Attitudes of second year Computer Science undergraduates toward plagiarism

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The apparent rise of academic dishonesty such as plagiarism is of great concern to the academic community worldwide. Although there is a large volume of literature on plagiarism in developed countries, there appears to be a dearth of literature for the Caribbean, a developing region. An exploratory study was conducted at a Caribbean university to determine the attitudes of 85 second-year computer science students toward plagiarism using the Attitudes Toward Plagiarism (ATP) survey instrument. Although 74 percent of the students were able to provide a basic definition of plagiarism only 5 percent included self-plagiarism in the definition. Students had a moderate, positive attitude toward plagiarism (which is not desirable) and low to moderate subjective norms. There was a statistically significant difference between a positive attitude for gender and age; and a statistically significant difference for subjective norms for gender. Many students believed that self-plagiarism is not harmful and therefore should not be punished. The author recommends an extension of the current plagiarism policy to include self-plagiarism and, the creation of a systemic academic honesty education programme that is both gender and age specific. These strategies can potentially help to mould reputable young researchers and build institutional reputation.

Key words: academic dishonesty, plagiarism, self-plagiarism, source-code plagiarism, academic integrity

Introduction

Allegations of academic dishonesty, which include plagiarism, appears commonplace in the press; for example, in April 2012 the president of Hungary, Pat Schmitt, resigned after allegations of plagiarism in his doctoral thesis submitted to Semmelweis University (Karasz, 2012). These allegations stemmed from the fact that 16 pages of his thesis were found to be an identical translation of a German author's work while a further 180 pages were identical extracts of a Bulgarian's author's work (Karasz, 2012). In the same year, Romania's Prime Minister, Victor Ponta, was accused of plagiarising large portions of his PhD thesis a month after research minister, computer scientist Ioan Mang was accused of plagiarizing several papers (Schiermeir, 2012).

Numerous allegations of plagiarism have also rocked the academic community in Germany due to the identification of several cases of unattributed materials being used in doctoral theses (Schuetze, 2011). In 2011, the defence minister Karl-Theodor zu Guttenberg was forced to resign from office (Schuetze, 2011), as well as the European Parliamentarian, Jorgo Chatzimarkakis (Borrud, 2011). Furthermore, in 2013 Annette Schavan also quit over allegations of plagiarism (BBC, 2013). Another notable instance of alleged academic dishonesty was the case of the Dutch psychologist Diederik Stapel who was accused of falsifying and manipulating data included in over 30 papers published in peer-reviewed journals (Callaway, 2011; Bhattacharjee, 2013).

Plagiarism is an issue that can affect the reputation of any tertiary level institution therefore its effects need to be examined. Some universities have well established plagiarism policies and fully utilize plagiarism detection software as a part of their overall prevention strategy. Other universities however have only recently implemented policies and plagiarism detection tools (TNN and Agencies, 2012). Just because a policy is in place however does not guarantee that plagiarism will not occur. Students need to be sensitised to the issue of plagiarism by first being provided with a clear and consistent definition; they should also be trained in best practices to encourage ethical behavior and correct attitudes toward plagiarism.

Although there is a substantial volume of literature on plagiarism (including students' attitudes toward it) for many developed regions, there is a dearth of literature relating to the Caribbean context. This is a problem because institutions in the Caribbean are striving to meet international standards as they aim for accreditation in order to extend their reach into international markets. The academic integrity of these institutions will therefore have to be considered.

The university campus under study offered both undergraduate and post-graduate programmes in law, social sciences, the arts, education, medicine and the sciences and had a student enrolment of approximately 8,500 (including undergraduate and post-graduates) at the time of the study. Students in the Department of Computer Science, Mathematics and Physics (in the Faculty of Pure and Applied Sciences) were able to undertake three year B.Sc. Computer Science and B.Sc. Information Technology degree programmes, as well as joint majors such as Computer Science (CS) and Accounting, and Information Technology and Management. Both Computer Science and Information Technology majors were required to complete a Software Engineering course, while Computer Science majors were also required to complete a Computer Architecture course.

Just before the beginning of this study the university introduced a plagiarism policy and the use of plagiarism detection software, TurnItIn, in courses. This policy however was vague with regard to source code plagiarism and did not address self-plagiarism. In individual CS courses some lecturers provided information on source code plagiarism, however the approach was not systemic.

This paper describes a cross-sectional study which explores the attitudes of CS students toward plagiarism at a tertiary institution in the Caribbean. It specifically examines students' definition of plagiarism and their attitudes toward

plagiarism and self-plagiarism.

The research questions are:
1. How do CS students define plagiarism?
2. What are the positive attitudes, negative attitudes and subjective norms of CS students toward plagiarism?
3. Are there significant differences in positive attitudes and subjective norms toward plagiarism across sex and age?

Literature Review

Academic dishonesty is a broad term used to describe instances of plagiarism (use of another's work without acknowledgement); fabrication (publishing manufactured results); falsification of data (invalid or inadequate data collection procedures); and cheating (Kizza, 2009a). Academic dishonesty has become commonplace at many institutions worldwide which impacts the ethics and morality of people (Kizza, 2009a; Kizza, 2009b). Furthermore, plagiarism in fields like computer science and engineering may lead to a large number of insecure and unsafe systems since the plagiarised source code is often not fully understood or fully tested (Kizza, 2009a) and may become harmful to people (Kizza, 2009b).

What is plagiarism?

