

Teaching first year students to communicate their reasoning

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It is important for university students to be able to think critically and reason. It is equally important that they be able to express their reasoning verbally or through the written word. This is particularly difficult for many of the international students, for whom English is a second language. This paper gives an overview of methods used in an Information Systems course at ACU National, whereby these skills were taught to the students. Some of the experiences of the students are then discussed and conclusions as to the effectiveness of the methods are drawn.

Introduction

The Australian government's Ministerial Discussion Paper on Higher Education at the Crossroads [Nelson, 2002, p.14] describes the need for “*a system that produces graduates who can think critically and have adaptable skills sets as well as technical expertise*”. The paper indicates that too often graduates leave university without being able to think logically, write clearly or speak coherently.

While most academics would agree that it is important for students to learn these skills at university, many of us give our students assignments expecting that they will already have acquired these skills or that they will learn them as they go along. Students, who cannot express their reasoning on paper, are more likely to fail whereas those who can are more likely to pass. Little effort is put into helping students to improve their ability to communicate their reasoning to others.

First year students and the writing of good arguments

Students attending university for the first time will often feel overwhelmed by the transition from secondary school. The writing skills students need at university often differ from those used in high school and students may need assistance in adapting their skills to a tertiary level (Baldauf, 1996).

Driskill, Lewis, Stearns and Vole (1998) discuss the problems that first year students have in understanding the difference between knowing the material and being able to regurgitate information, and the ability to be able to argue a point and explain their reasoning. Driskill et al. say that even after receiving feedback on examinations, students have difficulty recognizing the difference between a “memory dump” and giving an answer that explains a concept and establishes the connections between facts.

University education is not only about acquiring knowledge, it is also about developing better ways, and more critical ways, of thinking. Students need to learn how to think critically, have opinions about topics, determine the meanings and assumptions behind ideas as well as learn how to develop and communicate a reasoned argument (Lander & Latham, 1997). It is also important that students acquire the skills for managing intellectual conflict in a constructive way. Conflict situations can be used in the classroom to capture students' interest and attention and help them to internalise knowledge (Johnson, Johnson and Smith, 1997). Developing this ability in students is the difficult part.

A further problem that vexes university educators is problem of plagiarism. Students will often take the ideas of others and write them as if they are their own. They may even change the wording a little, but generally have problems integrating information, writing things in their own words and putting forward their own ideas rather than those of others. This problem is exacerbated when students have English as a second language. They are often scared to use their own words, as they are afraid of making mistakes.

In order to address these concerns, in 2002 the Course Review Committee for the Bachelor of Information Systems at ACU National decided to introduce a unit into the first year of the course which would focus on developing students' abilities to reason and to think critically. The unit was called "Reasoning and Critical Thinking for IS Professionals" and this paper will discuss how this unit promotes the process of students learning how to structure good arguments in order to communicate their reasoning to others. In particular the paper will concentrate on how the students' ability to write about their reasoning was fostered throughout the unit.

The Reasoning and Critical Thinking for IS Professionals unit

During the review of course curriculum for the Bachelor of Information Systems at ACU National in 2002, the course review committee decided that a new unit in Reasoning and Critical Thinking for IS Professionals was needed in the first year.

The objectives of the unit given in the unit outline are (ACU, 2002):

- "On completion of this unit students should be able to:*
- (i) understand and explain reasoning, critical thinking and problem solving;*
 - (ii) apply the principles of critical thinking;*
 - (iii) develop and apply relevant skills to problems related to information systems, particularly algorithm development;*
 - (iv) demonstrate an understanding of the application of reasoning and thinking in the information systems discipline."*

The types of thinking that are suggested should be covered in the unit are: strategic, critical, analytical, systems, creative, consequential and reflective. These thinking skills should be applied in writing, analysis, systems development programming and algorithm design.

The unit was offered for the first time in the second semester of 2003. It was offered on three of the campuses of ACU National, in Brisbane, Melbourne and Sydney. The authors of this paper were the lecturers in the three states. While the lecturers taught from a common set of notes and had similar assessments, each put their own flavour to the teaching and learning experiences of the students.

Thinking is often expressed in words through talking or writing. Sometimes a person can be a 'smart thinker', but be unable to express himself or herself. This can be especially frustrating when trying to work in a second language. At other times a person can be a skilled language user but be a 'poor thinker'. Being articulate or writing a beautiful essay does not necessarily indicate good thinking skill. To be really effective we need to have both – we must be able to think and we must be able to express our thoughts in writing or verbally (de Bono, 1976).

