

# ***Assessing Critical Thinking: Putting Discourse to the Test***

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This paper describes a study of a course – Critical Thinking and Writing – and its assessment. Specifically the paper has a twin focus: to describe the assessment package in this course, and to discuss the difficulties of assessing critical thinking skills through an evaluation of the package. Texts were found to be useful as stimuli for the thinking process. Text types such as reports and position papers were also found to be useful as product that learners need to produce as a result of having acquired critical thinking skills. The assessment package was found to be composed of elements such as critiques and position papers that are able to achieve a close match between teaching and testing, though these were not communication formats that the target students would need to produce at work. On the other hand, the package had other elements such as persuasive and investigative reports which, although are ideal at eliciting, practising and acquiring key critical thinking skills, were too multifaceted to be a true or reliable measure of the acquisition of critical thinking skills. The paper concludes that while the assessment package achieved some success in attempting to measure certain learning outcomes of the course, it shows deficiencies in key assessment areas. Finally, the paper proposes the use of critical thinking indicators as criteria in judging composite products such as reports to approximate a better measurement of component skills.

## **INTRODUCTION**

Critical thinking (CT) is a term for which it is difficult to have a generally agreed-upon definition. There are, as experts agree, too many definitions, and there are also often overlaps and blurring of concepts related to the term. Its assessment too suffers from the same fate – there is a plethora of assessment types that test CT.

This paper describes a multiple-measures approach (Spicer & Hanks, 1995) to attempt to resolve some of the difficulties of assessing critical thinking. The paper focuses on a single course,

Critical Thinking and Writing (CTW), which uses several discourse types such as argumentative texts and critiques for both teaching and testing. The paper first discusses what experts in the field of CT and its assessment have to say on developments in both CT and its assessment. Next, it describes the background of the course, its inception, objectives and the range of core CT skills that form the learning outcomes. The paper then describes the assessment package used in the course and its rationale. This part also describes the match between the teaching of CT skills and its assessment, using various types of discourse. The conclusion discusses the merits and drawbacks of this assessment package and how it may be improved upon in the future, using a model that recognises discrete skills involved in the problem solving process. It is hoped that the findings of this paper would provide insights into a more comprehensive assessment of CT skills where they are taught in tertiary institutions.

### **CT – A Suggested Definition**

Diffuse definitions have been suggested in a variety of disciplines such as cognitive science, developmental psychology or the study of human intelligence. As such, CT is a vague term prone to overlap; there are no distinct definitions. However, there is general acceptance that any course that purports to teach CT needs to incorporate the upper three levels of Bloom's taxonomy of educational objectives, namely, analysis, synthesis and evaluation. It might even include the next two levels: comprehension and application. The problem of clarifying CT is best described thus: "Defining thinking skills, reasoning, critical thought, and problem solving is troublesome to both social scientists and practitioners. Troublesome is a polite word; the area is a conceptual swamp" (Cuban, 1984). The definition of CT has also been studied by Ennis (1985, 1989). Critical thinking has been linked to reasoning (Glasman, Koff, & Spiers, 1984; Shulman and Carey, 1984). While others have parsed CT into activities that reveal more realistically the composite of CT (Watson & Glaser, 1980; Facione, 1990) the research of the last two decades has regarded CT as a set of more comprehensive skills and sub-skills.

The assessment of CT also suffers from the same fate; there is much research and as many tests (Boe, 1996) as there are CT skills and sub-skills. Research has centred on whether standardised

tests, such as multiple-choice items, test CT whose heart is the process of learning, not the product. Research has also asked whether there is content and construct validity in the tests that focus directly on the analytical, logical or CT skills. The work of CT experts has enriched us with ways to conceptualise CT so that syllabus design and assessment are not as horrendous as before (Ennis, 1985; Paul, 1990). Yet valid assessment has not reached a consensus, nor is it possible. Other experts have brought into the assessment picture the element of writing as a way to enrich thinking (Durst, 1987) and the role of persuasive writing in CT (Beyer, 1985; Ennis, 1962; Facione, 1990).

The present study was undertaken as an attempt to share with instructors of CT courses the role that discourse plays in the assessment of CT skills, and the inherent difficulties that might be fine-tuned to produce a reliable assessment measure.

## **COURSE DESCRIPTION**

### **Background to Course**

For more than a decade, engineering students at the National University of Singapore were required to read, as part of their engineering education, a communications module, deemed an essential elective module, together with other essential electives such as economics, sociology and human resources management.

In 2000, it was felt that such a module – with its emphasis on the acquisition of written and oral skills to ensure an engineer's survival in the work world – had outlived its usefulness, and that the students needed a critical thinking course to equip them for the challenges of being not merely engineers but entrepreneurs, technopreneurs and middle management executives. In fact, it had long been felt that although the faculty admits high-calibre students, these were products of schools long accustomed to teaching “knowledge of subject-specific knowledge without encouraging thinking and mindfulness” (Glaser, 1984). The faculty also felt that the emphasis on a knowledge-driven economy necessitated a re-thinking of the calibre of students that are admitted into the faculty in the same way that many developing countries are also evaluating new directions: “Critical thinking is... critical inquiry, so such critical thinkers investigate problems, ask questions, pose new

answers that challenge the status quo, discover new information that can be used for good or ill, question authorities and traditional beliefs..." (Scahfersman, 1991: 3). Hence, armed with this perceived objective, the instructors of the communication module designed a module to realise the faculty's need to produce "thinking" engineers-to-be.

### **Course Objectives**

The resultant module is EG 1413, Critical Thinking and Writing (hereafter, CTW), a module that grew out of the following objectives:

- To equip students with the ability to think reasonably and clearly, to express themselves clearly and concisely, and to forcefully persuade others of the value of their thoughts.
- To equip students with life skills so that they can operate in an increasingly complex world: making choices, solving problems, taking initiatives, etc.
- To equip students with the skills of 'doing,' because knowing is not enough.
- To equip students with fluency in thinking skills that will complement their own innate or acquired knowledge or cleverness, and to turn out the entrepreneurs, organisers and leaders the society needs.
- To facilitate the shift students need to make between learning and thinking, i.e., helping students to think for themselves, to think reflectively and not merely to learn from what other people have thought, to take ownership for their own personal learning, to understand the logic of arguments, listen attentively, debate confidently, and to become life-long independent learners.

