



Substantiating contract cheating for symbol-dense, logical responses in any discipline, particularly mathematics

A guide for investigators

October 2021



Some key features of symbol-dense, logical responses in any discipline, particularly mathematics

- Referencing and paraphrasing are not generally required in undergraduate tasks in such disciplines, so that text-matching software plays no real role in detecting potential misconduct.
- Unlike a single essay or a report, a mathematical assessment task may consist of several questions. Each of these requires an extended response (calculation and/or reasoning), and there may or may not be a final 'answer' (number or expression).
- Responses will be symbol-dense, containing not only alpha-numerical characters, but also Greek letters and other mathematical symbols and cannot be 'read for sense' by non-experts. Diagrams may also be helpful or expected in the response.
- They are often submitted in handwritten form (scanned and uploaded) so that solutions obtained by contract cheating will usually be transcribed for submission.
- Alternatively, some assignments may involve submission of a spreadsheet or a 'workbook' in software such as Maple or Mathematica.
- Natural variation between responses should occur in extended calculations or arguments at this level, as it does in prose writing. There is not a single form for a correct response (a common misconception among students and non-experts) even where there is a correct final symbolic or numeric 'answer'. This variation can be subtle, but completely identical, uniform responses are extremely unlikely. (This extends to annotations and discretionary choices in a 'workbook').
- Non-experts may find it hard to distinguish between common versus uncommon errors or superficial versus substantive variation.
- The technological signals from above that are most relevant are: consult learning analytics, check document metadata (where spreadsheets or 'workbooks' are submitted), check IP addresses and conduct an internet search for the task/student.

This guide should be read in conjunction with the overall TEQSA investigator evidence guide *Substantiating Contract Cheating: A guide for investigators* which can be found at:
www.teqsa.gov.au/sites/default/files/substantiating-contract-cheating-guide-investigators.pdf?v=1588831095

Symbolic and logical signals	Why this may be a clue
Identical to response at external site	Natural variation between responses should occur in extended calculations or arguments at this level, as it does in prose writing.
Varies only superficially from response at external site	When transcribing such a solution, students may attempt to disguise this, or save effort, by changing minor details or truncating expressions (e.g. 'Let x denote the density of the ...' changed to 'x=density' or 'Let z denote the density of the...'). Variations are cosmetic or superficial; important aspects are the same as source.
Varies at most superficially from another student's work	Where the response is posted online by a contract cheating provider, any subscriber to the service can access solutions contracted by another subscriber. Alternatively, this could be a signal of collusion.
Logical errors or gaps	If working has been transcribed, sections may be missed e.g., the end of one line and the start of the next. Apparent subsequent correct working could not logically follow the gap or disjointedness.
Symbol drift	When outsourced work is transcribed uncritically, symbol drift can occur (such as s becoming 5, + becoming t, superscripts or subscripts moving from their correct position). This drift can go back and forth. A correct final answer could not have been obtained if they had been interpreted literally as they changed.
Missing or unnecessary line breaks	This may occur in transcribed work if the logic expressed in the structure is not understood.
Uneven quality	Some contract cheating services insist that their "experts" answer only one question posted by a student. When questions are answered by different experts, there can be variation in quality (of accuracy or of explanation). Some responses may be outsourced and others not.
Inconsistent formation of symbols	Some contract cheating services insist that their "experts" answer only one question posted by a student. When questions are answered by different experts, there can be variation in how they've drawn what should be the same symbol. The student may not recognize these as the same symbol and transcribe them exactly as they appear in the source answers.

Symbolic and logical signals

Why this may be a clue

Inconsistent use of discretionary stylistic elements

Some contract cheating services insist that their “experts” answer only one question posted by a student. When questions are answered by different experts, there can be variation in style. For example, logical connectives are used throughout one answer, but words are used in others (e.g., ‘therefore’ versus three dot symbol), equations are numbered in roman numerals in one question but not labelled or labelled in a different style in another. Neither is more right or wrong than the other, but it is unusual within the work of the same individual to find several different conventions being used.

Imprecise or general responses

If the answer has been produced by someone who did not have access to the teaching and the subject materials, there may be aspects expected in responses in this context of which they are unaware.

Handwriting inconsistent

If outsourced work is uploaded without transcription, it will be in the handwriting of the creator, and not of the student. This may apply to individual questions in the same task, or to assessment tasks submitted on separate occasions. Different paper may also be apparent (lined, blank, with holes or without) for different questions. Two students may submit work in the same handwriting if outsourced to the same person, which will differ from their previous submitted work.

Idiosyncratic error or misunderstanding (seen at external site)

There are many ways in which answers can be wrong but a marker looking at many students’ work for a task can distinguish a commonly made error (e.g. forgetting a negative sign) or misinterpretation of a question from an unusual one. This may extend to spelling errors, since handwritten work will not have been autocorrected or put through a grammar tool. Such identical errors occurring in two students’ work may indicate a common source rather than collusion.

Non-conventional symbol choice

Choosing a non-conventional symbol or name for a mathematical object or variable may be an attempt to disguise transcribed outsourced work.

Missing explanatory diagram

Only text and symbols have been included in transcription, and it has not been appreciated that an explanatory diagram was integral to the sense of the response.

Symbolic and logical signals

Why this may be a clue

Beyond scope of previous instruction

Based on knowledge of the student's prior work and previous studies, use of techniques or terminology or theory beyond or outside the scope of instruction to date may be a sign that the work has been outsourced.

Nonsense language in place of precise terms

Either the student or the person to whom their work has been outsourced has used a synonym generator to spin the text in the response, including what should be precise mathematical terminology. For example, "tedious frameworks" used instead of "complex systems", or the technical terms "real" (pure maths) or "significant" (statistics) replaced by "genuine" or "important".

Adapted, annotated and supplemented by the author, from Katherine A Seaton (2019) Laying groundwork for an understanding of academic integrity in mathematics tasks, *International Journal of Mathematical Education in Science and Technology*, 50:7, 1063-1072, DOI: 10.1080/0020739X.2019.1640399



Checklist for investigating suspected contract cheating for symbol-dense, logical responses

Symbolic and logical signals	No concern	Some concern	High concern
Identical to response at external site			
Varies only superficially from response at external site			
Varies at most superficially from another student's work			
Logical errors or gaps			
Symbol drift			
Missing or unnecessary line breaks			
Uneven quality			
Inconsistent formation of symbols			
Inconsistent use of discretionary stylistic elements			
Imprecise or general responses			
Handwriting inconsistent			
Idiosyncratic error or misunderstanding (seen at external site)			
Non-conventional symbol choice			
Missing explanatory diagram			
Beyond scope of previous instruction			
Nonsense language in place of precise terms			

Possible questions to ask in an interview with student

- What other related subjects have you studied in the past?
- Can you tell me in your own words what you are doing in solving this question?
- What is the technique that you are using here called?
- Can you explain how this part of the working leads to the next part?
- What is this symbol called, and why did you choose it? And this one?
- If the question was changed in [some way], what would change in your response?
- Your response is very similar to [website or other submission]. Can you explain why this would be?
- Can you show me the rough working for your assignment?
- This is not a technique taught in this subject. Can you show me the learning materials you used for this technique?

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