A first look at analysing other people's arguments

The students were given their first assignment during the second week of class. This assignment was used to help them to see how other people put forward their arguments and how they counter-argued against reasons put forward by others. The assignment was done before they had learnt any formal methods of analysing other people's reasoning or presenting their own.

The students were asked to read two articles. The first reasoned that the Apollo Moon Landings did not occur (Overstreet, 1998) and the second countered the arguments, proposing that the moon landings did occur (Yates, n.d.).

- i) The first question asked the students to draw a diagram showing how the arguments related to one another.
- ii) The second question asked them to analyze how the one article refuted arguments put forward in the other article. For example, Overstreet (1998) said that one of the problems was that there were no stars in the sky in the pictures that were taken on the moon. Yates (n.d.) refutes this argument by saying that stars in the sky were not the intended object of the photography; that had the exposure time required to capture stars on the film been sufficient (several seconds) then the intended objects of the photographs would have been 'blurred, over-exposed smudges.
- iii) The third part of the assignment tried to get them to incorporate their own ideas by looking for reasons as to why NASA might have faked the moon landings and reasons why their opponents might want to suggest that the landings were faked.
- iv) The last question asked them to take a stance for or against the moon landings and to support their stance with well-thought out arguments.

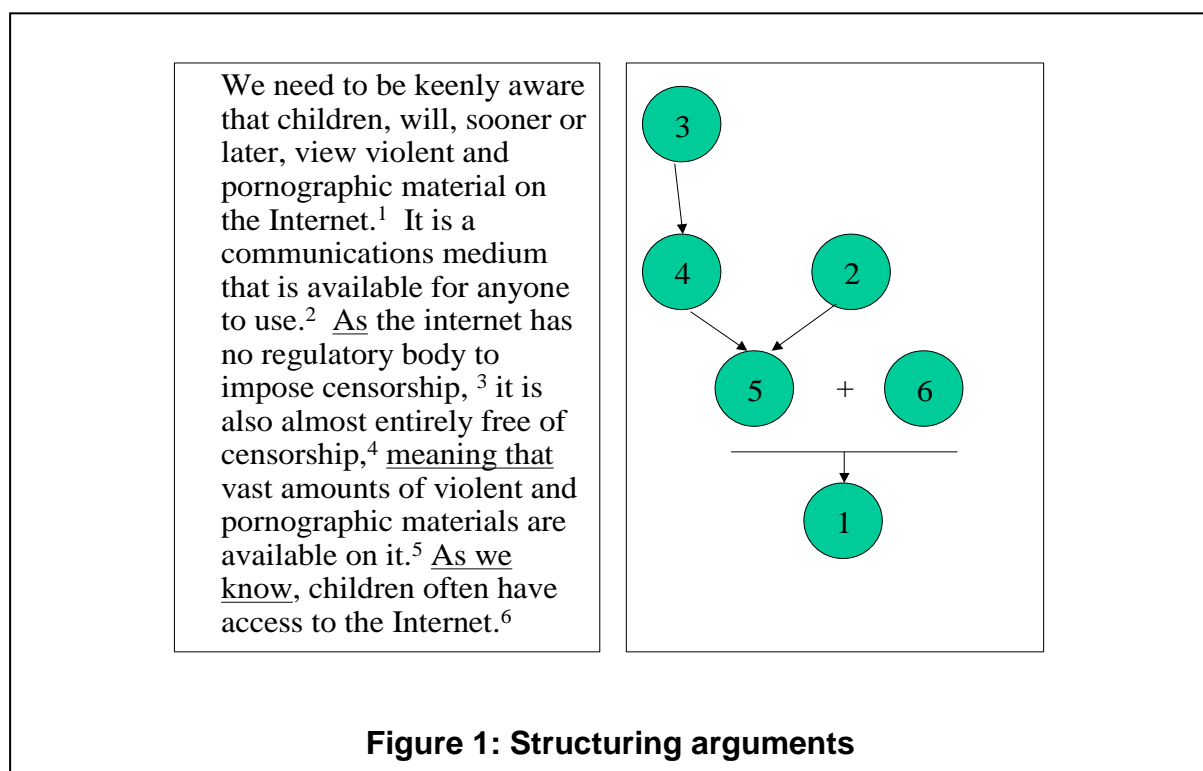
The students were given a week to prepare a draft of the assignment. The students were asked to put their mother's maiden name and their date of birth on the assignment to identify it. The assignments were then handed in and given to another student to evaluate anonymously.

