



CHEATING IN ENGINEERING EDUCATION: MODERN METHODS AND POTENTIAL COUNTER MEASURES

NJ Cooke¹

University of Birmingham
Birmingham, UK

<https://orcid.org/0000-0003-2247-0663>

KIM Hawwash

University of Birmingham
Birmingham UK

<https://orcid.org/0000-0002-5642-4334>

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ABSTRACT

Engineers must engender trust in order to collaborate successfully to produce solutions that the world needs. As part of building this confidence, students with an accredited degree must meet learning outcomes i.e. demonstrate skills to an acceptable standard. Cheating during such assessments reduces professional integrity and future work quality. Through careful assessment practice and encouraging a professional culture with ethics, we may minimise student's opportunity and motivation to take short-cuts. With this in mind, it is useful to understand which technical and professional skills are most affected. Cheating is evolving, with more collaborative online opportunities. Previous research suggests a majority of student's admit to dishonesty at least once, and that there are several motivations, including individual, demographic, institutional, and societal. We describe today's engineering education environment in terms of how it affords cheating behaviours and their methods, including the popularity of online services such as Chegg. By analysing potential cheating methods against a current agreed inventory of contemporary engineering skills, we highlight where educators might focus efforts to reduce bad learning practices. We also consider how the covid pandemic with more online and remote studying amplifies the situation.

¹ *Corresponding Author*

NJ Cooke

n.j.cooke@bham.ac.uk



1 INTRODUCTION

Prior to employment, a young engineer's development relies heavily on meeting learning outcomes through university programmes. Accreditation bodies set these objectives at national or multinational levels, and higher education institutions (HEIs) provide the environment to teach the skills. Universities and the accreditation bodies foster mutual trust in the teaching and evidencing student achievement through rigorous assessment.

HEIs use a variety of assessment methods, either to assess individual teaching blocks, or synoptic assessment for a series of modules. While accreditors don't determine the testing and evidencing regime, they observe, probe and draw on their experience of visiting other places to satisfy themselves that the quality of education is comparable. They will look at programme structure, teaching materials, and various assessments including examination scripts, coursework, and laboratory reports.

Graduate employers trust HEIs to award degrees which are fit for purpose. University ranking, reputation, and the accreditor's seal of approval increases industry's confidence. This is particularly so for a vocational degree like engineering, where the question becomes whether the graduate, with the correct blend of emerging technical and professional skills, will fit into the company and contribute to its commercial success.

In this paper we reflect on the challenge for HEIs to maintain confidence in student achievement, which in turn, preserves the confidence of accreditors and potential employers that engineering graduates are not only well taught and that the assessments accurately demonstrate competency level, but that no cheating has taken place which might inflate grades. The sudden move to online assessment during the COVID19 pandemic has undoubtedly increased the potential for academic dishonesty, and the question we face is how to detect and deal with it rigorously, fairly, and with compassion.

We reflect on issues related to students cheating - which existed prior to the pandemic - but have been accentuated due to the increasing reliance upon online teaching resources and assessment. We base our commentary on experiences over the past three years both at our home institution and through discussions with other institutions that have observed similarities in the approach of some students to dishonestly enhance their performance, thus potentially deceiving future employers that their learning outcomes are truly reflective of their achievements.

2 BACKGROUND

2.1 Academic dishonesty

Academic dishonesty is endemic, as evidenced by the longitudinal studies on American and Canadian college students by Bowers then McCabe [1] [2] spanning over half a century; e.g. in one study between 2002-2010, 59,907 of 90,145 students anonymously self-reported one or more of nine identified cheating behaviours which



we'll refer to by their numbers in later sections: 1) Copying sentences from material without quoting / citing sources. 2) Adding unused citations to the bibliography. 3) Plagiarizing published works. 4) Getting questions and answers before taking exams. 5) Copying another student's work. 6) Unpermitted collaboration with other students. 7) Submitting another students work as their own. 8) Giving answers to other students in exams. 9) Using unpermitted notes.

The motivation to take short-cuts includes wider societal norms and behaviours, and more localised peer, family and classroom expectations. A framework proposed by Murdoch [3] on motivational factors for cheating identifies 3 questions that students may ask themselves. Table 1 lists these questions, together with examples of influences we've identified from the literature and our own practice (column 2).

Table 1. Motivations for cheating (adapted from [3])

Motivational question	Examples of influences which encourage cheating
What's my purpose ?	Low grade expectations, unfavourable peer comparison, inconsistent faculty approach to cheating, extrinsic goals overriding subject mastery.
Can I do this?	Underconfidence, limited available effort, inadequate learning level reached, unclear assessment standards.
What are the costs?	Low personal morals, unfollowed or ignored codes of academic practice, poor faculty monitoring and detection of cheating, perceived classroom injustices.

