Plagiarism on the rise? Combating contract cheating in science courses

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Abstract

This paper is largely based on a paper presented at ACSME 2011 (O'Malley & Roberts, 2011). It describes a relatively new, but rapidly expanding, cause for concern for academics and administrators, that of students plagiarizing by using online auctions, a practice also known as "contract cheating". The prevention and detection of such plagiarism in the context of science education presents particular difficulties. The paper suggests several innovative and possibly controversial methods to minimize the number of occurrences, ensuring that as few students cheat as possible, and describes various techniques to aid in the detection of those that do.

Plagiarism

Plagiarism can be loosely defined as "*…the act of representing as one's own original work the creative works of another, without appropriate acknowledgement of the author or source"* (University of Melbourne, 2007). That plagiarism levels are continuously on the rise, and represent a major cause for concern, is well-documented in the literature (McCabe, 2003; Birchard, 2006; Shepherd, 2008). Only relatively recently has a new form of plagiarism, contract cheating, been identified as being significantly on the increase (Lancaster & Clarke, 2008).

Students' perceptions of plagiarism have been the subject of much research (Marshall & Garry, 2005; Yeo, 2007; Devlin & Gray, 2007; Comas-Forgas & Sureda-Negre, 2009; Gullifer & Tyson, 2009). Two common findings are that there is student confusion about what constitutes plagiarism, and coupled with this fears of perceived sanctions. A comparative analysis of students' self-reported beliefs and behaviours between conventional and digital plagiarism can be found in Stephens, Young and Calabrese (2007).

Many partial solutions to the problem of plagiarism have been suggested. The most widely accepted of these is the need for institutions to set up and implement a comprehensive plagiarism policy which validates that work is original and can be certified (see for example Culwin & Lancaster, 2001; Baggaley & Spencer, 2005; Devlin, 2006). The use of automated tools for plagiarism detection like *Turnitin CopyScape,* and *Plagiarism Detector 360*, has also been implemented in many institutions (Lancaster & Culwin, 2001; Warn, 2006; Butakov & Scherbinin, 2009). Some research has confirmed that anti-plagiarism tutorials are effective in reducing the incidence of plagiarism (Dee & Jacob, 2010).

The importance of employing a holistic approach, however, which encourages an appreciation of enquiry has been emphasized by Duggan (2006) and (McGowan, 2005a; 2005b). Rather than focusing on the negative and punitive aspects of plagiarism, McGowan suggests that a partial solution to the problem of plagiarism may be the instilling of an appreciation of the culture of enquiry at the tertiary level (McGowan, 2005a; 2005b). Bouville also has suggested that there is importance in drawing a distinction between plagiarizing ideas and plagiarizing words when examining possible solutions (Bouville, 2009).

The move to online classes seems to have exacerbated the existing problems. The prevalence of plagiarism in online classes has been confirmed by Lanier (2006). An overview of the problem of plagiarism specifically in the online environment, together with problems and suggested solutions, can be found in Roberts (2008).

Plagiarism in science education

Plagiarism is plagiarism, regardless of the field of study. However, within the sciences, identifying that plagiarism has occurred, and detecting the source of that plagiarism, can present special challenges.

In the arts, assessment items frequently take the form of an essay or exposition. When constructing essays, it is relatively easy for students to take text from other sources, without proper attribution. For example, if an essay is required on, say, *the life of Abraham Lincoln*, there are tens of thousands of resources available on the Web from which passages can be taken.

One means of attempting to prevent plagiarism is to make assessment topics more specific, such as asking students to *identify the major achievements and disappointments in the first 100 days of the Lincoln administration*, or, even more specific, *to contrast the first 100 days of the Lincoln administration with that of his predecessor, James Buchanan*. However, while such techniques may reduce the problem, they do little to prevent it entirely.

With regard to detection, plagiarism often first comes to attention because certain passages of text do not seem to bear the signature of the student involved. Perhaps the English is just a little too perfect, or sophisticated phrases, normally beyond the reach of the student concerned, have been used.

In the sciences, such student signatures are likely to be more difficult to identify. For example, in the field of mathematics, many problems – whether elementary, like simplifying fractions, or complex, like non-trivial integrations – have singular, particular solutions, and the steps leading to those solutions are likely to be very similar across students, even when no plagiarism or copying has occurred.