### **Course Syllabus**

The course developers were mindful that the required module had to focus on critical thinking which they describe as "reasonable, reflective... [and] focused on deciding what to believe and do" (Ennis, 1993: 180). It had to be the composite of processes, strategies and representations that people use to solve problems, make decisions and learn new concepts, despite the fact that the target students were already competent in knowledge acquisition.

Hence, the goals of the course are critical thinking skills and sub-skills.

In line with the broad objectives of the course and the adopted definition of CT, it has several student learning outcomes. At the end of the course, students should know how to do the following:

- Judge the relevance and credibility of sources.
- Identify thesis, reasons, assumptions and conclusions.
- Judge the quality of an argument, its reasons and evidence
- Develop and defend a position on an issue.
- Identify a problem, plan a simple study, adopt a suitable method of obtaining evidence or proof to substantiate claims, and draw conclusions.

These abilities and dispositions are also equally ambitious given the duration of the course and the fact that students originated from a school system that has, in the main, focused on the acquisition of content knowledge, not on independent learning and CT. Nevertheless, it posed a challenge that the course designers attempted to respond to in practical ways, with tasks and practice activities.

From the outset, CTW aimed to be a course built around problems, issues, and questions. It recognised the primacy of process over product. It was designed on the premise that thinking is best promoted in an environment that stimulates critical enquiry. Here, thinking necessitates problem solving.

The course designers wanted the course to be based on problem solving. As it turned out, the course relied heavily on students being exposed to the problem based learning approach, where they were given a situation which is not ideal and were then asked to investigate inherent problems with the intention of providing solutions to them. Additionally, the designers believe in problem solving as anathema to all that the target students had undergone in their previous school experience, where rote learning predominates and much content is learnt without application.

## **Curriculum**

Subscribing to much of the research on CT and its assessment, the designers of CTW tried to achieve coherence throughout the course by deciding what students need to demonstrate, what they know, and what they can do. Certain questions were important in the planning of the course: "What is most essential for students to learn in order to achieve the broad goals the faculty has for them?" and "What counts as proof that they have learned to do this?" It was determined that engineering students would need to be competent in selected CT skills which could be demonstrated in strong, contextualised performance assessments. Hence, working backwards, curriculum development concentrated on materials that would help the designers achieve that end. Materials, therefore, focused primarily on discrete skills as well as the application of those skills in meaningful contexts. The following description focuses on the role of text types in both teaching and testing.

## **Course Schedule**

CTW became a 36-hour module taught over 12 weeks, comprising 6 hours of lectures and 30 hours of class contact time, with another 10 hours weekly of preparation time on the part of students. They earn 4 modular credits and follow the module over a 12-week period. Teaching methods include lectures, tutorials, writing laboratories, and the use of IVLE (Integrated Virtual Learning Environment), the campus courseware management system. Assessment is part in-course assessment (ICA) which accounts for 60 % of the final grade, and part examination (2-hour written) which makes up 40 % of the final grade

## **THE ASSESSMENT PROCEDURE**

In order to evaluate the assessment of CT in CTW, it is necessary to describe the assessment package, specifically the discourse used in relation to the teaching of CT skills.

### **Use of Discourse**

**Definition and Function:** This paper understands discourse as types of language produced in communication, both oral and written. The role of discourse in encouraging language use is not new. By

extension, the teaching of critical thinking benefits from discourse, as is put forward by Glaser (1984). Moreover, there is much research done on the link between thinking and writing, and although there has been no clear explanation on how writing aids critical thinking, the course designers believe that persuasive writing is a medium that can elicit the practice of specific CT skills.

Believing in the primacy of discourse and writing, CTW confronted students with texts, both oral and written, in order to force CT dispositions and to encourage production at the end of a problem solving situation. The Receptive and Productive Discourse for text types that students are required to read and process is produced below.

### **Receptive and Productive Discourse**

In CTW, discourse has a dual purpose: students are exposed to discourse as stimulus, and they produce it to demonstrate that they have learnt certain CT skills. For instance, to foster analytical and productive reading, students read texts on common topics to identify concepts like topic, thesis, issue, etc. This is perhaps the simplest thing we can ask students in adult CT classes to do: say verbally what these elements are in the texts. Then, students read and evaluate critically (letters to a newspaper forum, position papers, etc) what they read. Finally, students respond or react to something in writing or speech. This they do in the form of feedback to a topic in the Discussion Forum and debates in class. This is one example of the basic sequence of activities that are planned to promote CT skills throughout the course. Implied in this sequence of events is a complex matrix of students grappling with texts, both as receptive and productive tasks.

In oral discourse, there are ample opportunities for students to listen to others' comments on specific topics; they routinely hear others' suggestions and solutions to dilemmas they try to solve in class. Additionally, they review and critique a team presentation done by their peers and view, as stimulus and model, a team presentation video on the course website.

Table 1 summarises the use of discourse types for student practice and acquisition of core critical thinking skills.

**Table 1. CT Skills Practised with Discourse**

<b>Skills</b>	<b>Discourse type</b>	<b>Practice in:</b>
*Basics of argumentation: -structure of arguments -assumptions, implications, types of fallacy	*Letters to the Forum page of the newspapers *Texts (linear and non-linear) with which students formulate thesis, discuss issue and extract arguments, and provide counter-arguments	-Extracting arguments in extended text; counter-arguing -Writing summaries, paraphrases and rephrasing as to clarify understanding of text -Discovering logic and fallacy -Analysing the structure of arguments
*Reading and responding to contributions	*Discussion forum postings	-Agreeing. Disagreeing -Analysis and synthesis -Contributing personal responses to a topic
*Undertaking basic research *Formulating thesis *Gathering evidence/proof *Solving problems	*Research Reports *Articles (government department reports) on the Web *Oral peer reviews *Oral presentations -done by peers -view video, available on course website)	-Problem solving skills: -doing field work -organising information -presenting findings individually and in groups -writing up results individually and in groups

**Criteria for Assessing CTW**

It is clear that standardised tests (objective or otherwise) would not do justice to a thinking module such as CTW, the assessment of which would require the following considerations:

- An assessment of outcomes and the processes (or experiences) that lead to a solution.
- Measurement of the skills (and sub-skills) students have become better at in relation to the learning outcomes of the module.