Plagiarism in its simplest form may be defined as "claiming credit for ideas or creations without proper acknowledgement" (Martin, 2004, p. 1). There are many types of plagiarism including: plagiarizing of ideas, word-for-word plagiarism (reproduction without quotation marks), plagiarism of authorship (claiming someone else's work as your own), and self-plagiarism (Martin, 2004; Collberg and Kobourov, 2005). A person might even be found guilty of plagiarism of secondary sources by using, but not reading an article cited in another article (Martin, 2008).

In CS there is an additional level of complexity when considering plagiarism, specifically source code plagiarism, and disagreements often occur when attempting to differentiate between software reuse and plagiarism (Cosma and Joy, 2008). This stems from the fact that the reusing of existing source code is a standard practice in software engineering (Gibson, 2009). As a result, additional forms of plagiarism (other than cut-and-paste) must be considered, for example 1) collusion (when unacknowledged help is received); 2) unacknowledged reverse engineering (moving from source code to an abstraction such as a design or idea, and reusing it); 3) unacknowledged translation from one computer language to another, and; 4) unacknowledged code generation by a software tool (Gibson, 2009). A code of practice is therefore required to guide students through the software production process (Gibson, 2009).

Collberg, Kobourov, Louie and Slattery (2003) described self–plagiarism as "the use of one's own previously published materials in the creation of a new published material without crediting the previous paper as a source"(Collberg et al., 2003, p. 1). Similarly, Kizza (2009b) defined self-plagiarism as the reuse of

parts of a previous publication in a subsequent publication. Self-plagiarism is a significant issue in CS since students often reuse code, which was written in a previous assignment, in a subsequent assignment (Cosma & Joy, 2008).

Students' attitudes toward plagiarism

Pupovac, Bilić-Zulle and Petrovečki (2008) studied the prevalence and attitudes toward plagiarism in Spain, the United Kingdom, Bulgaria and Croatia. In the United Kingdom (UK), 92 students were studied and it was reported that self-plagiarism was the most common type of plagiarism, with 35 percent of the students committing it at least once. These students saw nothing wrong with copying from Internet forums and discussion groups. Similarly, in the Bulgarian study, 40 percent of the 94 students studied believed that plagiarism was acceptable and 47 percent committed self-plagiarism at least once. In the Croatian study of 295 students, it was reported that 65 percent of the students felt that self-plagiarism was justifiable. Finally, in the study of 727 students at universities in the Balearic Islands, 66 percent of the students admitted that they plagiarised from non-digital sources and 77 percent committed cyperplagiarism at least once during their programme; compared with 47 percent (for non-digital sources) and 59 percent (for cyperplagiarism) at other Spanish universities.

In later work, Mavrinac, Brumini, Bilić-Zulle and Petrovećki (2010) developed the attitude toward plagiarism (ATP) questionnaire and validated this 29 item questionnaire (through a study of 227 students from three Croatian universities), which was divided into three factors that measured attitudes toward plagiarism. Factor I (12 items) measured the positive attitude toward plagiarism (approval of plagiarism); factor II (7 items) measured the negative attitude toward plagiarism (condemnation of plagiarism); and factor III (10 items) measured the subjective norms toward plagiarism (common thinking about plagiarism and its acceptance in the academic and scientific communities). Further, Mavrinac et al. (2010) reasoned that a low positive attitude, a high negative attitude and low subjective norms reflect favourable attitudes in terms of academic integrity.

Pupovac, Bilić-Zulle, Mavrinac and Petrovečki (2010) subsequently used this instrument to determine the attitudes toward plagiarism of 146 first year medical students at a Croatian university. The results revealed a moderate positive attitude toward plagiarism (a score of 36 ± 7), a moderate to high negative attitude (a score of 26 ± 4), and moderate subjective norms (32 ± 6). In addition, they found that: half of the students would plagiarise to hide poor writing skills (item #1); three-quarters of the students believed that plagiarism was important to discuss (item #14); two-thirds felt that plagiarism was not a serious offence (item #15) and does no harm to science (item #17); half of the students felt that they were studying in a plagiarism-free environment (item #26); and, three-quarters of the students did not mind copying text from their previous work (item #23).

Ghajarzadeh, Norouzi-Javidan, Hassanpour, Aramesh and Emami-Razavi (2012a) examined the attitudes toward plagiarism of 198 undergraduate medical

students (comprising Interns, Clerks and Residents) at the Tehran University of Medical Sciences in Iran. The study utilised the Persian version of the ATP questionnaire, which comprised of 10 items in factor I, 7 items in factor II and 8 items in factor III. It was reported that overall interns gave the most correct answers (attitudes that reflect academic integrity), while resident participants gave the most incorrect answers. Interns also had more correct answers to questions about self- plagiarism than residents and clerks. Conversely, Ghajarzadeh, Norouzi-Javidan, Hassanpour, Aramesh and Emami-Razavi (2012b) studied the attitudes of 87 medical faculty members at the Tehran University of Medical Sciences. This cross-sectional study also utilised the Persian version of the ATP questionnaire. Faculty members were able to answer correctly fewer questions related to negative attitude than positive attitude and subjective norms; and there was not a statistically significant difference in the number of correct answers between males and females.