The multitude of influences suggest that efforts that we make to contain academic dishonesty must utilise a several strategies. Typically, most faculty rightly claim to adopt a consistent approach to cheating through clear assessment standards and requiring students to agree to codes of academic practice. These approaches however, may not inhibit all influences.

2.2 New engineering skills

The challenge to teach new skills in engineering degrees can motivate academic dishonesty because our understanding of what is required is still evolving. The SEFI engineering skills special interest group surveyed 25 2021 conference delegates about 8 typical barriers faced by educators when teaching emerging technical and professional skills (Figure 1). Responses revealed that an overloaded curriculum (row 4 and 8) and lack of time and resource were common hinderances, despite industry demand being strong (row 5).

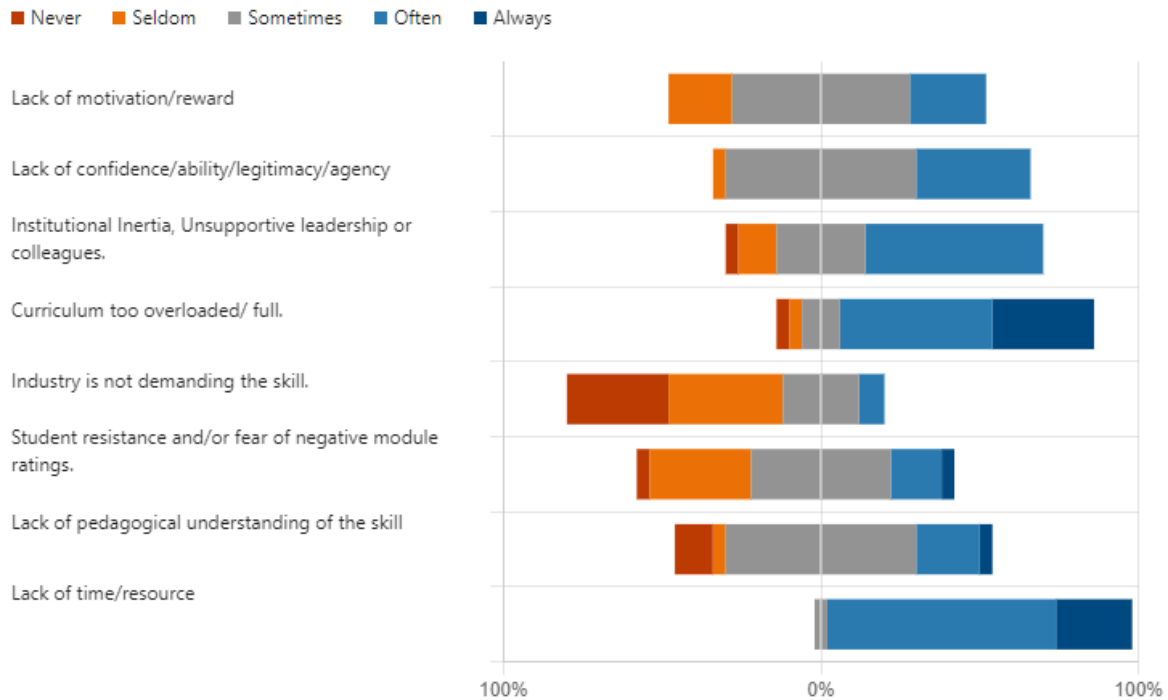


Fig. 1. Responses of the SEFI 2021 Engineering skills SIG survey to the question “I have come across the following hindrances in teaching new design, technical or professional skills:” (n=25)

Although the sample size from this survey is too small to draw meaningful conclusions, many of the hinderances identified can be related to the influences which motivate cheating in table 1. e.g. An educator's lack of pedagogical understanding in teaching the skill results in an inadequate learning level reached and unclear assessment standards, which influences students to answer affirmatively to “Can I do this?”. Thus, educators must be aware that, as we evolve the curriculum, our barriers to teaching skills effectively may inadvertently motivate cheating.

3 THE CURRENT ENVIRONMENT

3.1 Academic integrity process (honour code)

The methodology relies on our experience of operating a ‘academic integrity process’ at our home institution in which engineering is but one discipline and therefore being able to compare the concerns faced with other scientific but also non-scientific disciplines. We consider how each of the nine cheating behaviours in section 2.1 manifests in modern practice in sections 3.2, 3.3 and 3.4, and outline our process for detection and resolution in 3.5.