- Recognition of both individual and group contribution, for purposes of grading and monitoring both the individual student's progress as well as to award group effort in the completion of the tasks (see Table 2 below for assessments of individual and group effort).
- The importance of writing in the thought process, both in how it impacts the student to think and how it affects the quality of the resultant product.

In general, the assessment package needed to assess various categories of skills which CTW encompasses. This paper adopts Winocut's listing of skills (Costa, 1985) which includes *Enabling Skills, Processes and Operations* (Howe & Warren, 1989), critical skills CTW intends its students to acquire. While *Processes* include distinguishing fact from opinion and evaluating the relevance of information, *Operations* encompass logical reasoning, problem solving skills (subsets being analysis of situation/problem, devising a plan or strategy, carrying out the plan, and evaluating the plan and its outcome). Finally, *Enabling Skills* comprise comparing and contrasting, observing and prioritising, and these are acknowledged as sub-skills that students would need to acquire in reaching the final outcomes.

It is clear from this long list that some skills are easier to test than others, there being a close match between test format and skill tested. It is also clear that some skills are not easy to test yet are very pertinent for their close links to the learning outcomes. These are the same skills that are unyielding to discrete forms of testing.

### **Task-based Assignments and Rationale**

Several types of discourse were found to satisfy these requirements. The following types of discourse were chosen as being formats that would require students to display an understanding of the core skills acquired: a critique, a position paper, a report, and an oral presentation.

The nature of these assignments requires students to do a substantial amount of writing because it is believed that an ideal way to teach critical thinking is to require students to write. Writing inevitably forces students to organise their thoughts, contemplate their topic, evaluate the information they have gathered in a logical

way, and present their findings and conclusions in a persuasive manner. Moreover, good writing is one of the indicators of good critical thinking (Burkhaffer, 1998).

The critique and position paper both compel students to confront arguments and allow them to judge the logic of arguments by examining their structure, seeing the relationship between thesis and reasons or support, and learning about types of fallacies. Though these skills have roots in the formal study of logic, the approach taken in CTW is that students learn fundamental issues in argumentation: thesis, reasons or support, conclusion, assumptions and fallacy types common in poor argumentation (such as straw man, circular, confusing “what is” and “what should be” over-simplification or false cause, etc.). While the critique teaches students to examine objectively a writer’s reasoning, the position paper elicits their own response to an issue. It is, in fact, a student’s objective explanation of a writer’s argument while the position paper elicits a student’s subjective response to a topic requiring either agreement or disagreement with a position given in a text. Both these formats are scored with a marking scheme of descriptors.

Together, the report and the oral presentation are the final outcome of the major problem solving task (see Table 1), as well as the processes through which students learn a host of problem solving skills. Underlying this assessment format are the project and problem-based approach, the writing-across-the-curriculum approach and even the “apprentice in the discipline” approach (Kurfiss, 1988). The latter approach is one where students are put in the position of simultaneously learning the content and inquiry methods involved in conducting a project. The skills simulate those a researcher is involved in: discussing findings in groups, writing up results individually or in groups and exchanging work in progress to elicit suggestions from each other.

In summary, there is a close link between what students practise and how they are assessed, especially for the first two assignments, that is, the critique and position paper. For instance, in the tutorials, they learn about types of fallacies and examine texts that contain them. They are then assessed with a critique in which they describe the components of the argument (in writing or with a structural diagram) and critically analyse the writer’s reasons,

assumptions and conclusion. Similarly, they critically read texts that offer a position on a topic, learn to extract the arguments with accompanying support or reasons, and then learn to offer counter-arguments. The two large assignments, namely the report and the oral presentation, are designed to match the range of skills and sub-skills in problem solving that students practise throughout the course. Table 2 summarises the match between skills practised and assessed.

**Table 2. Teaching-Testing Matrix**

Topic/ Skill	Teaching and Practice	Discourse type for assessment	Individual/ Group
Arguments	Interpreting a text for main point/argument, supporting reasons and underlying assumptions Stating thesis, identifying assumptions, etc. Analysing structure of arguments to establish links between thesis and reasons	Critique	Individual
Arguments	Critical reading of argument in connected text Extracting argument and reasons/support in connected text Evaluating arguments Providing counter-arguments	Position paper	Individual
Problem solving; Argumentation; Organisation & presentation of information	Identifying problem Identifying information gaps Formulating thesis Undertaking simple field research Analysing cause and effect Drawing conclusions Prioritising solutions -Examination of sample report to discover structure and argument Joint construction of 'skeleton' report on air safety	Report	Group
Problem solving; Argumentation; Organisation & presentation of information	Problem solving -- what to make of context, audience -presenting information (in another form)/analysing differences between written and oral persuasion	Oral presentation	Group

	-being an effective presenter; presenting in a team -presenting information visually (using PowerPoint programme)		
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## PEDAGOGY

In order to have an understanding of the problems associated with assessment in CTW, the following sections preview the classroom activities and the nature of the assigned tasks.

### **The Report: Teaching and Testing**

In CTW, the orchestration of skills learnt is achieved and assessed through the final project, which takes a heavier weightage of marks in the assessment package. In line with the belief that challenging and discipline-specific topics achieve greater success, the project involved engineering students in simple research, including research using primary and secondary sources.

The following is a description of the sequence of both lecture and tutorial activities that provided students with the practice and skills needed to complete the project:

First, lectures were given to expound theories behind the following broad topics that would be involved in the students' completion of the projects:

- Practical applications of CT: evaluative, productive and reflexive.
- Structure of arguments.
- Genres such as writing critiques, position papers, reports, and oral presentations: basic differences, format, purpose, audience, characteristic language features and rhetoric.

Second, the tutorials helped students practise different sets of skills needed to complete the project. The major project sees students demonstrating an orchestration of the skills learnt.

The sequence of the tutorial activities is described below:

### *Stage 1*

Students are introduced to the concept, problem and major issues of safety related to engineering. With a letter to a newspaper forum, students practise the following skills:

- Distinguishing facts from opinion.
- Identifying thesis, topic and issue within the letter/text.
- Understanding the use of rhetoric and its forms within arguments.
- Evaluating an argument through its oversights and distortions (see Appendix 1 for a sample of the argument used).

Students end this round of activity by brainstorming this question, "Who should be responsible for safety on the roads?"

