PLAGIARISM IN SCIENCE EDUCATION: PREVENTING CHEATING VIA ONLINE AUCTIONS

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ABSTRACT

This paper 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 possible 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 IN SCIENCE EDUCATION

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). A review of quantitative studies of student plagiarism over the past forty years can be found in Scanlon (2003).

An overview of the problem of plagiarism in the (relatively) new online environment, together with problems and suggested solutions, can be found in Roberts (2008). A recent survey of online plagiarism amongst students in UK higher educational institutions, (based on a self-report study of 1222 undergraduate students) is that by Selwyn (2008). 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).

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 may first come 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, e.g. '*write a program to test the Collatz Conjecture for the first 1000 positive integers*' (Scalettar, 2011), for problems in physics, e.g. '*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*' (Kantor, 2004), for problems in chemistry, e.g. '*determine the empirical formula of a compound containing 2.644 g of gold and 0.476 g of chlorine*' (O'Brien, 2010), and so on.

It should be noted in passing 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, etc, so that two essentially identical pieces of programming code can on the surface appear completely different.

CONTRACT CHEATING

In this paper we focus on one specific type of plagiarism, often referred to as *contract cheating*, in which students attempt 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 (e.g. Jenkins & Helmore, 2006; Korn, 2006). We have been unable to find any research into the prevalence of such cheating within Australian institutions, or whether it is more prevalent amongst certain disciplines than others. These are areas which would benefit from further research.

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 assignment. 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.

Our personal observations from viewing many dozens of such auctions would suggest that 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 assessment submission deadlines determined by the university concerned.

Such plagiarism can be very difficult to detect. If the student has obscured the assessment specification by removing the educational institution's name, academic staff names, etc., then it can be a very time-consuming matter to find the auction. In addition, because the student can obtain a solution to the assessment very quickly, the entire process can be concluded before it is even noticed by academic staff.

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 and Lancaster 2006).

TECHNIQUES TO COMBAT CONTRACT CHEATING

Conventional plagiarism detection tools, such as *Turnitin, CopyScape, Plagiarism Detector 360*, etc., tend to look for plagiarism by comparing assignment submissions to chunks of text on the Web, and/or by comparing submissions to one another (Turnitin, 2011; CopyScape, 2011; Skyline Inc., 2011). Unfortunately, they are likely to be ineffective against contract cheating. Similarly with the *MOSS Copy Detection System* (Aiken, 2010). While specifically designed for the field of computer science, it is effective only for detecting similarities between submissions.

Other techniques are therefore required. We describe five techniques, *just-in-time release of assessment specifications, the securing of assessment specifications, the embedding of special search tags, the implementation of student rewards*, and *the use of cheat-trap solutions*, that can be used to combat contract cheating.

JUST-IN-TIME RELEASE OF ASSESSMENT SPECIFICATIONS

It is a common practice for educational institutions to 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, it enables assessment specifications to be delivered to students along with other important course materials, such as study schedules, topics covered, text book information, and so on.

This otherwise very praiseworthy practice allows students intending to cheat a significant amount of time to organise for a third party complete the work on their behalf. The most obvious way to limit this time is to delay the distribution of assessment specifications, thus providing less time to organise an online auction, less time to request bids, less time to select a winning bidder, and less time for the winning bidder to get the work done. However, the delay of assessment specifications may be regarded by the academic staff members concerned (or by the institution) as undesirable or even unacceptable. If so, other measures are needed.

SECURING OF ASSESSMENT SPECIFICATIONS

If assessment specifications are distributed 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 the course or educational institution to which they belong.

In addition, if the specifications are distributed in paper form, or they can be printed, then the pages can be scanned and the resulting images can be cropped and sections erased to remove all traces of the course and educational institution. Thus, students with even very basic skills can quickly and easily make such assessment items almost impossible to trace. This being the case, it is important for educational institutions to make it as difficult as possible for students to copy, paste, alter, and disguise assessment specifications, so that the risk of discovery becomes uncomfortably high.