Ryan, Bonanno, Krass, Scouller, and Smith (2009) reported the results of an "attitudes to plagiarism behaviour survey" conducted at the University of Sydney in Australia. During the study, 897 pharmacy students (823 undergraduates and 74 postgraduates) answered questions that probed their rating of acceptability of a number of plagiarism practices. The results showed that many of the students (at both levels): invented references because they had forgotten the details of a source; copied other people's words without proper referencing; submitted assignments that were already assessed; included downloaded materials in assignments without referencing; and copied colleagues' work without their knowledge. The authors concluded that this behaviour was worrisome since so many students engaged in unacceptable academic writing conventions. Shear, Dick, Markham, Macdonald and Walsh (2002) also reported the results of administering an 18 scenario questionnaire on "Questionable Work Practices" to IT students at two universities in Australia. The 287 participants found several of these scenarios unacceptable; for example, copying a student's work and submitting it; copying materials from the Internet or a text book for an essay; and, submitting an assignment, all of which was copied from a friend. Although many of the students admitted to cheating, none of them stated that they practiced all of the scenarios; also, students at both of these universities perceived that these cheating practices were occurring at their university.

Thompsett and Ahluwalia (2010) reported, in a pilot study, that undergraduate bioscience students from a UK university struggled with understanding the difference between plagiarism and collusion. These students believed that a tutorial at the beginning of the course could help them to avoid plagiarism. Thompsett and Ahluwalia (2010) further suggested that there was a difference in understanding of plagiarism across age ranges; however caution needs to be exercised when interpreting these results since their sample size was small.

Strategies to prevent plagiarism

Several strategies have been proposed in the literature to prevent plagiarism including the use of plagiarism detection software, academic honesty policies, and plagiarism education.

Segers and Connan (2007) described two mechanisms for plagiarism detection in text documents, a robust method and a lightweight method. Although the authors reported good results when using a database of random scientific papers sourced from the Internet, the robust method was less reliable if long sentences were modified and the lightweight method was time consuming. Niezgoda and Way (2006) created a software tool called SNITCH which detects cut and paste plagiarism. The performance of the tool was good with plagiarised text being detected 80 percent of the time when run against a database of synthetic papers.

Collberg, Kobourov, Louie and Slattery (2003) designed a system called SPlaT (Self-Plagiarism Tool) which detected self-plagiarism in academic papers downloaded from the websites of 50 CS Faculties. SPlaT found instances where conference papers were not appropriately referenced since they had the same introduction and/or the same related work; it also found instances where more than 50 percent of these papers were the same. In addition, authors had published a given paper in both a conference and journal without appropriate referencing.

Many tools have been created to detect plagiarism in source code. These include Sim (Gitchell and Tran, 1999), JPlag, Marble, Moss and Plaggie (Hage, 2010) which all tend to be sensitive to numerous small changes in code. Other tools such as Brass (Belkhouche, Nix and Hassell, 2004) overcome this sensitivity by performing comparisons at the software design, rather than software code level. The approach used by Vamplew and Dermoudy (2005) for automatic detection of source code plagiarism however is somewhat different. Instead of scanning the final program for plagiarism, an anti-plagiarism editor was used to monitor and log students' activities while they were creating the software, as well as when they submitted the final version. A major drawback of this approach is that students were not allowed to use any other editor for their assignments. In addition, although copying and pasting from other applications was disabled when using the anti-plagiarism editor, a student could still manually type the program, thus committing the equivalent of copy and paste plagiarism.

Although a strategy based on automated detection can save time, it is not foolproof. This became evident when the case of cheating at RMIT University was closely examined (Zobel, 2004). It was reported that several students utilised the services of an external tutor (a former student) to complete coding assignments in a number of computer science courses. Detection of this fraudulent activity required a timely process that not only required the examination of the coding style of programs (which was not completely conclusive) and mail logs (which recorded those students who had sent the tutor email); but also the fact that the marks of students being helped changed drastically. If the tutor was providing unique

solutions to students it would have been difficult, even if automatic detection was used, to detect these instances of plagiarism.

In an effort to deter occurrences of academic dishonesty in online courses Adkins, Kenkel and Lim (2005) proposed ten different methods to tackle this problem. These included: academic dishonesty education, the development of academic honesty contracts and the designing of assessments that were less easy to plagiarise.

Martin (2004) described a two-fold strategy for addressing the issue of plagiarism, namely detection and education. Although Kizza (2009a) also recommended the use of detection he believed that policies should also be used. Carroll and Appleton (2001) argued that a balanced approach to plagiarism should be adopted including: informing students about plagiarism regulations and policies, redesigning assessments, teaching students academic writing and how to cite (education) and using electronic detection tools. In addition, they noted that traditional examination board procedures would not provide justice for students accused of plagiarism. Rather, care should be taken when considering the interaction and responsibilities of the examination board and disciplinary processes (Carroll & Appleton, 2001).

Wolfgang Löwer, an ombudsman for the German Research Foundation, is one of the many German academics calling for a course on rules and procedures of academic scholarship (Schuetze, 2011). University administrators noted that the course, which would be mandatory for incoming students, could become an important element in the effort to prevent fraud. Hamilton, Tahaghoghi and Walker (2004) reported good results when employing a workshop-based approach to curb plagiarism. The workshop introduced students to academic advisors, counsellors, teaching and learning advisors and plagiarism guidelines. Feedback revealed that undergraduate/postgraduates and local/international students had different needs, for example international students wanted clarity on the rules for plagiarism avoidance. This led them to believe that separate workshops for these groups were required.