The issue of academic integrity is introduced to students by a presentation and they’re pointed towards online resources which set out its importance and the consequences of falling short. The materials explain what is acceptable assessment



practice. This is part of an “honour code” [2] which is a learning agreement between student and university.

3.2 Plagiarism detection in coursework (behaviours 1,3 and 7)

Universities have moved to online submission of most coursework to allow checking for copying through similarity checking software such as Turnitin [4]. Students upload their submissions and Turnitin checks its extensive database to identify matches that contain either a fully copied piece of work from another author at one end, heavily copied and unattributed or badly attributed material in the middle of the scale, to badly referenced material which can be improved through better referencing practice. Turnitin is helpful in investigations into plagiarism when students would have to explain why the similarities have occurred. However, what it cannot reliably identify is work translated from other languages, or copying of text or table via their inclusion as images that are not textually searchable.

3.3 Online resources that facilitate cheating (behaviours 2,4,6 and 7)

The internet affords the academic community many helpful resources such as substantive reports and research studies, but information can be weak and not peer-reviewed. Students in particular will use public search engines such as google to help them in their learning. The challenge HEIs face is in how to point students to good external assets on a particular topic. For engineering, some online materials use different methods to solve problems and explain concepts, which may enhance overall understanding or clarify misunderstandings from the in-house teaching.

However, a recent issue that became a challenge with wider use of online assessment is using sites that invite students to upload questions that others can answer that the student then uses substantially as ‘their’ answer. A platform rapidly gaining popularity reported by many institutions is ‘Chegg’ [5]. This file-sharing platform offers services to students which range from access to notes to providing expert advice on ‘homework’. Subscribers can upload questions and receive answers with the term ‘homework’ used rather than examination. Chegg allows HEIs to request the email and the IP address used by subscribers. At this stage the laws of countries where students are using this and similar services do not judge the sites to be illegal.

3.4 COVID19 pandemic and closed-book examinations (cheating behaviours 5, 8 and 9)

The procedures for dealing with closed-book examinations and those for online examinations are different and present different challenges. The pandemic resulted in a sudden move to only online examinations or only continuous assessment through coursework which in many cases universities and academics judge as appropriate to replace closed book examinations. Most universities also introduced emergency regulations to help arrive at fair outcomes in terms of actual module marks and overall GPA or degree classifications. They have produced challenges in themselves, however this is not the subject of this paper.



3.5 Code of Practice on Academic Integrity – detection of cheating.

Our home university operates what is referred to as a Code of practice on academic integrity (including plagiarism and conduct in examinations and class tests), which like other codes of practice is reviewed on an annual basis. It sets out the responsibilities of the principle academic units, the responsibilities of the students and the processes for investigations into different aspects on academic integrity. It describes categories of plagiarism, how investigations are to be conducted when a student is suspected of breaching academic integrity and the sanctions available to the principle academic unit to impose. Very serious cases are referred up to college misconduct committees and the students have a right of appeal which can reach senate and the external body for student affairs if a student pursues an appeal all the way through the university processes but is still dissatisfied with the outcome.

The sanctions available range from a revise and resubmit to the recording of a mark of zero and no further opportunity to resubmit, which depending on the weighting of the component under investigation, could result in failure of the whole programme. An example of this is a taught master's level project, which counts for one third of the credits for the 12-month degree programme. Should a student be awarded a mark of zero after an investigation and not be allowed to resubmit, the student could not achieve enough credits to be awarded the master's degree and would therefore leave the university either with no degree or a diploma or certificate depending on the number of credits achieved.

There are three levels of plagiarism or cheating which the code asks Academic Integrity Officers (AIOs) to judge in any investigation. They are: poor academic practice, moderate plagiarism (or cheating), and serious plagiarism (or cheating). The level at which the student is studying is a factor as it is expected that a first year student's understanding of plagiarism and cheating is less than that of a more senior student.

Following a referral to the AIO from an assessor raising concern related a student's piece of work, the AIO decides whether the concerns merit an investigation and if so, calls the student to a meeting where they have an opportunity to respond. The AIO in consultation with a member of the module team determines the plagiarism level and then decides upon a sanction based on the options provided by the code of practice. Most cases under poor academic practice relate to inadequate referencing or to a misunderstanding of how to write a report following extensive reading in which it is not clear which parts relate to the literature read, and which parts are the student's own writing.

4 REFLECTION

4.1 Plagiarism detection in coursework (behaviours 1,3 and 7)

Plagiarism continues to be challenging in relation to student research and report writing skills. Making the judgement about what is synthesising and reporting other authors' findings rather than the student's own writing does not come easy to



students. It is a skill that requires time for development. It is particularly difficult for students whose first language and culture are different to the university. What has become clear over several years is that the concept of plagiarism is considered differently in different countries. Students often argue that in their home countries they are encouraged to identify 'the best resources' and to include text from them without following appropriate referencing practice to distinguish between their words and those of an original author.

