STUDENT ATTITUDES TOWARD PROFESSIONAL PRACTICES IN SCIENCE

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ABSTRACT
There has been anecdotal evidence that students from various cultures have different perspectives toward professional practices, including (1) how to use quotations, (2) occupational health and safety and (3) recording data, but there has been a lack of hard evidence to either confirm or contradict this belief. This paper presents a snapshot of student attitudes toward professional practices in Australia. The survey group consisted of students enrolled in an undergraduate 1st year, 2nd semester, chemistry subject. Students generally agreed that they should paraphrase and should cite sources of information. However, there was confusion about the use of extensive quotations and occupational health and safety. There was no significant difference in the responses by the country of secondary schooling or family background, but were some significant differences by the respondents' age, number of years in university and by the discipline area of study.

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INTRODUCTION
There has been anecdotal evidence that students from various cultures have different perspectives toward professional practices: for example, giving a gift may be seen as a mark of respect in some cultures, but seen as bribery in others (Donaldson, 1996). Cultural differences in attitudes to professional practices have been observed in the academic area (Ballard & Clanchy, 1991; Chesney, Mahaffy & Lim, 2010), but there has been a lack of substantial quantitative data to support the qualitative evidence. Furthermore, "culture" is not just based on ethnicity; culture can be based on age (e.g., "youth culture"), or profession (Snow, 1960), or educational background, or other factors. Socio-cultural factors can also have significant effects on the learning of science (e.g., Jegede & Okebukola, 1989).

For example, extensive quotations are discouraged in scientific writing (e.g., Dodd, 1997; Lim, 2003), but quotations and sometimes extensive quotations are commonplace in law (e.g., Hinchy, 2008) and other non-science disciplines (e.g., ACU, 2010; Kimberley & Cotesta, 1997). The use of extensive quotations is often viewed as lacking in professionalism in science, but as accepted practice in law, literature, theology and other disciplines.

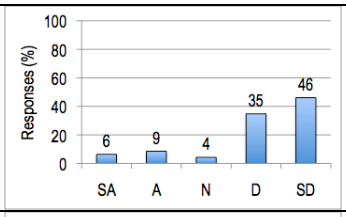
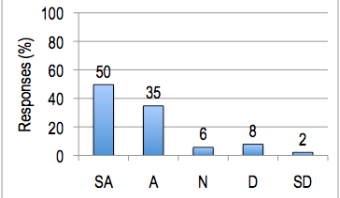
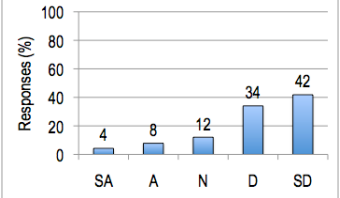
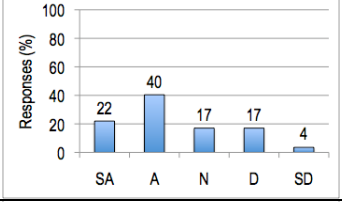
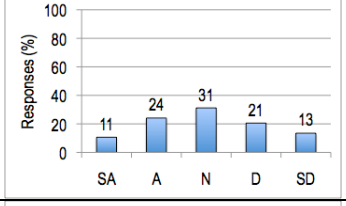
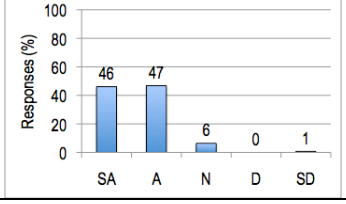
Accepted practice or the "norm" can also vary according to age, and progression through educational or employment career. Berger and Berger (1972) have discussed how an individual moves through different "institutions", cultures or tribes, as that person moves through life, from the maternal/parental home/nest, to pre-school, primary school, secondary school, etc. Each "institution" has its own set of rules, moralities and values. A person's attitudes as to what is "correct" behaviour and the intrinsic motivation for the behaviour changes at these different stages.