Encrypted PDFs can be used to achieve this objective. 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. 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. The proportion of such "honest coders" is open to speculation; again, a topic worthy of further research.

Various software can be purchased to create secure PDFs from Word documents, PowerPoint presentations, etc, such as *Adobe PDF Writer*. In addition, other software enables the creation of secure PDFs from non-secure PDFs, such as *PDF Security*. In either case, the time and effort required to create secure PDFs is small. 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.

Such security measures make it far more risky for students intending to cheat via online auctions. They will have the options of uploading the assessment specifications in full to the online auction web site (the easier but far more risky road), or trying to crack the security measures on the assessment specifications, or re-writing the assessment specifications and trying to obscure their origin. Our experience would suggest that many such students are reluctant to invest even the small amount of time normally required to re-type the assignment specifications from scratch!

EMBEDDING OF SPECIAL SEARCH TAGS

An alternative to using secure PDFs is to make use of special tags. These can be used to make assessment specifications as easy to identify and find as possible, so that if they are uploaded to an online auction web site, or elsewhere on the 'net, then there is a high chance of locating them with the minimum amount of searching.

For example, for a typical Java programming assignment, 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 specification, then such assignments are much easier to find and identify. For example, if a string as simple as '*Jaava*' (note the deliberate spelling mistake) is added to the assessment specification, then this text can be searched on, producing more focused results. Such a simple technique can drastically reduce the time required for searching. If deliberate spelling mistakes are considered beyond the pale, then the use of a particular name or phrase can serve the same purpose.

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

IMPLEMENTATION OF STUDENT REWARDS

It may be possible to offer small financial rewards to those who alert academic staff to plagiarism or auctions on web sites, especially when such action reveals sufficient evidence to allow the formal identification of those involved. One possible addition to assessment specifications to achieve this aim might be of the form: '*Help us to stop plagiarism! If you find this assessment specification on an online auction web site and you are the first to tell us about it, we will pay you a $20 reward'.*

Reward conditions have to be fair. If such is the case, then students are quite likely to inform on their peers if they have reason to believe they are cheating, and therefore trying to avail themselves of a higher mark or grade unfairly. Even if no such reports are made, this warning in the assessment specification alone is often sufficient to make students reconsider.

Some may find this practice bordering on the unethical, and, at the least, it is worthy of serious consideration and debate prior to implementation. There is little doubt, however, that such a strategy allows academic staff to be made aware of plagiarism attempts via online auctions without having to conduct laborious and time consuming searches themselves.

USE OF CHEAT TRAP SOLUTIONS

If an online auction for the solution to an assessment item is discovered, at least two courses of action are 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 be such as not to alert those involved, yet at the same time be easy to identify during marking.

EXAMPLES

Space permits only three examples, from different fields. The examples have been especially selected to demonstrate that the techniques described earlier have applicability across a broad range of assessment types.

The first, from computer science, illustrates the use of a cheat trap solution for a programming assignment. The second, from the field of biology, illustrates that some techniques can be used even in short-answer assignments. The third, from physics, illustrates techniques that can be used for assignments 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 assignment that MO had set. A quick scan of the site revealed that this was just the latest of a series of such attempted purchases

by the same person across multiple courses. Such repeated violations are apparently the norm (Clarke & 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.

In the event, such a solution was indeed submitted, by a single student. Following a series of interviews, the student was awarded a Fail grade for the course, and the University's plagiarism policy was amended to accommodate contract cheating, making it an offence that could result in exclusion or expulsion.

SHORT ANSWER
An example of an assessment question of a *'fill-in-the-blanks'* format, taken from the biology GCSE & IGCSE question bank (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 list only 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 – for example, '*thousamds*' instead of '*thousands'*, or '*remeining*' instead of '*remaining*'. 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 a short but descriptive answer 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

This article may have given the erroneous impression that the majority of students are seeking to cheat at every opportunity. In fact, the opposite is the case; the majority of students are honest and hard-working. It is this majority that are treated unfairly if plagiarism checks are not rigorously applied, and action 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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