Methodology

In this study, self-reported questionnaires were utilised. The questionnaire design was informed by the ATP questionnaire (Mavrinac et al 2010). The author and an assistant administered the questionnaire to a convenience sample of computer science undergraduates reading the software engineering and computer architecture courses who were invited to participate in the study. Participation in this study was completely voluntary so consent to participate was acquired.

Participants

A sample of 90 computer science students participated in the study. Forty-one of these students were completing the second year software engineering course during Semester II of the 2011/2012 academic year (January to May 2012),

while 25 were completing the same course in Semester 1 of 2011/2012 (August to December 2011). The remaining 24 students were completing a second year computer architecture course in Semester 1 of 2011/2012. Of the 85 participants with valid completed surveys, 53 were male and 31 were female (one participant did not provide a response to this question). Twenty-five of the participants were between the ages of 16 and 20, 42 were between 21 and 25, and 18 over 25 years old. Sixty-eight of the participants were from Barbados; two each were from Dominica, Grenada and St. Lucia; three were from Trinidad and Tobago; and seven were from St. Vincent (one participant did not provide a response to this question). The majors undertaken by the participants varied widely as illustrated in Figure 1.
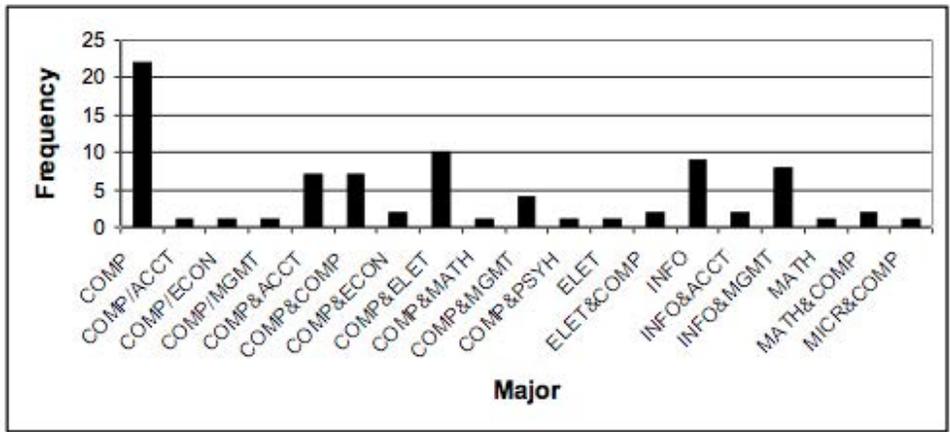

Figure 1. The Majors Undertaken by the Participants in the Study

The majors represented are COMP – computer science, ACCT – accounts, ECON – economics, MGMT – management, ELET – electronics, MATH – mathematics, PSYH – psychology, INFO – information technology, and MICR - micro biology. Joint majors are denoted using the "&" symbol while minors are denoted using the "/". For example, COMP/MGMT denotes a major in computer science with a minor in management.

Data collection

Data was collected for this study during November 2011 (Semester 1 2011/2012) and February 2012 (Semester II 2011/2012). During November 2011 the instrument was administered to the students of the software engineering and computer architecture courses while in February 2012 the instrument was administered once again to a software engineering class. In each classroom the purpose of the survey was described before being administered. After being informed that the study was voluntary and anonymous the participants consented to be involved. Participants were asked to complete all questions honestly. The instrument was distributed to the students during the class session, completed by them and returned immediately after completion. Ninety surveys were administered and all were completed and returned, however five of the questionnaires were subsequently removed due to incomplete responses.

Survey instrument

The survey instrument sought: demographic information (sex, age, and nationality), academic information (department, Faculty, degree level and major), definitions of plagiarism, general knowledge of plagiarism and students' attitudes toward plagiarism. The general knowledge questions included their level of plagiarism training, their awareness of the university plagiarism policy and the existence and use of online paper mills. Finally, the students' attitudes toward plagiarism were determined using the ATP questionnaire (Mavrinac et al., 2010)(the 29 items are listed in Table 3 (factor I), Table 4 (factor II) and Table 5 (factor III)).

Data analysis

The free text definition of plagiarism responses were analysed using the classification criteria outlined in Table 1. The result of this classification was the percentage of occurrence of each response type.

Table 1. The Classification Used for Grouping Participants' Definition of Plagiarism Responses

Response Type	*Classification criteria*
Type A	The definition states that another person's work was being used without proper acknowledgement (plagiarism of authorship) and that self-plagiarism is plagiarism
Type B	The definition states that another person's work was being used without proper acknowledgement (plagiarism of authorship)
Type C	The definition is incomplete, unclear or contains a misconception about plagiarism, for example if consent/permission is given to use text then it is not plagiarism even though the text is not properly acknowledged
Type D	No response was provided

The data for the second research question was analysed using means and standard deviations for each attitudinal factor and frequencies for the responses of each questionnaire item (descriptive statistics). The data for the final research question was analysed using a *t*-Test for independent samples to determine if there were any significant differences in attitudes across sex and the analysis of variance (ANOVA) was used to determine if there were any significant differences in attitudes across age. SPSS 19 was used in the analysis.

Findings

How do CS students define plagiarism?