### *Stage 2*

Out of class, students participate in the Discussion Forum on IVLE, the university-wide electronic learning management system, on which are mounted various resources for courses. They post responses to the question posed: Should engineers ever put cost above safety considerations? (see Appendix 2 for sample student responses)

### *Stage 3*

Students proceed to use convergent and divergent thinking to brainstorm solutions to a hypothetical situation as outlined in following dilemma:

You are a project engineer in charge of the construction of a steel suspension bridge. When work begins, you discover that the steel purchased for the project by the client is of a slightly inferior quality to your original recommendation. The client refuses to make an exchange for the original type, citing cost concerns, and threatens to reject your company's tender for a further bridge if you persist with your objections. Your company Chairman also insists that you comply with the client's wishes. What should you do?

Using the Discussion Forum postings, the class discusses issues beyond the original boundaries of the argument.

#### *Stage 4*

Students are next taught to dissect a text into its component structure, i.e., main argument, supporting reasons, underlying assumptions, in order to help them see the faults and fallacies in it, so that they can avoid making these fallacies in their own extended argument later in the project.

#### *Stage 5*

Students collaborate on the project by brainstorming a land transport safety issue of interest to them. To show the scope and the extent of their proposed research, they submit for approval their topic, thesis, proposed supporting proof (following particular means of research). This requires the involvement of students in teams discussing a topic that they feel needs to be addressed in Singapore. They are given the context of their investigation, a pseudo work-world scenario: a taskforce addressing safety issues of specific means of land transport, the eventual objective being recommendations of solutions to improve existing safety concerns.

#### *Stage 6*

In teams, students work on the following major tasks grouped below for the convenience of examining the kinds of critical thinking skills practised by students:

##### *Problem Identification*

This activity involves the following:

- Identifying and stating a problem, an area of transport in which safety is felt to be compromised; expression of statement of thesis of project/study.
- Identifying information gaps: obtaining information to prove thesis, and accessing sources of such information.

At this stage, students brainstorm areas of public transport where safety is felt to be compromised, identifying an area they would like to work on. They discuss and then submit a statement of

their thesis for their study to the tutor for approval. This is to ensure that each group has chosen an area whose scope is neither too large nor too limited. Deciding the scope was in itself an integral aspect in critical thinking as students grappled with the need to investigate an area where safety in transport was compromised, that would not exhaust them in terms of time (they had about 4-6 weeks to do this) and effort (they had to undertake primary and secondary research). Next they identify information gaps: the information they would need in order to illustrate a situation or prove their thesis. They also weigh and consider a suitable type of instrument that would need to be used such as field studies, survey questionnaires, interviews, etc. Support is provided in the form of readings on these research instruments as well as in guidance in designing survey questionnaires.

### *Research: Data Collection*

At this stage, students undertake the kind of research that they have decided will give them the information they want. The sources range from the Internet (with necessary data from the various governmental department, e.g., Traffic Police) to conducting interviews with officers from various governmental departments to carrying out a survey to determine common accidents on public buses. Students then analyse and interpret the gathered data, evaluate the proof and use it to build up an argument and modify the thesis and original suppositions and assumptions. Based on the findings, they think of solutions to the perceived problem. Part of this process included comparing and contrasting various solutions and recommending those that fit the evaluative criteria set up at the beginning of the study, criteria such as cost, effectiveness, implementation time, safety aspect, etc.

### *Presentation of the Argument*

The context of the assessment necessitated that students report on their study in two formats: (a) a written report, and (b) an oral presentation, the audience of both being 'authorities from the Transport Ministry'.

## (a) The Written Report

Students learn to organise information, that is, knowing where to put what and making sense of the format of a work world discourse (the report) largely alien to them. Using sample reports done by past students, tutors guide students to identify the following aspects in their writing:

- Report as argument.
- Report structure, organisation and language.
- Use of data, statistics and non-linear texts (pie charts, graphs, etc.) to make arguments convincing.
- Clear objectives/purpose and concise writing, formatting, headings and layout.
- Audience and context: who reads the report and why, and how to tailor message to intended audience for maximum effect.

In order to help students write the report, tutors and students jointly construct the 'skeleton' of a report as forerunner of the one they are going to produce (see Appendix 3 for skeleton or outline of report).

The students, on completion of their reports, self-assess and conduct peer reviews following a set of guidelines (Appendix 4). Following this, they submit a draft of the finished report for eventual face-to-face conferencing with the tutor. The conference affords students a chance to discuss with the tutor major issues encountered in the writing of the report. Again, tutors guide students to see the writing of the report as part of the problem solving process. Issues such as the following are brainstormed: how the data gathered can be used as argumentation; how the organisation of the information adds to the logicity of the argument (not only that it aids readability); how arguments can be put across more effectively, and how problems of context, audience and appropriateness of tone and register (in the language) can be solved. Only after this conference do students re-submit their report for grading. The process of drafting and redrafting recognises the primacy of process in writing. It also adds a real-world dimension to the task, as students do not submit their first draft without having revised and edited for organisation, audience and language.



## (b) The Oral Presentation

In general, students conduct an analysis of audience and context, recognising that the audience of the oral presentation may be made up of people who have read the written report. They then evaluate information pertinent to this second presentation of their study, i.e., what and how to present results that the audience is presumably familiar with. They also structure their arguments in order to present it convincingly and effectively in the oral presentations. They do this with the aid of a PowerPoint programme.

Support at this stage is provided in a set of PowerPoint notes and slides made available on the course website. These notes show how to prepare such slides and how to refine their own slides. They also watch a group of their peers present the project orally. Additionally, they may watch a video of a group presentation on another project to learn team presentation techniques. These activities enable each group to watch how it is done by a group of peers, and by using a set of guidelines again, they peer-assess the presentation (Appendix 5).

The assessment of group projects commonly awards one grade to a group of students whose abilities and contributions might not be similar; hence, the assessment of the report includes a separate grade for individual performance. Each member of the group submits an executive summary of the report. Similarly, in the oral presentation there is a separate grade for individual performance by each of the group members.

## FINDINGS AND DISCUSSION

This part of the paper discusses, through a description of the merits of the assessment package, the difficulties that emerged in arriving at a reliable assessment tool for a CT course such as CTW.