Unfortunately, this is likely to be the case also for problems in computer science (*write a program to illustrate the truth of the Collatz Conjecture for values less than 5000*), for problems in physics (*two long parallel cylinders at fixed distance from each other, and immersed in a viscous liquid, are rotated in opposite directions. Find the relation between the parameters of the system and the velocity of its propulsion*), for problems in chemistry (*find the molecular mass of sucrose, which has a molecular formula* $C_{12}H_{22}O_{11}$), and so on.

It should be noted that the field of computer science presents especial problems, since it is a trivial exercise for the student submitting a programming assignment to change variable names, alter spacing and indentation, and make other trivial alterations, so that two essentially identical pieces of programming code can on the surface appear completely different.

Contract cheating

One aspect of plagiarism which has received relatively little attention is *contract cheating*, which is becoming more prevalent in mathematics and science. C*ontract cheating* refers to students attempting to obtain assessment solutions via online auctions. Prominent amongst the research in this area is that conducted by Thomas Lancaster and Robert Clarke, of Birmingham University in the UK (Clarke & Lancaster, 2006; Lancaster & Clarke, 2008). Small-scale studies into the phenomenon of contract cheating have been conducted by several academics and administrators (eg Jenkins & Helmore, 2006; Korn, 2006). It has been suggested that over 12 percent of postings on a popular website for outsourcing computer contract work are actually bid requests from students looking to attempt some form of contract cheating (Clarke & Lancaster, 2006).

Contract cheating typically involves the following steps.

1. The student sets up an auction for a project on a web site such as *Rent A Coder* (https://www.rentacoder.com/) *Script Lance* (http://www.scriptlance.com/), *Get A Freelancer* (http://www.getafreelancer.com/) or one of many other similar web sites. The student then uploads all or part of the assessment specification. In some cases, the student may try to obscure part of the assessment specification so that its origin cannot easily be recognized.

2. Various bidders registered on the web site place bids to complete the work. The minimum bid accepted by most auction web sites is normally around US$5, with typical bids being around US$20-40 for a first year mathematics or computer science assessment. Usually the auction web site charges a percentage of the bid price in fees, with a minimum of around US$3 - therefore, a winning bid of, say, US$30 may result in a net profit to the bidder of around US$27.

3. The student selects a winning bidder, and arranges payment for the work. At this stage, the student usually elects to *privatize the auction*, which means that only they and the winning bidder can view the auction, effectively locking out all others.

4. Upon completion, the winning bidder uploads the work to the auction web site. The winning bidder receives payment only when the student accepts their work as complete. The student then submits the winning bidder's work for the assessment item as their own work.

The entire process is quite simple and often proceeds very quickly. The time between initiation and completion is sometimes less than 24 hours, and rarely longer than a few weeks. Such speed is necessary because of the need to meet the timelines for submission of the assessment.

Such plagiarism can be very difficult to detect. Often students obscure the assessment specification by removing the academic and educational institution's name, and the entire process can be concluded before it is even noticed by academic staff.

Techniques to combat contract cheating

Although, conventional plagiarism detection tools, such as *Turnitin, CopyScape,* and *Plagiarism Detector 360*, detect plagiarism by comparing assessment submissions to chunks of text on the Web, and/or by comparing submissions to one another (Turnitin, 2011; CopyScape, 2011; Skyline Inc., 2011) they are less effective against contract cheating. Tools specifically designed for the field of computer science, such as MOSS *Copy Detection System* (Aiken, 2010), are effective only for detecting similarities between submissions. Other techniques are therefore required. Here we describe five techniques that can be used to combat contract cheating including; *just-in-time release of assessment specifications, the securing of assessment details, the embedding of special search tags, the implementation of student rewards* and *the use of cheat-trap solutions.*

Just-in-time release of assessment specifications

Many educational institutions distribute assessment specifications to students at, or before, the start of term. This approach has at least two advantages: first, it ensures that core assessment material is finalized in good time; and second, assessment specifications are delivered to students along with other important course material, such as study schedules, topics covered, text book information, and so on, thereby providing a single source of information, and permitting students to view the alignment between content and assessment.