Figure 2. Participants' Definition of Plagiarism Responses Classified by Type
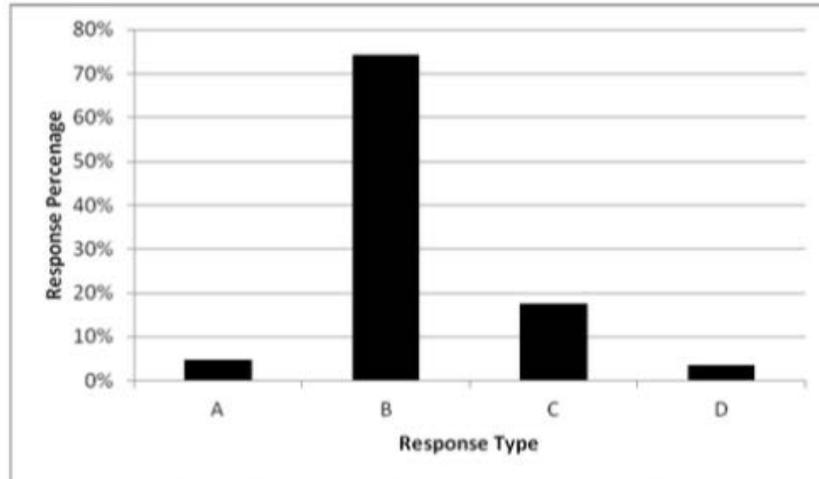
Five percent of the participants provided type A responses (which includes self-plagiarism), for example a participant's response was "plagiarism is the act of using someone else's work as yours without citing it. It is also the act of re-using previous work for a current project. For example submitting the same document for two (2) different courses/projects." About 74 percent of the students provided type B responses when asked to define plagiarism (plagiarism of authorship). For example, one participant stated that plagiarism is "using other people's work without giving credit to the owner," while another wrote that plagiarism is "the deliberate use of someone's elses [sic] work as your own." A significantly smaller percentage (18 percent) of participants provided type C responses, for example, participants stated that plagiarism is "when a person takes another person's work and use [sic] it in their own with out [sic] permission," "copy & pasting," "work that is not yours (word for word)," "stealing" and "copying and pasting information with out [sic] any editing."

What are the positive attitudes, negative attitudes and subjective norms of CS students toward plagiarism?

The means and standard deviations of the three attitudinal factors (Table 2) indicated that students had a moderate positive attitude (36 ± 7), a moderate negative attitude (21 ± 3) and low to moderate subjective norms (28 ± 6) toward plagiarism. Cronbach's alpha for the positive attitude, negative attitude and subjective norms scales were .826, .176 and .767, respectively.

Table 2. The Attitudinal Factors for the Participants in the Study

Attitudinal Factor	N	Mean	Standard Deviation
Positive Attitude	85	35.6706	7.12706
Negative Attitude	85	21.3176	2.70894
Subjective Norms	85	28.2588	5.56809

The frequencies of the responses for the statements describing positive attitude, negative attitude and subjective norms are presented in Tables 3, 4 and 5 respectively.

Table 3. Results for Statements Describing Positive Attitude

Statements describing positive attitude	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
1. Sometimes one cannot avoid using other people's words without citing the source, because there are only so many ways to describe something.	1	12	7	51	29
2. When I do not know what to write, I translate a part of a paper from a foreign language.	33	42	17	5	4
3. Self-plagiarism is not punishable because it is not harmful (one cannot steal from oneself).	4	11	20	31	35
4. Short deadlines give me the right to plagiarize a bit.	17	46	20	12	5
5. Self-plagiarism should not be punishable as plagiarism.	4	7	20	24	46
6. It is justified to use one's own previously published work without providing citation in order to complete the current work.	5	22	40	17	17
7. Young researchers who are just learning the ropes should receive milder punishment for plagiarism.	12	21	27	32	7
8. It is justified to use previous descriptions of a method, because the method itself remains the same.	1	10	30	54	6
9. If one cannot write well in a foreign language (e.g. English), it is justified to copy parts of a similar paper already published in that language.	17	49	24	8	2
10. If a colleague of mine allows me to copy from her/his paper, I am NOT doing anything bad, because I have his/her permission.	13	33	32	21	1
11. Plagiarized parts of a paper may be ignored if the paper is of great scientific value.	19	44	28	8	1
12. I could not write a scientific paper without plagiarizing.	11	47	28	11	4

Table 4. Results for Statements Describing Negative Attitude

Statements describing negative attitude	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
13. Plagiarism impoverishes the investigative spirit.	5	17	34	38	7
14. In times of moral and ethical decline, it is important to discuss issues like plagiarism and self-plagiarism.	2	5	22	51	20
15. Since plagiarism is taking other people's words rather than tangible assets, it should NOT be considered very important.	21	57	19	4	0
16. The names of the authors who plagiarize should be disclosed to the scientific community.	5	26	29	35	5
17. A plagiarized paper does no harm to science.	11	48	20	19	2
18. Plagiarists do not belong to the scientific community.	4	25	41	26	5
19. Plagiarizing is as bad as stealing an exam.	1	21	18	42	18

Table 5. Results for Statements Describing Subjective Norms

Statements describing subjective norms	Strongly disagree (%)	Disagree (%)	Neutral (%)	Agree (%)	Strongly agree (%)
20. Those who say they have never plagiarized are lying.	4	15	40	18	23
21. Sometimes I copy a sentence or two just to become inspired for further writing.	2	17	12	60	9
22. Authors say they do NOT plagiarize, when in fact they do.	0	6	48	40	6
23. I do NOT have bad conscience for copying verbatim a sentence or two from my previous papers.	6	18	22	40	14
24. Sometimes I am tempted to plagiarize, because everyone else is doing it (students, researchers, physicians).	15	44	19	19	4
25. It is NOT so bad to plagiarize.	13	46	26	14	1
26. I work (study) in a plagiarism-free environment.	24	44	26	6	1
27. Sometimes, it is necessary to plagiarize.	13	29	28	26	4
28. Plagiarism is justified if I currently have more important obligations or tasks to do.	12	49	27	7	5
29. I keep plagiarizing because I haven't been caught yet.	27	47	18	7	1

Are there significant differences in positive attitudes and subjective norms toward plagiarism across sex and age?