The students were then asked to comment in writing on their fellow student's assignment. After this peer-evaluation, the students' assignments were returned to them and they were allowed to make a second attempt at the assignment. If they did not agree with the comments of their peer evaluator then they could write a short paragraph saying what they disagreed with and why they did not make a change that was suggested.

Assessment was carried out on their first attempt, their comments on the other person's assignment as well as their second attempt. Assessment of the peer-review is important as discussed by Jackson (1995).

Structuring arguments

In this part of the unit, students were firstly introduced to the idea of making claims and structuring arguments. This was based on the work of Allen (1997) and Jones (1997). Students were also shown how to develop a visual representation of a structured argument (see Figure 1). This part of the work involved taking the written arguments of others and analyzing them to identify the premises and conclusions and then to determine how the argument was structured. Sometimes the examples given were not arguments at all and the students had to realize this..



These exercises were used to help students to analyse other people's arguments as well as to structure their own. One of the things that the lecturers learnt from these exercises was the importance of taking the language skills of the students into account when creating exercises.

Students were asked to determine the structure of the statements:

“Delphina's triple chocolate A-bombe, which is extremely delicious, is apt to be high in calories and fat. Most really delicious desserts are very high in calories and fat.” ,

The international students, whose first language was not English, were very confused and a long discussion was necessary to help them understand what was meant.

Discussion groups using WebCT

The students' ability to reason and explain their reasoning in a structured way was practiced using discussions on WebCT. The lecturer would post a topic for discussion and the students had to take a view on the discussion topic and contribute something new to the discussion. Students were encouraged to take a stand on some controversial topic and to show why their opinion was correct and/or why they disagreed with the opposing point of view.

One of the early topics used in Brisbane was "*Many arguments have been put forward to support the continued criminalisation of marijuana use. The same arguments apply to the use of alcohol and therefore, alcohol should be criminalized as well.*". As this was the first discussion topic submission, parameters were not set on the size and level of detail that the submission should contain. Student submissions to the discussion topic averaged over 500 words and were presented in a standard essay-type format. The positions taken and arguments presented tended to be poorly structured and based more on emotive persuasion than reasoned logic.

One brief example was "*I don't think that any of the arguments that are being used to keep marijuana illegal are good. The people that think we shouldn't be able to use marijuana are either old people or people that don't want us to have any fun. They think that alcohol is ok because it is already legal and that it doesn't do anyone any harm to have a drink. They like having places to go and they want alcohol served so they can get a little high but they don't want us kids to have any fun getting high. Maybe this is because they think we are too young to handle it but then we can drink at 18 so it doesn't seem to make any sense. I don't think marijuana should be illegal and this would make it easier to get and have control over like they do alcohol. If they keep it illegal we will have to find different ways to get some and this means there will be more criminals and the jails will get fuller. I don't think this is a very good idea.*"

The last topic for student discussion dealt with the use of the Internet (ie WebCT) for presentation and assessment of educational material. The topic was described as follows: "*Increasingly, universities are encouraging the use of Internet-based presentation and assessment of material. The justification of this encouragement comes from very different perspectives. For this week's topic, you are required to write a short paragraph (<150 words) that argues a particular position regarding use of the Internet for presentation and/or assessment of educational material. You are then required (in the same submission) to put your argument in 'standard form' followed by a short statement on the type of argument you have used.*" Although the students were allowed to develop their submission in the same manner as previous discussion topics, this submission had specific guidelines set on its size and form.

In this instance what was of particular interest to the researchers was the anecdotal evidence that students were beginning to develop their mental arguments in standard form and then expand the statements and conclusion into the required paragraph. In the submissions where the required standard form preceded the subsequent paragraph, the paragraph was significantly more complete and well-formed whereas the reverse was true when the standard form was presented in the submission following the required paragraph.

As an example, the submission for the last topic is taken from the same student who submitted the previous paragraph on marijuana versus alcohol:

"Statements:

More high school kids are going to university every year.

Most kids going to university have computers at home.

Kids like using the web to do things.

Lectures can be presented through the web.

Tests and assignments can be taken on the web.