Although educationally sound, this practice has the unfortunate side-effect of allowing students more time to organize for a third party to complete the work on their behalf. The most obvious way to limit the time available to organize cheating is to delay the distribution of assessment specifications. Shortening the time between distributing assessment details and submission time provides less time to organize an online auction, request bids, select a winning bidder, and less time for the winning bidder to get the work done.

The delay of assessment specifications, however, is regarded by many academic staff members (and institutions) as undesirable or even unacceptable.

Securing of assessment details

Several techniques can be used to make assignments more secure, such as the proper use of PDFs.

If assessment details are distributed in paper or electronically as Word documents, simple HTML web pages, or plain text then these can very easily be copied, pasted, altered, and disguised to remove all traces of course and educational affiliation . It is more difficult for students to copy, paste, alter, and disguise assessment specifications if encrypted PDFs are used which make the risk of discovery uncomfortably high. To be as secure as possible, PDFs should also be secured against printing (if a secure PDF can be printed, then it can be printed to another non-secure PDF or text file, and then copied and pasted).

Details such as the name of the educational institution, the course, or the lecturer's name and email address can be included in the PDF itself. Water marks can also be used to achieve a similar purpose. The name of the educational institution, for example, can be placed behind every page. Secure PDFs can be created from non-secure PDFs using *PDF Security*. If this is done, and the PDF is uploaded to an auction or other web site, honest coders who happen to view the auction can see where it originates, and notify those concerned.

Such security measures make it far more risky for students to cheat via online auctions because they either need to upload the assessment specifications in full to the online auction web site, or crack the secure PDF, or re-write the assessment details to obscure their origin.

Embedding of special search tags
Special tags can be used to make assessment details easy to identify and find. If such tags included within assessment items are uploaded to an online auction web site, then searching for such items becomes substantially easier.

For example, for a typical Java programming assessment, searching on "*Java"* on any online auction web sites is likely to result in a listing of many thousands of auctions, because Java is a very popular programming language. However, if special or unusual text is embedded in the assessment details, then such assessments are much more readily identifiable.

The workload associated with embedding special search tags in assessment details is minimal.

Implementation of student rewards
It may be possible to offer small financial rewards to students who alert academic staff to auctions on web sites. One possible addition to assessment details to achieve this aim might be of the form: *"Help us to stop plagiarism! If you find this assessment details on an online auction web site and you are the first to tell us about it, we will pay you a small reward"*.

Whether this creates positive relationships between peers is however questionable. Some academics may find this practice unethical. At the least it is worthy of serious consideration and debate prior to implementation. There is little doubt, however, that such a strategy assists academic staff find plagiarism attempts via online auctions without having to conduct laborious and time consuming searches themselves.

Even if no such reports are made, the warning in the assessment details alone may be sufficient to make students reconsider using on-line auctions.

Use of cheat trap solutions
If the solution to an assessment item is discovered in an online auction there are at least two courses of action possible: first, if the teaching staff are alerted to the auction by a third party, such as one of the coders who bid for work on the auction web site, then this third party may agree to help, and perhaps even win the auction; and second, the teaching staff may attempt to win the auction themselves by bidding the minimum amount to provide the completed work.

If either of these courses of action are successful, then a carefully crafted *Cheat Trap Solution* should be prepared that can be uploaded to the auction web site. Such a solution should not alert those involved, and at the same time be easy to identify during marking.

Examples

Three examples are given here. These have been especially selected to demonstrate the techniques described earlier have applicability across a range of assessment types.

The first, from computer science, illustrates the use of a cheat trap solution a programming assessment. The second, from the field of biology, illustrates that some techniques can be used even in short-answer assessments. The third, from physics, illustrates techniques that can be used for assessments requiring a descriptive answer.

Programming

In an actual case, one of us (MO) was notified by a staff member from another University that someone was attempting to use a cheat site for a COBOL programming assessment. A quick scan of the site revealed that this was the latest in a series of attempts by the same person. Studies have found that such repeated violations are the norm (Clarke and Lancaster 2006).