Given the poor reliability of the negative attitude factor (a Cronbach's alpha of .176) only the positive attitude and subjective norms factors were considered. The mean scores and standard deviations for the male and female participants for the remaining two attitudinal factors are shown in Table 6. When a T-Test for independent samples was run for the independent variable sex and the dependent variables positive attitude and subjective norms at the 0.05 probability level, there were significant differences in the participants' positive attitude (t=2.374, p=.020) and subjective norms (t=2.097, p=.039).

Table 6. The means and standard deviations for the positive attitude and subjective norms factors based on sex.

Attitudinal Factor	Sex	N	Mean	Std. Deviation	Std. Error Mean
Positive attitude	Male	53	37.0943	6.37683	.87593
	Female	32	33.3125	7.76027	1.37183
Subjective norms	Male	53	29.2453	5.18840	.71268
	Female	32	26.6250	5.86818	1.03736

The Analysis of variance (ANOVA) was run at the 0.05 probability level for age (Table 7) and there was a statistically significant difference for positive attitude (F[2,82]=5.780, p=.004) but not for subjective norms (F[2,82]=2.866, p=.063).

Table 7. Comparisons of participants' positive attitudes and subjective norms based on age.

Attitudinal factor	Age range	N	Mean	Std. Deviation	Std. Error
Positive attitude	16-20	25	38.2400	6.87556	1.37511
	21-25	42	36.0476	6.37813	0.98417
	25+	18	31.2222	7.42457	1.74999
Subjective norms	16-20	25	30.2400	6.41794	1.28359
	21-25	42	27.9048	5.01125	0.77325
	25+	18	26.3333	4.94678	1.16597

Discussion

As illustrated in Figure 2 most participants were able to provide a basic definition (Type B) of plagiarism (Martin, 2004, p. 1); of note however only about 5 percent of the participants included self-plagiarism in their definition. Some 18 percent of the participants had misconceptions about plagiarism which is worrisome especially when these misconceptions include that you can use another person's work if that person gives you permission (this implies that the owner does not

need to be acknowledged). Students will therefore be willing to submit assignments with materials received from colleagues (for example, from past assignments) because the owners gave them permission. It is also noteworthy that none of the participants acknowledged the existence of source code plagiarism despite being computing majors.

In this study the negative attitude factor (Mavrinac et al., 2010) was found to be unreliable, therefore this discussion will be restricted to an analysis of the frequencies of the responses used in that scale. Participants had a moderate positive attitude but low to positive subjective norms which is far from ideal since students should not believe that plagiarism is okay and perceive that only some of society frown on it. Purpovic et al. (2010) also reported that students had moderate positive attitudes (36 ± 7, the same score that was reported in this study) and moderate subjective norms (a score of 32 ± 6 compared with 28 ± 6 which was reported in this study). Although students appeared to have close to desirable subjective norms, their higher than desired positive attitudes indicate the need for plagiarism education (Martin, 2004; Carroll & Appleton, 2001; Hamilton et al., 2004).

On the positive attitude scale, 80 percent of the participants admitted not being able to avoid using other people's words without attribution (item #1)(this was also characteristic of Australian students (Ryan et al., 2009)); over 20 percent more students in this study were willing to cover up their poor writing skills than in the study reported by Pupovac et al. (2010). On the negative attitude scale, 71 percent of the participants believed that plagiarism and self-plagiarism should be discussed in this age of moral and ethical decline (item #14) which is comparable to the percent in the Pupovac et al. (2010) study. Finally, on the subjective norms scale, 69 percent of the participants were okay with copying a sentence or two for inspiration (item #21); 54 percent did not have a problem with copying a sentence or two from a previous paper (item #23); and, 68 percent disagreed that they work (study) in a plagiarism-free environment (item #26)(a similar result was also reported by Sheard et al., 2002); compared with 67 percent (item #21), 67 percent (item #23) and 9 percent (item #26) in the Pupovac et al. (2010) study. Clearly, students in this study were more willing to commit acts of plagiarise and self-plagiarism and believed that these acts were being committed by others.

A very disturbing result was participants' attitudes toward self-plagiarism given that 66 percent of them believed that it is not punishable since it is not harmful (item #3); and 70 percent believed that it should not be as punishable as plagiarism (item #5). There was some confusion as to whether it was justified to reuse one's own work without citing it (item #6) since 40 percent of the participants had a neutral response. These results seem to mirror those reported in the UK, Bulgaria and Croatian (Pupovac et al., 2008).

Over half of the participants did not have a problem with copying a sentence or two from a previous paper (self-plagiarism)(item #23). This could be problematic when considering source code plagiarism since participants might also be willing to "reuse" (Gibson, 2009) one or two functions, classes or programs from previous assignments. In fact, Cosma & Joy (2008) noted that students often

copy code from other assignments. A code of practice (as posited by Gibson (2009)) should be considered so that students would be able distinguished between plagiarism and source code reuse and determine when reuse is appropriate.