From the above description of the course and its assessment, it is clear that CTW looks like an ambitious course. The complexity of the assessment package attests to it. Discourse (or text types) was useful in being both stimuli for the practice exercise and assessment format or output, as the base for the critical reading tasks and the outcome of the orchestration of CT skills learnt.

## Merits

Undoubtedly, the package is comprehensive and recognises that CT is not a general ability but a complex set of general and specific skills. It makes good pedagogical sense, as the range of tasks calls into question many of the student learning outcomes. There are ample opportunities to assess the core thinking skills; there are tasks of differing sizes; and there is an attempt to reward both individual and group effort. Critical reading which involves, among others, skills of evaluating, drawing inferences and arriving at conclusions, is central to CTW because the reading of texts plays a prominent role in the content field, and is thus practised in all four assignments. The report and oral presentation are both performance based assessments that call for a demonstration of understanding and skills in an applied, procedural, open-ended setting.

In these two assessments, students apply a whole range of CT skills learnt, including moving away from the one-correct-answer model they are used to in many content modules, to one where they develop workable solutions to problems which require them to make choices and decisions based on a critical examination of information and opinions. When engineering students engage in solutions to environmental problems as they did in one semester (when the problem was one of devising solutions to waste management in the country), it was environmental education that came to the fore. Indeed, an invaluable opportunity to enhance the critical thinking of a group of students who should be engaged in such problems was given.

The report, being persuasive in nature, endows the assessment with all that research says is good about writing in relation to thinking (Rivers, 1987). Writing by itself mediates process and product and provides ample opportunities for students to review and revise. But persuasive writing forces students to apply the three highest levels of Bloom's taxonomy: analysis, evaluation, and synthesis (Bloom et al., 1956), and perhaps more. Additionally, since there is an audience to contend with, students learn to anticipate and answer potential objections from the audience and tailor the communication to them. The problem solving situation inherent in this assessment implies that the product is necessarily a set of arguments and support that have been individually worked out, and so are solutions and alternatives

unique to the students writers who designed and produced them. This achieves one of the original objectives of the course: to move students away from regurgitating others' solutions and to encourage students to be responsible for their own ideas.

### **Demerits**

Admittedly, the discourse types of critiques and position papers are not communication types that engineering students would need to write in their work. However, the match between teaching and testing is closer and the scoring is more transparent with the use of descriptors in the marking scheme (see Appendix 6).

In contrast, the report and oral presentations, with tasks that are more realistic of the work world, remain assignments that give but only a composite picture of a student's acquisition of CT skills. This is because they assess such a wide range of skills that they cannot describe accurately what students have learnt and what they have not. Additionally, scoring both the report and the oral presentation has to be done on the basis of the finished product so that there is no proper assessment of the discrete skills that make up the end product. Also, the complexity of the report and oral presentation formats necessarily introduces several other aspects that students need to pay more attention. In the report, for instance, students need to grapple with aspects as varied as format and language of reports. In the oral presentation, they have to deal with issues of context, audience and the differences between the written and oral mode of persuasion. While it is true that this assignment involves many other skills that need to be mastered for the performance of the task, they also feature problem solving issues. This is because, as far as possible, the approach taken in CTW is one of problem solving. For example, instead of looking at the oral presentation as merely another presentation format, students are guided to consider assessing it as part of the original problem. Through a series of questions, they discuss why report readers would like to invite them back for another presentation of the same findings, what they would need to do if the report had been read by the intended listeners, strategies to make their presentation convincing, and utilisation of oral presentation techniques (see Appendix 7).

The emphasis on problem solving is essential to CT but these latter two assignments are demanding tasks, necessitating a large amount of scaffolding in terms of teacher support, materials (made available for students), and students' self-guided efforts. More importantly, they might easily detract from the CT components intended as the focus of these tests. For instance, in all four tests, a large premium is placed on language fluency as a language component is built into each assignment. Furthermore, it is not easy to determine the extent to which students have learnt component skills implied in the output. Table 3 below summarises the merits and the drawbacks of the total assessment package.

**Table 3. Merits and Demerits of the CTW Assessment Package**

Type of test	Advantage	Disadvantage
Critique	<ul style="list-style-type: none"> <li>*Tests discrete skill of knowledge of argument structure, conclusion, assumptions, etc.</li> <li>*Easy to score (with descriptors)</li> </ul>	<ul style="list-style-type: none"> <li>*Little applicability for a student in the discipline</li> <li>*Presumes a high level of writing ability and language proficiency</li> </ul>
Position paper	<ul style="list-style-type: none"> <li>*Tests ability to extract argument, and to respond critically to it, and to provide counter-arguments</li> <li>*Easy to score (with descriptors)</li> </ul>	<ul style="list-style-type: none"> <li>*Little applicability for a student in the discipline</li> <li>*Presumes a high level of writing ability and language proficiency</li> </ul>
Report	<ul style="list-style-type: none"> <li>*Useful work world document/form of communication</li> <li>*Pays attention to process learning</li> <li>*Tests a whole range of abilities</li> <li>*Performance-based</li> <li>*Students learn a work world genre, and its discourse</li> <li>*Students learn to work in teams</li> <li>*Students see the report not only as product but as a form of argumentation</li> <li>*Persuasive element in report challenges students to make their writing more reader-centred</li> </ul>	<ul style="list-style-type: none"> <li>*Difficult to determine which skills student has/has not learnt well, since there is a range, from sub-skills to skills, that are involved</li> <li>*Difficult to determine each student's acquisition of skills since it involves group work</li> <li>*Students need to cope with discourse of report; project implies lots of input; students need to attend to many things</li> <li>*Scoring is based on the product- difficult to test discrete skills</li> </ul>
Oral presentation	<ul style="list-style-type: none"> <li>*Useful work world form of communication</li> <li>*Students learn to see the oral presentation as another form of argument or oral persuasion</li> <li>*Students learn to cope with a work world genre, and its discourse</li> </ul>	<ul style="list-style-type: none"> <li>*Students need to cope with many aspects related to the genre: e.g., oral presentation skills</li> <li>*Not easy to judge the argumentation aspects</li> <li>*Scoring is based on the product</li> </ul>

	<ul style="list-style-type: none"> <li>*Students learn to work in teams</li> <li>*Students learn to continue to solve a problem: of context, audience and purpose</li> <li>*Persuasive element of OP challenges students to make their presentation more audience-centred</li> </ul>	<ul style="list-style-type: none"> <li>*Skills other than CT skills assessed</li> </ul>
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## CONCLUSION

This paper has discussed how various discourse types are used in a critical thinking and writing course, and has shown the degree of match between the teaching and the testing of CT skills. It also shows how different types of discourse serve as foundational reading materials that CTW students first grapple with and finally produce. It is clear that the study of discourse is useful in such a course as it ideally promotes the importance of the process of thinking alongside the problem solving that students go through. Discourse types like reports and oral presentations are the products that show the thought processes students go through. Once regarded as merely product or outcome, reports and oral presentations can, in this course, be seen as the end product of a process in which learners can be assessed for their demonstration of performance-type behaviours, i.e., demonstrating and constructing arguments, and formulating solutions under specified conditions and standards.

