To what extent is critical thinking affected by language demands in a level seven technical degree course?
Nick Marsden, UNITEC New Zealand
In association with Niranjan Singh and David Clark

Abstract
Critical thinking can be said to be among the louder 'buzz phrases' in education in the 21st century. Both critical thinking and communication are key employability skills. Whilst there is a body of research on critical thinking, and its role in pedagogy, there seems to be a dearth of research linking second language ability and critical thinking. This area probably needs further examination given that it relates to subject specific discourse. Moreover the debate about domain-specific and generalist critical thinking skills is arguably impacted by language in ways that could disadvantage non-native English speakers in their assessed work.

This research, carried out with Automotive students in New Zealand, suggests the language support currently given on a Bachelor level course in Automotive may not be adequate, and might need to be made available in different ways because perceptions of language ability may impact on success. The findings from this project suggest that automotive students might in fact prefer more language support.

This information would be useful for course designers and facilitators at institutions elsewhere, particularly where courses might attract large numbers of non-native speakers either as international or domestic students. In either case, their perceived needs and expectations on the level of language support required to succeed are a focal point of this project.

Introduction
This project is an attempt to relate language needs to critical thinking, and to evaluate the way these needs are supported on tertiary courses. The students surveyed in this study were on the final year of a Bachelor in Applied Technology course. Graduates of this course typically end up as supervisors or workshop managers in the automotive sector. Making deductions and diagnosing problems are central to language demands. Key assessments include giving a final oral presentation, and presenting a 40,000 word written paper. The students would need to exercise critical thinking in problem solving of technical issues as well as in situations with a client interface. Apart from having a grasp of technical language, they would also need to use general English when communicating with clients. This paper will also evaluate the demands of the assessment currently used (a powerpoint presentation to a group).

The students in this cohort – by a large majority – were non-native speakers of English. The majority of them have studied technical skills to certificate level, and many have automotive workshop experience. The Bachelor course is seen as a way of gaining skills in order to move away from being 'just mechanics' and moving into areas such as design or management. The language demands of the course in terms of high word output assignments had a clear impact on them. Some seemed concerned that their language would let them down. The language needed to express critical thinking is sometimes complex, and students need to feel confident enough to speculate, hypothesise, argue, or perform other complex tasks using English. Given the situation where we have so many non-native speakers of English on our degree courses,

and also the fact that communication skills, along with critical thinking are expected qualities for employment seekers, it would seem imprudent not to highlight the way we deal with these 'soft skills' on technical degree courses, especially when language and communication are so fundamental to graduate employability.

Literature review
In the words of Kirby and Goodpaster (1999, p 76) "We think with words. As we read this, we are using language to think. Language is very important to how we achieve critical thinking. "There are two main schools of thought in the critical thinking debate: the 'generalists' and the 'specifists' (Davies, 2013). The generalists hold that critical thinking skills are teachable for all disciplines, while the specifists assert that critical thinking can only be taught as it applies to a particular discipline. Davies is in the generalist camp, and his research suggests that the specific approach is flawed. However, interestingly, he suggests that the issue of language may stand apart in some way; "The generalists do not hold that there are no discipline-specific differences in *application* of arguments, or in the *language* used to describe academic debates. They hold that the *skill* is generic in nature." (Davies, 2013). This implies that the issue of language, and how it may impact on critical thinking or the means to express critical thinking – is indeed a variable that needs to be examined more closely. It is unlikely that the students in this research project would solely be using technical English – in other words, that they would also need to use general English communication skills in interfaces with clients, so a generalist approach might be more aligned with their needs.

Rashid and Hashim (2008, p.373) make the links between language and critical thinking. Their research at Malaysian universities has focussed on the premise that "Critical thinking skills and mastery of English language are expected to become important outcomes of university education in Malaysia". This outcome has been tied into educational policy, and their research aims "to gain insight into the links between critical thinking ability and its possible link to their language proficiency." The initiative is driven by Malaysia's quest to become a developed nation by 2020.

Wharton (2011, p223) who has published research which tries to draw links between critical text analysis and language says: "For undergraduate students, there is an expectation that course content will be challenging and that critical thinking will be encouraged."
It follows that – particularly in the case of learners whose first language is not
English – there may be a need for support in this area, where language ability
may impact on performance in course tasks and assignments and unconfident language ability may constitute a disadvantage.