Participants seemed undecided whether the scientific community should expose plagiarists (item #16) given that only 40 percent agreed, while 31 percent of the participants disagreed. Participants also seemed unsure whether plagiarists should belong to the scientific community (item #18) since some 41 percent provided a neutral response. This has implications as to whether participants would be willing to expose known occurrences of plagiarism (or cheating); especially since students, in the literature, generally appear unwilling to report instances of cheating (Sheard, J., Dick, M., Markham, S., Macdonald, I., & Walsh, M. ,2002).

These results suggest that participants need help understanding and avoiding issues of plagiarism. A course, workshop or tutorial (as posited by Schuetze (2012), Hamilton et al. (2004) and Thompsett and Ahluwalia (2010)) could be used for plagiarism and self-plagiarism discussions and practical training on how to avoid plagiarism. The use of case studies such as Bhattacharjee (2013) and Zobel (2004) could also provide participants with examples of the consequences of plagiarism in the real world, providing opportunities for reflection and learning.

Finally, there were statistically significant differences in positive attitude for both sex and age; and a statistically significant difference in subjective norms for sex which implies that the plagiarism education programme should also be gender and age appropriate. From the results, it also appears that the younger students are more at risk of engaging in plagiarism than the older ones, and males are more at risk than females. The plagiarism education programme should be offered in the first year of study since this could potentially have the greatest impact (DeGeeter et al, 2014).

Limitations

The main limitation of the study was the fact that only second year CS students at a single tertiary institution in the Caribbean were used in the study. Although these results cannot be generalized, the results help to provide a baseline for further research.

Conclusion

This paper has described the worrisome issue of academic dishonesty, with a particular emphasis on plagiarism. The attitudes of 85 second-year CS undergraduates toward plagiarism were queried at a Caribbean university and generally speaking, although students could define plagiarism their attitudes toward it were moderate; furthermore they perceived that only some of the society frowned on it. Many of the students believed that self-plagiarism is not punishable since it is not harmful. From these results it can be inferred that students do not have a complete understanding of the definition of plagiarism and their attitudes toward it are inappropriate; especially when it comes to self-plagiarism. Students

are therefore likely to engage in these dishonesty activities after they graduate which is likely to affect the academic integrity of those who become researchers, and those response for engineering secure and safe systems in industry. This could potentially have dire consequences for the Caribbean region.

The establishment of a structured education programme that not only teaches about general plagiarism, but also self-plagiarism and source code plagiarism is of paramount importance. In addition, recognising the need to be both age and sex appropriate in this education is also important.

In terms of future work, not only should a longitudinal study be conducted to determine whether the introduction of a systemic plagiarism policy alone was enough to change students' attitudes toward plagiarism; but also, the issue of source code plagiarism needs to be investigated since this potentially has a negative impact on the quality of software systems produced by graduates. Furthermore, the underlying reason for these attitudes should be explored and the impact on society that the attitudes graduates have needs to be studied through more in depth research. This study also needs to be extended to other disciplines and universities within the Caribbean region.

Recommendations

Based on the survey findings, several recommendations are made as follows:

1. The creation of a clear, well-articulated plagiarism policy which not only includes general plagiarism, but also self-plagiarism and source code plagiarism;
2. The creation of an educational programme (an intervention) which aims to educate students about academic dishonesty (including plagiarism, self-plagiarism, source code plagiarism and fraud) and explain why this form of dishonesty hurts the research community and society. In addition, guidelines should be provided in the form of examples and best practices to help students avoid plagiarism and limit unintentional plagiarism. This programme must be both gender and age appropriate. This can complement existing research methods training;
3. The provision of guidelines for instructors which will help them to avoid (or limit) student plagiarism, for example in the design of their assessments; and,
4. The repeating of this study after the intervention to determine whether it changed the students' perceptions of plagiarism.

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References

Adkins, J., Kenkel, C., & Lim, C. L. (2005). Deterrents to online academic dishonesty. *The Journal of Learning in Higher Education, 1*(1), 17-22.

BBC. (2013). German minister Annette Schavan quits over 'plagiarism'. *BBC News Europe*. (February 9)

Belkhouche, B., Nix, A., & Hassell, J. (2004, April). Plagiarism detection in software designs. In *Proceedings of the 42nd annual Southeast regional conference* (pp. 207-211). ACM.

Bhattacharjee, Y. (2013). The mind of a con man. *The New York Times, 1368.*

Borrud, G. (2011). Another German politician loses doctorate due to plagiarized thesis. *Deutsche Welle*. (July 13)

Callaway, E. (2011). Report finds massive fraud at Dutch universities. *Nature News, 479*(7371), 15.

Carroll, J., & Appleton, J. (2001). Plagiarism: A good practice guide. *JISC publication*

Collberg, C., Kobourov, S., Louie, J., & Slattery, T. (2003). *A study of self-plagiarism in computer science*. Technical Report TR03-02, University of Arizona.

Collberg, C., & Kobourov, S. (2005). Self-plagiarism in computer science. *Communications of the ACM, 48*(4), 88-94.

Cosma, G., & Joy, M. (2006). *Source-code plagiarism: A UK academic perspective* (No. 422). Research Report.

Cosma, G., & Joy, M. (2008). *Towards a definition of source code plagiarism. IEEE Transactions on Education. 51*(2), 195-200.

DeGeeter, M., Harris, K., Kehr, H., Ford, C., Lane, D. C., Nuzum, D. S., Compton, C. & Gibson, W. (2014). Pharmacy students' ability to identify plagiarism after an educational intervention. *American Journal of Pharmaceutical Education, 78*(2).

