the judicious use of the software tool.

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