Another aspect of the discussion which will be of relevance, is whether critical thinking itself is a generic skill that can be applied to all disciplines, or whether it "should be considered specific to the individual disciplines" (Moore, 2004, 2011a). Whatever the case, it is likely that language might have a bigger impact on critical thinking ability than we think. If the issue is that students are "lacking argumentative skills to perform in universities and in the workplace" (Davies, M, p 543) then language must come into it somewhere. However, he also (2013, p. 542) points out that language cannot be the only variable, as "it does not explain the poor performance of native English speaking students in the experiments". This leads him to raise the question of whether critical thinking skills need 'dedicated intervention': "Employers are right to complain if graduates cannot think critically, educators are obliged to do something about it. The need is urgent." (Davies, M. 2013, p. 543). This

suggests that educators need to design and manage tasks appropriately in order to develop these skills. Davies (2013, p. 543) concludes his article with: 'there is a very sound basis indeed for the introduction of assessment measures such as the Graduate Skills Assessment test and, for that matter, any other well-validated test of critical thinking."

The main way in which graduates will be judged on their ability to think critically will be in the expression of their thinking. This will involve not only a mastery of technical concepts but also, the ability to describe and analyse this knowledge to an audience. Arguably this need not only be examined through written work, but perhaps via other means, such as problem based learning. In the workplace, the audience at the receiving end of the communication and critical thinking will usually be the client. This kind of transfer from a technical expert to a lay person would require some linguistic skill, and that is the kind of language act that needs to be developed.

Ross (2009) found that employers were favouring some graduates over others. Only 61% of international students were able to find full time work as opposed to 87% of domestic students. Employment outcomes for mainland Chinese graduates were as low as 49%. According to Davies (2013) some of the evidence about students' deficiencies with critical thinking skills might be due to language, and indeed, culture. "Some of this can be attributed to the large numbers of international students in universities who struggle with English and who come from cultures unused to the critical, argumentative culture of western universities." (Davies, p542) Conventions of speaking, including critical thinking around appropriate choice of key aspects such as vocabulary and intonation would need to be developed.

There is a great deal of literature which suggests there is a strong need to meet the needs of employers, and to future proof graduates by preparing them for demands of the workforce in 2020. Communication and critical thinking feature strongly among the top desirable Capabilities. Davies Fidler and Gorbis (2011, p.8) point out that: "As we negotiate the human/machine division of labour in the next decade, critical thinking or sense-making will emerge as a skill workers increasingly need to capitalise on." (Davies et al, 2011). It makes sense to say that educators need to take care that the tasks they design effectively measure these kinds of attributes.

The participants
The participants of this research are all taking a New Zealand Qualifications Framework level seven Bachelor degree course in Automotive Engineering at UNITEC Institute of Technology, New Zealand. The aim of the course is to take the candidates to a level beyond technical mechanical skills. Many hope to end up as supervisors, managers, or even, automotive designers. There were 26 (23 non-native speakers, about half of which were international students) participants in the research, and the information has been gathered through questionnaires (see appendices) and a follow up focus group meeting. Many of the students intended to get work in New Zealand and some wanted to return to their country. All of them expected that they would use English in their future work. The New Zealand Qualifications framework for level 7 bachelor degrees states that:

According to the New Zealand Qualifications Framework, a graduate of a Bachelor's Degree is able to:
• demonstrate intellectual independence, critical thinking and analytic rigour
• engage in self-directed learning
• demonstrate knowledge and skills related to the ideas, principles, concepts, chief

research methods and problem-solving techniques of a recognised major subject
• demonstrate the skills needed to acquire, understand and assess information from
a range of sources
• demonstrate communication and collaborative skills.
(New Zealand Qualifications Framework, p.14)

It is highly likely at level 7 that a student would be required to read and understand complex texts such as industry regulations documents. It almost certain that communicating ideas and expressing critical thinking – whether written or spoken – at this level would require a good grasp of language to be able to perform such functions as presenting a hypothesis, speculating, challenging an idea, and so on.

Methodology
There were two meetings with students from the class. In the first meeting, questionnaire 1 was used. The purpose of this questionnaire is to gain an idea of the students' level of confidence with using English, and to gauge their expectations of language support. Each of the students completed their questionnaire and the results were collated.
On the second occasion some weeks later, a focus group met to answer questionnaire 2, and to discuss one or two of the issues raised.
I was also able to view the students' written work, and to observe their oral presentations. I have commented on the format of the spoken assessment, and I have also selected sample errors.