Ghajarzadeh, M, Kiana H., Seyed-Mohammad F., Arsia J., Saharnaz, N., and Kiarash, A. Attitude toward plagiarism among Iranian medical students. *J Med Ethics doi 10* (2012a).

Ghajarzadeh, M., Norouzi-Javidan, A., Hassanpour, K., Aramesh, K., & Emami-Razavi, S. H. (2012b). Attitude toward plagiarism among Iranian medical faculty members. *Acta Medica Iranica, 50*(11), 778.

Gibson, P. J. (2009). Software re-use and plagiarism: A code of practice. *Proceedings of the 14th annual ACM SIGCSE conference on Innovation and technology in computer science education (ITiCSE '09), ACM*, New York, NY, USA, 55–59.

Gitchell, D., & Tran, N. (1999). Sim: a utility for detecting similarity in computer programs. *ACM SIGCSE Bulletin, 31*(1), 266-270.

Hage, J., Rademaker, P., & van Vugt, N. (2010). *A comparison of plagiarism detection tools.* (Technical Report UU-CS-2010-015). Department of Information and Computing Sciences: Utrecht University, Utrecht, The Netherlands. Retrieved August 26,2016 from: http://www.cs.uu.nl/research/techreps/repo/CS-2010/2010-015.pdf

Hamilton, M., Tahaghoghi, S., Walker, C. (2004). Educating Students About Plagiarism Avoidance - A Computer Science Perspective. *ICCE2004: International Conference on Computers in Education*, Melbourne, Australia, 1275-1284.

Karasz, P. (2012, April 2). Hungarian President resigns amid plagiarism scandals. *The New York Times*. Retrieved August 26, 2016 from http://www.nytimes.com/2012/04/03/world/europe/hungarian-president-pal-schmitt-resigns-amid-plagiarism-scandal.html?_r=0

Kizza, J. M. (2009a). Technology and academic dishonesty – Part I: A focus on students. *International Journal of Computing and ICT Research, Special Issue. 3*(1), 7-11.

Kizza, J. M. (2009b). Technology and academic dishonesty – Part II: A focus on academicians and other researchers. *International Journal of Computing and ICT Research. 3*(2), 7-11.

Martin, B. (2004). Plagiarism: policy against cheating or policy for learning? *Nexus (Newsletter of the Australian Sociological Association), 16*(2), 15-16.

Martin, B. (2008). Comment: Citation shortcomings: Peccadilloes or plagiarism. *Interfaces, 38*(2), 136-137.

Mavrinac, M., Brumini, G., Bilić-Zulle, L., & Petrovečki, M. (2010). Construction and validation of attitudes toward plagiarism questionnaire. *Croatian Medical Journal, 51*(3), 195-201.

Niezgoda, S., & Way, T. P. (2006). SNITCH: A software tool for detecting cut and paste plagiarism. *ACM SIGCSE Bulletin, 38*(1), 51-55.

Pupovac, V., Bilic-Zulle, L., & Petrovecki, M. (2008). On academic plagiarism in Europe. An analytical approach based on four studies. Digithum, 10, 13-19.

Pupovac, V., Bilić-Zulle, L., Mavrinac, M., & Petrovečki, M. (2010). Attitudes toward plagiarism among pharmacy and medical biochemistry students–cross-sectional survey study. *Biochemia Medica, 20*(3), 307-313.

Ryan, G., Bonanno, H., Krass, I., Scouller, K., & Smith, L. (2009). Undergraduate and postgraduate pharmacy students' perceptions of plagiarism and academic honesty. *American Journal of Pharmaceutical Education, 73*(6), 105.

Schiermeier, Q. (2012). Romanian prime minister accused of plagiarism. *Nature, 486*(7403), 305-305.

Schuetze, C. (2011, September 11). Germany tries to save prestigious title of Doctor. *The New York Times*. Retrieved August 26, 2016 from
http://www.nytimes.com/2011/09/12/world/europe/12iht-educSide12.html

Segers, V. M., & Connan, J. (2007). An Online System for Plagiarism Detection. Retrieved August 26, 2016 from http://www.cs.uwc.ac.za/~jconnan/publications/Segers%20No%2049.pdf

Sheard, J., Dick, M., Markham, S., Macdonald, I., & Walsh, M. (2002). Cheating and plagiarism: perceptions and practices of first year IT students. In *ACM SIGCSE Bulletin 34* (3) pp. 183-187.

Thompsett, A., & Ahluwalia, J. (2010). Students turned off by Turnitin? Perception of plagiarism and collusion by undergraduate bioscience students. *Bioscience Education*, (16).

TNN & Agencies (2012, February 20). University of Madras makes move to check plagiarism. Retrieved August 26,2016 from http://timesofindia.indiatimes.com/city/chennai/University-of-Madras-makes-move-to-check-plagiarism/articleshow/11955197.cms

Vamplew, P., & Dermoudy, J. (2005, January). An anti-plagiarism editor for software development courses. *Proceedings of the 7th Australasian conference on Computing education-Volume 42* (pp. 83-90). Australian Computer Society, Inc.

Zobel, J. (2004, January). Uni Cheats Racket: A case study in plagiarism investigation. *Proceedings of the Sixth Australasian Conference on Computing Education-Volume 30* (pp. 357-365). Australian Computer Society, Inc.