Conclusion:

Universities should use the web to give classes.

Paragraph:

Because more high school kids are going to university every year universities have to handle more students. Because more of the kids going to university have computers at home and they like doing things on computers and the web the universities can present lectures on the web and then they can give tests and have assignments submitted using the web. Therefore universities should use the web for classes so that students can study when they want and they will like doing it."

While the writing is still fairly poor, the structure of the argument has improved.

A last look at writing arguments

After all of the exercises that had been given during the semester, the students were then asked to do another assignment. This assignment investigated the topic of "Honeypots". "Honeypots" are a name given to false computer systems that are set up as a means of attracting and catching hackers. Four articles were given to the students and they were encouraged to look for more articles of their own on the topic. Most of the articles given were newspaper articles rather than journal articles.

The students were led through the writing of their viewpoint on the articles in the following manner:

- i. They were firstly asked to draw out from the articles all the claims that supported the idea of implementing "honeypots" and those that were against the idea.
- ii. Students were then asked to determine topics that were covered in the four (or more) articles.
- iii. The students then had to rewrite the claims for and against "honeypots" under those topic headings in their own words. They also had to integrate the knowledge from the different authors.
- iv. They were then asked to write a 500 word argument for or against the use of "honeypots" and to support their argument using sources from the articles.
- v. Lastly, they were asked to draw a diagram to show how their reasoning fitted together.

The assignment was given to the students in Week 10. In Week 11, they then went through the same peer evaluation that they had previously been through in the first assignment. The students were again given an opportunity to rewrite their assignment or to give reasons as to why they did not implement any changes suggested by their peer reviewer. Students were then asked to reflect on assignment and what they felt they had learnt from doing it. Driskill, Lewis, Stearns and Volz (1998) suggest that students need time to reflect on their answers and to determine whether these answers are written in such a way as to be useful to others. We feel that this reflection task could be expanded in future years. Once again, the students were assessed on the initial assignment, their peer review, their reflection and the final assignment.

This type of assignment proved to be an interesting exercise. Plagiarism is one of the most difficult things to eradicate in first year students work. On the positive side, this exercise helped many students to write in their own words with the outcome that the final written arguments were generally fairly well structured. Unfortunately those students whose arguments were poorly structured did not seem to grasp the role of the diagram in pointing out problems in their argument. Some students failed to see that a diagram showing claim 3 pointing to claim 14 pointing to claim 23 pointing back to claim 6 may indicate a problem. Another negative factor was that most of the students decided that they did not need to reference the original articles. Our assumption is that they felt that as they had rewritten the claims in their own words, this was not necessary. In future years these problems will be pointed out to the students early in the process.

Students' comments on their learning

At the end of the unit, the students were asked to reflect on their learning. Some of the students' comments are given in this section. They have been organized around the more important issues that arose.

One of the students reflected on the key issue of this paper, namely *“One of the key points of the subject was ‘you may be a great thinker, but it is just as important to be good at expressing your ideas’”* One of the international students commented: *“The result is good, because there is no one speaking my language in the class, just English, I have to speak as well, it really helps me to improve English, I found, the knowledge that is learning is very useful in every area, let you know how to think before you plan to do something.”*

Some of the international students found the unit helped them to become more open-minded and commented on how different the unit was to their previous experience. Early in the unit one of the international students told her lecturer that they were writing back to their friends in China to tell them of the different ways in which she was learning in the unit. Other examples of this are: *“I became an open minded person after studied the unit. Some thing that I come across with wider perspective. But on the other hand more information I get sometime more confusing I have on making decision for the situation.”* and *“Using the thinking can get more and more opinion, the brain is opened, so the argument is very easy to think out, you can choose the strongest arguments against or agree the topic.”*

Some of the students commented on the assignments. An example of this was student who said: *“I would have to say that the aspect that has, and will continue to help me the most in my studies is learning about analytical thinking. By completing the first assignment, I have learnt how to better analyse not only articles, but also basically anything that I read. I also feel that the assignment has taught me to re-read my work more thoroughly and try reading it from someone else's point of view. Through the peer-review process I feel that I was able to improve my work for the better. Then in the second assignment, I was able to use what I had learnt and submit a better assignment the first time.”*

Another international student commented on the assignments by saying: *“I like doing this kind of assignments compare to just writing essays. We need to do more research and do more think on claims, consequences, arguments etc. It was very helpful that the assignment was based on ‘computer theme’. Because we are Information Systems students I will always prefer doing everything related to Information Technology. Again I would like to express thanks for this kind of assignment as it did improve our reading, thinking and synthesizing*

ability. I improve my English knowledge and this assignment pushed me to 'do more than I usually do'. That means I spend more time on preparation, reading and especially writing. This is my acknowledgement not complaint."