MO created a temporary account on the site, bid a low price, and won the auction to provide the solution. He subsequently uploaded a carefully crafted solution including a cheat trap – that is, the provided solution included many indicators that would make it simple for any marker to identify. All of the markers allocated to the course were alerted to look out for these indicators.

As a result, the solution was submitted and following a series of interviews, the student was awarded a Fail grade for the course. The university's plagiarism policy has since been amended to include contract cheating as an offence that could result in exclusion or expulsion.

Short answer

An example of a *"fill-in-the-blanks"* assessment format taken from the question bank of a GCSE & IGCSE biology exam (Mackean, 2011):

> *Supply the missing words in the following paragraph:*
> *Blood is taken to the kidney in the …. (A)…. artery, which divides up into many arterioles. The arterioles enter the …. (B) …. of the kidney and supply thousands of glomeruli. In each glomerulus, …. (C) …. forces plasma minus its …. (D) …. out of the capillaries, and it collects in the …. (E) …. .This liquid passes down the …. (F) …. where …. (G) …. , ….(H) …. and …. (I) …. are reabsorbed into the blood. The remaining liquid, called ….. (J) ….. passes down the ….. (K) ….. and collects in the ….. (L) ….. before being expelled from the body.*

It may seem that any attempt to detect contract cheating in such a case would be impossible, since the student need only list one-word answers in their submission. However, this is not the case. Depending upon the time available, and the level of commitment to plagiarism detection, several steps can be taken.

First, a search can be carried out using Google or any other popular search engine on certain phrases within the document – in this case, a search on the extract "*of the kidney and supply thousands of glomeruli"* should suffice. Such a search is likely to be successful where the text has been copied and pasted not only to a cheat site, but to any of a number of forums, such as *Yahoo! Answers*. If the student has been careless enough to identify themselves in the posting of the question, appropriate action can be taken.

Second, a selection of cheat-sites can be scanned for any recent questions posed relating to "*arterioles*" or "*glomeruli"*, for example.

Third, the assessment item itself could be rephrased before being given to the students, to include one or more even more-readily identifiable phrases, or perhaps a non-vital spelling mistake, which would make subsequent detection even simpler. Such a deliberate mistake would probably not be acceptable in a key word such as "*capillaries*" or "*arterioles*", for a number of reasons, but may be acceptable in others. It is recognised, however, that the thought of including such deliberate errors may be painful to some (including the current authors).

Descriptive answer

A physics question taken from Cserti and Tichy (2010):

> *For suspension bridges, both the suspending cables and the bridge body represent sizeable weight. Which is the shape of the cable in this case? Study the special cases, when a) the bridge body is much heavier than the cable and b) vice versa. The two cases correspond to the `short' and `long' bridges. For a given spanned length of the bridge, in which case does one need longer cable? Study the Erzsébet bridge in Budapest as a realistic example!*

Such questions requiring short but descriptive answers are common across the sciences. Here, one may quite easily check for recent web postings containing "*Erzsébet bridge*", at both cheat-sites and in other web-based forums. If the student has been careful enough to omit the last sentence of the question, then a scan on a short extract such as "*bridge body represent sizeable weight"* may well prove profitable.

As described above, the course coordinator may then take the additional step of bidding to provide the solution themselves, or getting someone else to do the same. A sample solution, complete with cheat traps (perhaps a reference to the wholly imaginary "*Russell-Whitehead suspension bridge in southern Azerbaijan*") can be included, and appropriate action taken should the student decide to take the unwise path of submitting the solution as their own work.

Concluding remarks

Since the original presentation of much of this material at ACSME 2011 (O'Malley & Roberts 2011), few other remedies to the increasing problem of contract cheating have come to light. It seems, therefore, that one is forced to choose one or more of the alternatives mentioned above, or take a "head-in-the-sand" approach. When making such a choice, it should be recognised that the great majority of students are honest and hard-working. It is this majority that is treated unfairly if plagiarism checks are not rigorously applied, and action is not taken against those seeking to cheat.

The authors have attempted to describe the problems inherent in the specific area of contract cheating, and have outlined some possible remedial actions applicable across a broad range of scientific fields and types of assessment, that can be implemented in an effort to detect such plagiarism, and take action against those who choose to do the wrong thing.

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