On the whole, assessment of CT is complex and difficult, as demonstrated in CTW. Although multifarious, the assessment package in CTW shows the possibility of assessing fairly certain CT skills, leaving others un-assessed, not because it is not possible to but because it would be difficult to. Clearly, the CTW assessment package goes some way in measuring students' acquisition of CT skills. Based on personal experience and on feedback from other instructors of the course, the chief 'complaint' seems to be whether we have succeeded in arriving at a measure of how much a student has learnt and acquired (which specific skills he has and has not learnt well, and more importantly), and whether we can quantify the composite of skills that a student's final grade represents.

The problems of assessment in CTW are not insurmountable. In the future, it might well be possible for the course designers to consider using CT indicators such as those adopted in the

assessment of any scientific investigation that would measure specific aspects of the process which students go through to reach a solution, in much the same way as students in the laboratory would document the way in which experiments have been carried out.

This paper would like to recommend assessment of CT skills based on a model that will pay attention to discrete aspects that need to be assessed instead of merely the whole product or outcome, if indeed the course designers are interested in assessing the process at the outset. For instance, the important role played by the problem-solving steps might well be emphasised and students be given credit for having learnt them effectively. Table 4 below shows some of the possible CT components that might need to be taken into account in order to make the assessment of discrete skills more effective.

**Table 4. Assessment Using CT Indicators**

<b>Indicator</b>	<b>Assessment Considerations</b>
Brainstorming	-differentiates between fact and opinion -recognises more than one view point -makes connections between different sets of ideas -constructs/formulates measurable question/problem
Research	-formulates reasonable questions related to problem -locates information from variety of sources -identifies and seeks additional information/materials -engages in self-directed investigations -summarises information to demonstrate understanding of gathered information
Hypothesis	-selects a plausible solution from gathered information
Procedure	-logical sequencing of steps in research -adjusts steps in research where necessary -re-clarifies steps along the way
Results	-makes observations carefully -gathers information in organised manner -able to modify original thesis based on gathered data -analyse data coherently -uses diagrams and other visuals to show findings
Conclusion	-evaluates analysis of data -judges data to assess whether hypothesis supported or not
Solution	-solves problem first identified -considered from more than one aspect

Communication of Findings	-communicates information accurately to audience -takes note of context of communication and adjusts message to intended audience
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The specifications shown in this table will be useful as a guide in judging the comprehensiveness of a CT course assessment. Such a model may be used in many ways, such as a set of descriptors for instructors to assess the final product, taking cognizance of the discrete skills demonstrated in the production. It could also be used more effectively while students are carrying out the project, with the instructor evaluating one step of the investigation at a time, using a spreadsheet programme to indicate students' skill – those they are proficient at versus those they are not – so that small group, face-to-face conferences will be better used to facilitate student improvement.

The assessment package described in this paper represents an attempt to cover as many CT skills and sub-skills as possible that the target students need to acquire in a short span of time. Although CTW is an ambitious course, its multiple-measures approach in its assessment bears the mark of the many factors that must come into play in such a course.

The model recommended above to overcome the drawback of assessment that recognises finished products, seems prudent only in view of the belief that CT is a composite of skills whose assessment, if it is to be fair, should focus on these discrete skills. Moreover, if the primary focus of CTW is in problem solving as shown by the research project undertaken by students, the need to reflect discrete skills should be given more prominence.

More research is certainly needed to determine if students completing this course have indeed learnt some of the higher order skills (no matter how lofty these may seem) that their faculty requires. Specifically, future research needs to address the following questions:

- Do performance-based formats really satisfy the fact that thinking is not a general ability but a complex of factors?
- Are final outcomes (shown in document types such as reports) indicative of the acquisition of skills and sub-skills?

- Are there assessment formats that truly reveal the breadth and width of acquisition of CT skills?
- Are there assessment formats that focus on the process of thinking as distinct from other factors?

For now, the course designers of CTW can only claim that for all the constraints that they are working against (amount of time allocated for the course, an undesirable entry level competence for some students, etc.), it has gone forward in giving its students some practice and experience of what critical thinking is all about.

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## Appendix 1. Sample of an Argument

### Let us put safety factor back on the public agenda

Sonny Yap

MURPHY'S Law: "If something can go wrong, it will go wrong."

Call it yet another with-the-benefit-of-hindsight tut-tutting if you like, but it is hard to deny that the operation of this immutable law lay at the heart of the SQ 006 crash.

Just think of all those "if onlys" on that dark and stormy night. If only one of the "if onlys" could have been foreseen and forestalled, it might have broken the chain of errors and misses and saved 83 lives.

Perhaps the consolation from this horrendous event is the re-awakening of a more acute sense of safety consciousness among Singaporeans and the restoration of safety to the public agenda.

Profitability, productivity, efficiency, reputation and long-term fundamentals are important, but safety -boring as it may sound to new-economy ears and tedious as it may be to implement -must come first and foremost.

That's why it is especially gratifying to read about the move to train playground-safety inspectors, the setting up of a fire-safe wet market and a reader's concern about SMRT's readiness to cope in case a train catches fire in a tunnel.

The Singapore Airlines disaster was a national tragedy. But, without detracting from its impact and poignancy, let's not forget that individual tragedies are happening almost every other day in supposedly safe and secure Singapore.

Taken collectively, they are no less heart-wrenching in the impact on the families of the victims who have to cope without buddy support, instant relief payout, generous compensation offer and unstinting help from employers and the public.