The Questionnaire
The questionnaire was given, first of all, to the 26 participants to allow them all to give their individual responses in the early stages of the course, before their first assignment had been handed in to tutors. The choice to do so before the assignments had been marked was made so that response might be slightly more objective in that they would not be influenced by factors such as disappointment in a result or low grade given by a tutor, a missed deadline, or resubmission with error corrections, and so on. Of the 26 respondents, 3 were native speakers, 23 were non-native speakers. There was no group discussion the first time around. The responses from the questionnaire were as follows:

Table 1

Questions	Responses	Discussion
1. Is English your first language?	Yes – 3 No - 23	Of the 26 students who participated, 23 were non-native speakers of English, and three were non-native speakers. The ratio of non-native to native speakers is high. Perhaps the department as a whole could consider expanding the ways to address language support, including providing tutors to help in this regard, as part of a course success and retention strategy. The students resorted to different means of support. The majority used google or search engines. Whilst they were not specific about how they used this, they did say they used it to look up grammar and vocabulary. Some used it for writing ideas, but the use of Google was not tutor guided. A small number used tutors (3) or family (4). Very few used the central institutional support (1).

2. Do you need support with your reading, writing and speaking for this particular project?	Yes – 15 NNS No – 8 NNS No – 3 NS	A significant number of students would clearly appreciate support with these language skills in relation to their projects.
3. Where do you go to get support? (some gave several responses)	Learning support – 1 Friends/family – 6 Internet - 14	Most of the class felt that they needed support. There was variation in where the students went to seek support. Perhaps the institution could strengthen the choices and means available. This would include investigating the use of peer support, and developing ways for content deliverers to include language support in their teaching. This could be on-line or via a LMS such as Moodle or Mahara.
4. Do you think it would be useful to have support with your reading, writing and speaking in general as part of the course?		Students have different expectations of the kind of support they would like to receive. It may be that the institution needs to consider ways to cover **all** these bases to address the issue.

NNS = non-native speaker
NS = native speaker

Focus group discussion
Focus groups were held after the first assignment had been marked and returned, around 5 weeks later, and this involved a discussion with a small group of students about language support needs. The focus group meetings were deliberately held separately, as we wanted to allow time for the first Industry Practice assignment to be handed in and marked so that the students would have a better idea of their emerging needs in relation to language and critical thinking following assignment feedback. The group discussion brought out two main points:

➢ The anxiety produced by the word count and the language demands was tangible.

➢ The students wanted some kind of support with language. Whether this was guidance on usage, proof reading and so on was not clear. Perhaps the guidance on language could be conflated with critical thinking using typical automotive scenarios? They liked the idea of the support coming from the tutor rather than from the learning support unit, which is a generalist, central service. Perhaps the support coming from tutors has the potential to be both generalist (with their language in general) *and* specific (to the discipline) in terms of both language and critical thinking.

Sampling written work
In week 11 of the course, the students' interim reports were sampled, specifically try to get an idea as to whether their written language was interfering with the critical thinking process. The majority of the students are non-native speakers, but in some cases it was apparent that

the language errors did not impede the general message being communicated. However, students' fears about the quality of their written language are justified, since errors of grammar, vocabulary and syntax can make a piece of student writing less accessible to the reader. This impact on the 'audience' can be negative in that the reader has to work harder, and this in itself may colour judgement. There are instances of written work which requires re-reading in order to glean the writer's intention, and often this is down to wrong word choice, sometimes tense, or to mismatched subject verb agreement. It borders on being a subjectivity issue, which could probably have an impact on success in an assignment in a level 7 degree course. Some kind of awareness raising and standardisation of language expectations among tutors might also be beneficial even if only to better comprehend the extent of the language demands of the course. In other words, there needs to be clarity and consistency in expectations of what a successful graduate's attributes are in relation to critical thinking and language. Having some clear expectations and some support in relation to written work would be a great help.

Sampling of assessed spoken presentations
A number of student presentations were observed. These were in the form of monologues presented to an audience of classmates and three automotive lecturers.
The format dictated that each candidate presents a monologue to the group. The topic is the same as for the 40,000 word essay. Candidates prepared a monologue delivery with powerpoints, and needed to allow time for questions at the end. This format of presentation requires a degree of formality and forms a monologic discourse complete with signposting language for an audience. The format does allow candidates to exercise critical thinking around a problem (for example, how to reduce emission outputs in a city at peak traffic hours) but it could also be tempting for a student to learn a monologue by rote. On the other hand, it could be argued that the format is unrealistic in terms of preparation for negotiating with a client. As the choice of assessment mode would impact the choice of language, perhaps a presentation delivered as a monologue presents a different range of critical thinking skills than might be required in a dialogue situation where a greater degree of flexibility and unpredictability might present itself.