Another commented on another facet of the peer-review process saying "The peer assessment process proved an invaluable experience. It allowed for clarification in areas that were unclear or incorrect. It also provided a chance to offer assistance to other students that were having difficulty. In the same way comments from other students could be used to ensure that sufficient detail was provided, ensuring the clarity of the ideas being present. This assignment (about Honeypots) encouraged critical thinking because the questions required that also (allow?) sides of the topic be considered. The nature of the topic meant that responses did not consist of one right and wrong answer but of many. The transition to the final versions of the assignment required extensive reflection as well as a willingness to accept the ideas of the peers that provided external feedback. ... The invaluable lessons learnt from others led to a greater understanding which would be impossible by any other means."

A different student wrote: "The aspects of this unit that I think will be the most beneficial in the future would have to be the analysis of articles.... Analysing articles and seeing the journalist's point of view and how they persuade the reader. As I read the newspaper almost everyday, this helped to analyse the articles I am interested in and become more wiser (sic) in my decisions and which side to take."

It was interesting to note that some of the students specifically mentioned the discussion groups. One wrote: "The discussion groups were great in being able to practice putting forward my ideas and critically thinking when reading others work. In the future, in the workforce, I most look forward to being able to express my ideas well and being an analytical and critical thinker." Another felt that: "There have been a number of aspects through which this unit has helped me to develop my ability to write and develop arguments better. One of these aspects was the exercise involving the discussion postings, which helped me to learn to defend my viewpoint and argue with others. Another of these aspects could be detailed study of claims involved with this unit, which developed a better understanding of claims and arguments and helped me to write them effectively."

Many students commented on their ability to structure arguments more effectively. Examples of this are: "The aspects that have helped me with my day-to-day life, have been my ability to see people point of view and look at it using the different styles of thinking to better understand a person. I have been capable of communicating my opinion in a more constructed manner, to better represent my view and convey it." and "The unit has had a great impact on the way I write and develop my arguments. I no longer just look at an argument and jump right into answering it. I now put a great deal of thought into the ways that I will construct my claims, I look at the ways that they should interact in the best way possible in order to develop an argument that is well constructed and answered to the best of my ability."

Another view that was expressed by more than one student was concerned with how this unit had helped them in their other studies. For example, one student wrote: "When writing a management essay, I broke down those theories written in the text book into several pieces, reanalyzed them then found the common points and connection between theories that from the different writers... It also helped me structure the whole essay." Another student, who did not have English as a first language wrote: "I used to have a difficulty to write a long

sentence, especially writing an essay. Now I am not scared of writing even though my writing is still bad. The important thing to me is I enjoy reading and writing in English. It's a big change."

There were, naturally, also some negative comments. Most of these negative comments were concerned with the students' not understanding the relevance of the structuring of arguments to their course, to the Information Systems profession or to their day-to-day life. One student said: *"I feel that the claims diagrams were a waste of time and could not see the relevance of it, as I could not understand how it related to information systems at all."* The development of the unit required a lot of time as there was no suitable textbook. It was not always possible to use Information Systems examples or examples that were directly relevant to an Information Systems student. This aspect will be investigated in more detail in 2004.

Conclusion

The students' comments suggest that the unit Reasoning and Critical Thinking for IS Professionals has been useful in helping them to develop their ability to communicate their reasoning and thinking to others. There is some work that should be done by the lecturers in making the unit more relevant to the Information Systems student, but on the whole the unit seems to be successful in helping students to analyse and write arguments.

The unit will, however, not have achieved its goals unless students transfer the skills learnt in this unit to other units that they take in later years. Lecturers of other units in later years of the course can help students use the techniques that they have learnt in Reasoning and Critical Thinking for IS Professionals to analyse questions and understand the subtleties of questions, to determine the major premises of their answers and to write these premises in a logical fashion making all the connections that are required for good argument. This will require education of the other lecturers teaching in the Bachelor of Information Systems so that they will be able to help students to further develop the skills learnt in their first year.

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