I am referring to the carnage that goes on unabated on the roads and at homes, construction sites and factories whose total death toll in any given time span would far exceed the number of those who perished at Chiang Kai-shek International Airport.

Let me just pullout some statistics from the Grim Reaper's harvest: In the first six months of this year, 116 people were killed in road accidents. Last year, 197 people met their untimely end in similar circumstances. At this rate, about five people die on the road each week. . Construction sites continue to be killing field. As of Oct 7, the lives of 40 workers have been snuffed out this year. The man who was buried alive by cocoa beans was

## Appendix 2. Student Responses

[Previous](#) | [Next](#) | [Previous Topic](#) | [Next Topic](#)

**Topic:** SHOULD ENGINEERS EVER PUT COST ABOVE SAFETY CONSIDERATIONS?

**From:** TOH ENG KIAT, ANTHONY

**Date:** 14/01/2002 06:42:07 PM

Personally, I feel that ways of cutting cost should be centred around the issue of safety and be carried out only once the basic and minimum safety considerations has been attained. In addition, it would only be professional and ethical of us engineers to pursue the best and efficient engineering design without compromising safety, which could lead to undesirable consequences. Unless the pros in doing so very much outweigh the cons, I do not see why cost should be put above safety consideration which in my opinion be given first priority.

[Post](#) | [Reply](#)

**SHOULD ENGINEERS EVER PUT COST ABOVE SAFETY CONSIDERATIONS?**

**From:** LOW CHEE WAH

**Date:** 21/01/2002 12:37:19 PM

Ethically speaking, we should always place safety as a top priority when undertaking any project, especially if it involves or may affect the lives of many. Realistically, of course, as all of us know, this may not be so ideal every time. First of all, the decision may not be in our hands. The budget may be decided by the firm. As such, you will be working under a constrain (even if you are unwilling). Secondly, how safe is safe? Accidents happen unpredictably and it is almost impossible to ensure "perfect safety". Thus, the only way to ensure a fixed percentage of cost delegated to safety when undertaking the project and ensures that you maximise this portion of the budget.

**SHOULD ENGINEERS EVER PUT COST ABOVE SAFETY CONSIDERATIONS?**

**From:** LOW SAY SIONG

**Date:** 17/01/2002 10:19:39 PM

Personally, I think that engineers should always follow the Codes of Ethics for Engineers and put safety above all considerations while performing their duties. Ensuring safety precautions will prevent workers from getting injured unnecessarily. In the long run, I am sure that both the companies and the workers will benefit a lot from this.

Nevertheless, most of the companies today put cost above all things. Due to the economic crisis and the money-loving nature of humans, many companies are trying to cut cost. As a result, they neglect the safety of their workers which I feel that it is very unethical and unprofessional.

[Post](#) | [Reply](#)

## Appendix 3. Outline of a Report

### Tutorial: Joint Construction Activity on Report Structure & Content

#### PROPOSAL FOR IMPROVING AIR TRAVEL SAFETY

- I. Introduction
  - A. Background/Current Situation
  - B. Purpose of Report
  - C. Outline of Report
  
- II. Methods and Procedures
  - A. Sources of Information
  - B. Evaluative Criteria *[what can/should these be?]*
  
- III. Findings and Discussion  
*[Discuss how you can organize information in this section]*
  
- IV. Conclusion
  - A. Summary of Problem
  - B. Summary of Findings and Discussion
  
- V. Recommendation  
*[Discuss how you can organize information in this section]*

#### Proposal for Improving Air passenger Safety

- I. Introduction
  - A. Background
    - 1. After 11 Sept, need for higher security for air travel
    - 2. Airline industry suffering worldwide
  - B. Current Situation
    - 1. Singapore Airlines declared forth quarter 2001 loss, cutting staff.
    - 2. Civil Aviation Authority of Singapore is reviewing policies and set up task force to make recommendations for improving passenger safety on all flights leaving from Singapore.
  - C. Purpose
    - 1. Discuss proposed passenger safety procedures
    - 2. Evaluate suitability of these proposals
    - 3. Outline steps necessary for implementation
  - D. Outline of the rest of the report
  
- II. Methods and Procedures
  - A. Sources
    - 1. Passenger safety recommendations from US Federal Aviation Authority compared to current CAAS procedures
    - 2. Case studies from Heathrow (London), Narita (Tokyo), O'Hare (Chicago) and Changi (Singapore)
    - 3. Airplane manufacturers recommendations – Boeing, Airbus
    - 4. Airline crew survey
  - B. Evaluation Criteria
    - 1. Projected added safety value
    - 2. Practicality of implementation
    - 3. Time for implementation
    - 4. Cost
    - 5. Possible problems

## Appendix 4. Proposal Checklist

Please answer **Yes**, **No**, or **Partly** to the following questions. If the answer is **Partly** or **No**, please add a written comment to explain the reason for your answer and or a suggestion for improvement.

### Content :

Have the writers:

1. \_\_\_\_\_ given an appropriate informative *title* heading to the report?
2. \_\_\_\_\_ included an *Executive Summary* with information from the proposal that is important & relevant to decision maker?
3. \_\_\_\_\_ introduced the proposal with a description of the context and a clear statement of *objectives*?
4. \_\_\_\_\_ described the method of gathering data, the sources used and why those sources were relevant?
5. \_\_\_\_\_ presented clear *findings* and offered a convincing interpretation of them?
6. \_\_\_\_\_ considered alternatives and *counter-arguments* adequately in the evaluation?
7. \_\_\_\_\_ presented an adequate *summary* of key findings & discussion in 'Conclusions'?
8. \_\_\_\_\_ proposed reasonable & practical *solutions*, which are clearly supported by research findings?
9. \_\_\_\_\_ included appropriate *graphics* which effectively support the text?
10. \_\_\_\_\_ put supporting information for optional reading in the *Appendices*?

### Organization & Layout :

Have the writers:

11. \_\_\_\_\_ placed information appropriately into the respective parts of the report?
12. \_\_\_\_\_ sequenced information within each part effectively & logically?
13. \_\_\_\_\_ included transition phrases/sentences where needed (i.e. are ideas well linked)?
14. \_\_\_\_\_ used appropriate headings and sub-headings so that the information in report can be easily and quickly accessed by the reader?
15. \_\_\_\_\_ placed graphics alongside or after the portion of the text in which they are cited?
16. \_\_\_\_\_ used attractive & reader-friendly page design/layout (i.e. considered the use of fonts, white space)
17. \_\_\_\_\_ labeled and named all graphics and the information in the Appendices?