On the whole, the presentations revealed a clear critical thinking process, as they generally related to engineering solutions for engineering problems. However, there were issues with language. Although the presentations themselves often displayed creativity and critical thinking, some were let down due to errors of wording, appropriateness and grammar. While some of the errors don't interfere with basic messages, they do reveal a lack of clarity and this can have a direct impact on the expression of thought and critical thinking. Some language input around presentation skills, would almost certainly help with the effectiveness of the presentations. Some degree of focus on clarity of intonation and word stress, for example, could potentially have a beneficial impact on clarity and hence a better impact on the 'audience' that receives the communication.

Not all of the student observers taking part of the students' assessment were listening actively, or asking questions at the end of the presentation. If critical thinking is to be promoted it might be good to set up observation tasks for all participants and to expect full participation in such sessions. Such questions would encourage reflection and help the other students to prepare and structure the delivery of their own projects. This might help to develop critical thinking and language at the same time, in that the participants would be encouraged to listen more intently to their peers' presentations, to offer comment, and to

formulate questions. This is exactly the kind of skill that might help in workplace contexts, job interviews, and so on.

In most cases, the power-points contained errors that could easily be corrected but which revealed a range of language issues including spelling, subject verb agreement, and other basic grammar areas. Phrases such as this from the sample: 'the demotic driving history of China is much shorter compare to develop country,' can take quite a lot of unpacking by the listener.

A further conclusion that could be drawn from sampling the presentations is that possibly, a transactional discourse such as this (in other words, a power point presentation) may *not* be the most important way to assess these candidates' spoken ability. It may be that a role play scenario where they explain a problem to a client and give a solution would be more appropriate. An interactional set up would also bring to light other aspects, such as the appropriateness of intonation, without which communication strategies might not work successfully.

Focus group discussion

When I met with the focus group of 12 students, it was clear that writing is not a perceived as a major strength among most students on this course. This may not be surprising for the subject area, but the course writing demands in fact place considerable emphasis on this skill. Using a scale of 1 – 5, with 5 being weak, and 1 very good, 6 in the group considered their writing skills to be at 3. 4 rated themselves at 2, and two of them rated themselves at 4. All of the students were non-native speakers, and a degree of structured, perhaps even curated on-line support would be useful in relation to language matters. It might also be important to review the word count for the Industry Project assignment, which places a heavy emphasis on a large written output.

In answer to the question: "Where do you go for help with your writing when you need it?" four said friends and family, 6 said the internet, 1 said the library/learning centre, and one said grammar books. The students clearly use a variety of sources for support outside the course, some of which may have questionable reliability. It was somewhat surprising that only **one** used the institution's learning support centre. Not one mentioned the tutor (in answer to this question) as a source of support with writing. This suggests that more ways of giving support could be in place, including on line, and perhaps giving feedback on writing in tutorials.

To the question "Does your tutor help you with your writing in relation to critical thinking?", 10 out of 12 respondents answered 'yes', 1 answered 'no'. One did not answer the question; one said that the workshops for the assignments were not clear. Although the comments are generally positive in relation to tutor help, there is little reference to tutor help interventions in relation to language.

Question 4 asked if they had any other concerns with writing on this course? This response drew many more comments that suggested a need for more guidance and support with language. The first issue was the word count. One said "Asking for too many words (40,000 words) so we end up having to repeat stuff or make stuff up. Reports are suppose (sic) to be concise." Another comment revealed worries about language: "Not good on research, have enough knowledge to write an assignment but grammar not good might be

a concern." Another said: "Grammar. I am more worry about by using wrong grammar will affect my score."

In relation to the research question, the responses about grammar are a concern, as they reveal a level of insecurity about being assessed in a language which is not their mother tongue. The word count (40,000 words) is a source of anxiety. This is hardly surprising considering the fact that most students are doing their written and spoken assessments in a second language. Several comments point to a perceived need for more teacher guidance and support with language.