Attempts to encourage correct referencing at the start of programmes and then to reinforce the importance of avoiding plagiarism continue as students progress through their degree programmes. However, the issue of English language competence adds a further challenge to students attempting to read widely, to synthesise correctly and to then reference accurately. Experience by many academics who use Turnitin indicates that a substantial proportion of students use it at the draft stage of report to paraphrase sentences and paragraphs to reduce the similarity with the source they've copied. The skill being developed by students becomes beating the similarity algorithm, rather than developing the skills to write and reference correctly.

4.2 Online resources that facilitate cheating (behaviours 2,4,6 and 7)

This does seem to be an increasing threat to the integrity of the assessment system, which the COVID19 pandemic extenuated but will also apply to online assessment going forward. It's important to start with an acknowledgement that if it were not for online examinations, the progression and completion of university degree programmes during the pandemic would have been extremely difficult, especially with many students studying remotely.

By their nature online examinations were typically open-book, which for many engineering academics was not the norm and therefore may have risked pedagogical frialty. Extra time to complete the exams was given to allow for uploading the answers and to help students overcome internet difficulties. Students taking the examinations in different time zones meaning some would start and finish before others within a designated window. Even with this flexibility some students failed to upload their answers as specified, and emailed them afterwards claiming they uploaded the wrong version, raising suspicions as to whether they had obtained external help with the final versions. The decision on whether to accept a later emailed answer version was left with individual lecturers resulting in potential arguments and disputes.

There was also the potential that students used social media apps such as WhatsApp and telephones to obtain the examination paper from another student who logged on and stared the examination early in the time window available and therefore to gain unauthorised extra time to complete the examination.

For both coursework and online examinations the potential to use platforms such as Chegg to upload questions and purchase answers was encountered. It is in theory possible to post questions at the start of an online examination, to start answering



the questions but then amend answers if external answers were offered in time. Sometimes these answers were shared with others. Furthermore, students could simply Google a question to see if similar questions have been solved.

While in the early days of these potential incidents occurring, students may have used an email address and IP address that could be identified with them as it was used by them in other communications with the university. But there's evidence that they are now much more careful with this once learning that Chegg responds to queries from universities for information on individuals uploading their questions.

4.3 COVID Pandemic and Closed-book examinations (cheating behaviours 5, 8 and 9)

The challenge in closed book examinations generally revolves around potential cheating through bringing unauthorised resources into the examination rooms, hiding them, and using them when possible. In previous years, this has included the dishonest use of programmable calculators but has in recent years moved towards the use of mobile telephones to store additional materials, such as lecture notes and tutorial questions and answers. Investigation procedures are now long established and if a cheating offence is identified and evidence is collected, the procedures available can deal with the dishonesty in a now established way. The pandemic is gradually easing and the issues with closed-book examinations being compromised by remote exams is seen as less worrisome. However, universities that believe in developing new online assessments are striving to find a way to keep the integrity of the assessment even when online.

4.4 Further reflections on staff resource

The impact on staff resources of this growing development of academic dishonesty shouldn't be underestimated. More time is required for staff to identify and evidence suspicions of cheating and for the processes employed to continue to be fair and robust. This is particularly the case with 'homework' platforms such as Chegg where the identification of cheating and evidencing it is not always straight forward. The system relies on the module team to identify plagiarism and cheating and to spend time evidencing and challenging the students identified as not displaying the honesty required. A possible reaction to the challenges presented could be to move back to assessment by closed book examinations only, particularly in the latter years of programmes when the recent trend has been to use more diverse ways of assessing the development of skills and attributes.

5 SUMMARY AND ACKNOWLEDGMENTS

We've reflected on the current challenges of academic dishonesty in an engineering faculty through reference to nine cheating behaviours and their modern guises. By considering student motivation for taking short-cuts and the underlying factors, we consider that the barriers educators face when teaching emerging skills may be encouraging students to take the wrong path.



We require multiple strategies to reduce academic dishonesty because there are many influences. While faculty work hard to dampen the third motivating question “What are the costs?”, to make progress we need to develop strategies that counter the preceding questions: “What’s my purpose?” and “Can I do this?”. This means going far beyond a consistent approach to cheating, clear assessment standards and agreeing a code of academic practice, towards upskilling educators to teach and assess emerging skills without hinderance while compassionately addressing students’ beliefs and goals.

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