### Language:

Have the writers:

18. \_\_\_\_\_ used a formal, impersonal tone?
19. \_\_\_\_\_ used factual, objective and specific *language* ?
20. \_\_\_\_\_ avoided inflated words and flowery rhetoric?
21. \_\_\_\_\_ defined/explained technical terms or field-specific *jargon*?
22. \_\_\_\_\_ made any *spelling, grammar* or *punctuation* errors?

Names of Reviewers: \_\_\_\_\_ Names of writers: \_\_\_\_\_

## Appendix 5. Team OP Peer Evaluation Form

Topic: \_\_\_\_\_

Speaker 1/2/3\*: \_\_\_\_\_ Reviewer: \_\_\_\_\_

\* Circle appropriate item

Items of Review	Comments/Suggestions
<p><b>A. On the Individual Speaker</b></p> <p><b>Content/Organization</b></p> <p>Introduction/Body/Closing*:</p> <ul style="list-style-type: none"> <li>- Did the Introduction grab your attention? Was a clear overview given?</li> <li>- Were ideas supported adequately with relevant information, examples, etc?</li> <li>- In the Closing, did speaker remind you of main points?</li> </ul> <p>Was he/she persuasive in communicating the team's recommendations?</p> <ul style="list-style-type: none"> <li>- Did the presenter display full grasp of the subject matter? Was he/she convincing?</li> <li>- Was the information well organized? Were there clear transition signals to make the communication easy to follow?</li> </ul> <p><b>Delivery Language</b></p> <p>How good was the delivery, in terms of :</p> <ul style="list-style-type: none"> <li>• confidence level</li> <li>• voice projection and variation</li> <li>• eye contact</li> <li>• presence/absence of distracting movements/speech habits</li> <li>• fluency</li> </ul> <p><b>Visual Aids</b></p> <ul style="list-style-type: none"> <li>• Were they relevant and effective?</li> <li>• Were they well managed?</li> <li>• Did they enhance the speaker's presentation?</li> </ul>	
<p><b>B. On the Team as a whole</b></p> <p><b>Cohesion/Persuasiveness</b></p> <ul style="list-style-type: none"> <li>- How cohesive was the presentation? Did the speakers support each other in terms of what they said and what they did?</li> <li>- How smooth was the transition from one speaker to the next?</li> <li>- Were there unnecessary repetitions?</li> <li>- How convincing was the proposal as a whole?</li> </ul>	

## Appendix 6. Marking Scheme – Assignment 2 (Position Paper)

Criteria/Range	Mark Range & Descriptors		
Content/50	Good-Excellent	Fair	Poor
	35 & ↑	26-34	25 & ↓
	<ul style="list-style-type: none"> <li>* Addresses assigned task</li> <li>* Clear thesis</li> <li>* Summarizes arguments of opposing side effectively</li> <li>* Substantive counterarguments – has sufficiently well-developed ideas/support/reasons</li> <li>* Key terms well-defined</li> </ul>	<ul style="list-style-type: none"> <li>* Addresses assigned task</li> <li>* Thesis is not well stated/implicit only</li> <li>* Insufficient summary of arguments of opposing side</li> <li>* Lack concrete support</li> <li>* Arguments brought out but not well argued/exploited</li> <li>* Some attempt to define terms</li> </ul>	<ul style="list-style-type: none"> <li>* Does not address assigned task at all</li> <li>* No thesis at all- implied or otherwise</li> <li>* No reference at all to arguments of opposing side</li> <li>* Has little substance and ideas hardly have concrete details/support</li> <li>* Arguments are poor/shallow/not well developed</li> <li>* No attempt to define terms at all</li> </ul>
Organisation/25	17.5 & ↑	13-17	12 & ↓
	<ul style="list-style-type: none"> <li>* Ideas are arranged logically and clearly; ideas are easy to follow</li> <li>* Uses organizing devices correctly</li> </ul>	<ul style="list-style-type: none"> <li>* Ideas generally arranged logically but not in all parts of text</li> <li>* Organizing devices used inconsistently</li> </ul>	<ul style="list-style-type: none"> <li>* Arrangement of ideas far from being reader-friendly-frequent breakdown in logical sequencing</li> <li>* Incorrect use of organizing devices</li> </ul>
Language & Structure/25	17.5 & ↑	13-17	12 & ↓
	<ul style="list-style-type: none"> <li>* Text has hardly any grammar errors-easy to read</li> <li>* Vocabulary has a wide range</li> <li>* Word choice and usage are very effective</li> </ul>	<ul style="list-style-type: none"> <li>* Some to few grammar errors – these do not impede meaning</li> <li>* Somewhat fluent</li> <li>* Word choice and usage generally effective</li> </ul>	<ul style="list-style-type: none"> <li>* Text is full of grammar errors – reading is difficult</li> <li>* Very limited vocabulary range</li> <li>* Ineffective word choice and usage</li> </ul>



## Appendix 7. Preparing for the Oral Presentation (Assignment 4)

### 1. Clarifying situation/context

The Director, whom you directed the report to, has read the report and has requested that the team presents the report orally in front of him and other high ranking officers of the Ministry.

What are the possible implications of this context?

No	Known information	Implications
1.	Has read the report	?
2.	And other high ranking officers of the Ministry	?
3.	Being called to re-present something that had been submitted in a report	?

### 2. Clarify roles

- Who is the audience?
- Who are you?
- How are the two related? (implications for dressing, form of address?)

### 3. Clarifying purpose

- What is the audience's purpose in being present at the OP?
- What is your purpose? (implications?)

### 4. Clarifying similarities & differences between report and OP

#### *Similarities*

How similar?	Report & OP
Purpose?	In both, we?
Audience?	?
Information from study	Same findings, same recommendations but?
Style of presentation	Formal, i.e. ?

#### *Differences*

How different?	Report	OP
Impact made by:	Report format (organization), Error-free language, ? ?	Speaker (dressing, ???) Slides (Power point)
Reader/Audience	Can read & re-read; cannot answer reader's questions so must?	Speak clearly; get his attention? Look at audience to?
Use of pronouns	?	?