Conclusions

Language is central to critical thinking. Language demands such as the ability to speculate, persuade, negotiate and hypothesise in relation to critical thinking can be foreseen at the task or assessment design stage. The design of an assessment task needs to consider the nature of the language required to perform the task, so educators need to be aware of the kind of language a task elicits, and whether the task is realistic for the vocation for which the course is preparing students. It is worth considering whether an interactional rather than a transactional task delivered to a group of listeners might be a more appropriate assessment for these students. By this is meant skills such as dealing with a customer complaint, or negotiating in a meeting. Perhaps these more aligned to workplace demands than oral presentations. The nature of the assessments need to be considered in order to extend critical thinking, and tasks need to be natural and appropriate for the vocational context. It is hard to imagine that automotive bachelor course graduates would need power-point presentation (monologic) skills more than dialogic skills for meeting clients. More thought might be given to connecting language demands with critical thinking activities so that critical thinking in a second language can be highlighted. Certain language acts will require certain language functions, such as the ability to speculate using hypothetical language. Analysing these acts might help use to prioritise which language areas may be most useful to perform critical thinking tasks and discussions. This would shed more light task design, matching critical thinking and language required when dealing with clients whether it be to solve or explain a problem, describe a procedure, and so on. It would be foolhardy not to emphasize the need for critical thinking about appropriateness of tone and choice of words when communicating with a client, and the importance of this needs to be highlighted on a technical degree programme. The current spoken presentation format used on the course may not be the best skill to focus on since in a workplace situation. It may be that they are more likely to need language to have a dialogue with an individual or group of individuals rather than to present information to an audience in a group in a monologue.

It seems to be clear that the international students surveyed in this Level 7 Automotive course do have anxieties about the language demands of their course, and this should not be a surprise, given the fact that by a long way, the majority are non-native speakers. How much of an impact this has on displaying the level of their critical thinking skills is not easy to quantify, but suffice to say that language is a source of anxiety for them, since it is inextricably linked to their assessed work on the course, whether spoken or written. It might also have an impact on the way their work is judged and assessed. A role-played problem might provide a more realistic assessment of problem solving, critical thinking and communication skills than the present assessment regime.

From the students' comments, it is clear that there is an expectation of language support, and currently, this does not seem to be sufficiently embedded in the programme. It suggests that a fresh look at models of support would need to be in place to allay students' fears of the impact of language on their ability to express critical thinking expertise. Whilst it might be too much to ask of content focused teachers to become language teachers, it seems clear that a greater degree of guidance and support needs to come from somewhere. This could be in the form of communication/language support from occasional lecturers, or at the very least, on-line language support. Given that the most effective support may be best coming from the content focused lecturers, some upskilling in this area would certainly be beneficial, and may have the most positive impact on retention, and graduate employability. Alternatively, language and discipline experts could work collaboratively in team teaching. Some kind of awareness raising of language use among the lecturers, and a reconsideration of the appropriateness of tasks might help to match the language demands with critical thinking requirements more naturally.

To conclude, there is clearly a need for a more mindful focus on language acts on content based course design, particularly if language performance is used in the assessments (such as spoken monologic presentations). Given the high proportion of non-native speakers on mainstream courses, and the complexity of some of the language functions that might be required, this support should be embedded, and where possible, the links between critical thinking and language should be made explicit wherever possible.

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Appendix 1
Research Project Title: To what extent is critical thinking affected by language demands in a level seven technical degree course?

The aim of the project is to identify the language requirements (vocabulary, reading, listening, writing and speaking) to meet the critical thinking demands of APPT7116 Industry Project at level seven in the Bachelor of Applied Technology.

<u>Questionnaire A: language and critical thinking on your level 7 Automotive course</u>

<u>Date:</u>

<u>Time:</u>

1. Is English your first language?   [Yes]   [No]

2. Do you need support with your reading, writing and speaking for this particular aspect of the course?   [Yes]   [No]

3. Where do you usually go to get support?

   [   ]

4. Do you think it would be useful to have support with your reading, writing and speaking in general as a part of the course?   [Y]   [N]

5. What kind of support do you think would be most useful?

- Te Puna Ako – learning support centre
- Your tutor
- Your classmates
- Embedded within your course
- Other (Please specify) _____

Appendix 2

Questionnaire B
BAT Level 7 Focus Group Interview questionnaire: language and critical thinking on your level 7 Automotive course
Date:
Time:
Writing on the BAT level 7 course

1. **On a scale of 1 – 5, how do you rate your writing skills? (5 = very good, 1 = weak)**

2. **Where do you go for help with your writing when you need it?**

3. **Does your tutor help you with writing in relation to critical thinking?**

4. **Do you have any other concerns with writing on this course?**

Nick Marsden, May 2016