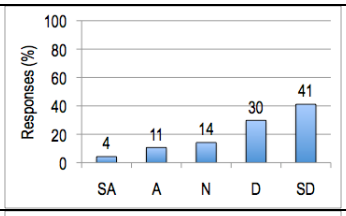
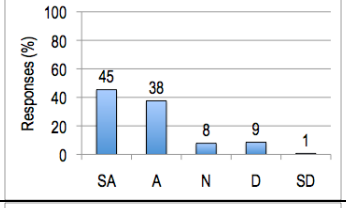
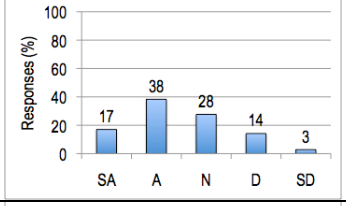
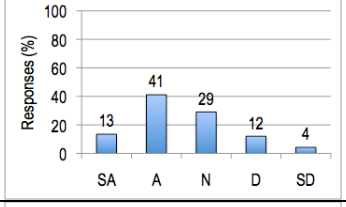
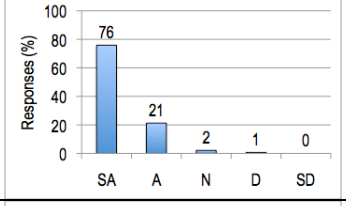
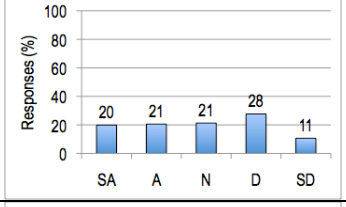
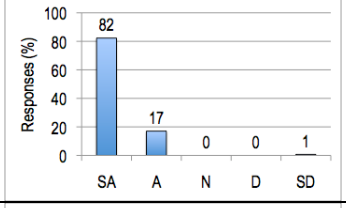
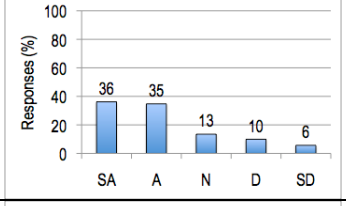
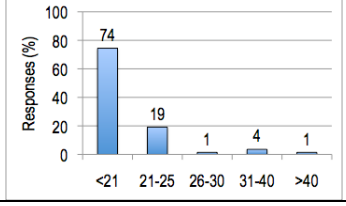
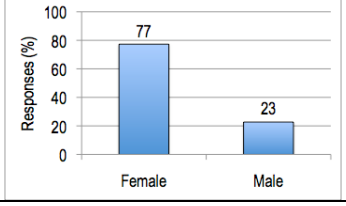
The aim of the present study was to take a snapshot of a group of undergraduate students in science to establish if their attitudes are consistent with, or, are contrary to, commonly accepted professional practice, and secondly, to address whether different "cultural" groups have significant differences in attitudes.

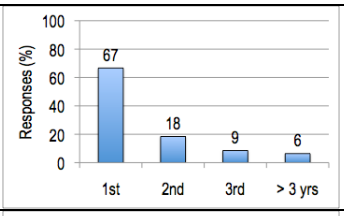
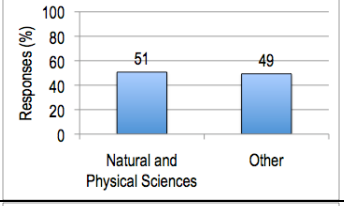
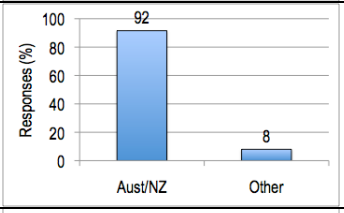
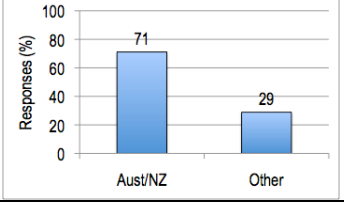
METHOD
An on-line survey of students enrolled in a level-1 chemistry unit was conducted in late 2010, probing attitudes towards professional practices, including the quoting of texts in reports and assignments, occupational health and safety, and recording data. The terms academic misconduct, plagiarism, professional practices and unprofessional practices were deliberately not used as they are judgmental and presuppose a "correct" professional practices; some practices, which are regarded as non-professional in "western science", might be acceptable in other "cultures". There were 14 substantive questions asking for student responses to statements using a 5-point Likert scale from strongly agree to strongly disagree. The wording of statements was such that commonly accepted professional

practice (Australian Standard, 2005, 2006, 2010; Commonwealth of Australia, 2002; Deakin University, 2010; Dodd, 1997; Lim, 2003; Pavia, Lampman, Kriz, & Engel, 2002; Zubrick, 2004) corresponded to agreement with 11 statements (Questions 2, 4-6, and 8-14) and disagreement with 3 statements (Questions 1, 3, and 7), so that there was some mixture of agree/disagree statements. These questions were delivered in a random order using the Blackboard learning management system, to minimize "push polling", whereby the wording of a particular question or statement might cause students to change their response to a later question or statement. Since this survey was primarily intended to collect data to inform the improvement of teaching-and-learning practice, the study was covered by human research ethics approval DUEC-029-2008. In addition, there were 4 questions about informed consent for anonymous collated responses to be published, and 9 questions about the demographics and cultural background of respondents. 142 students participated in this survey. The statements in the survey instrument and the student responses are listed in Table 1. Student *t*-test was used to determine if there are statistically significant differences in the responses from different subsets of the cohort. Rounding responses to the nearest integer percentage means that in some cases the percentages seem to add to more than 100%, but this is an artifact of the reporting.

Table 1: Student responses to statements about attitudes towards various professional and ethical practices.

1. "Students should not acknowledge the source of the data and ideas in their reports, assignments and essays."	
2. "Students should acknowledge the source of the data and ideas in their reports, assignments and essays, by the use of citations."	
3. "Students should quote extensively from textbooks and other authoritative sources, but these sources do not need to be acknowledged by the use of citations because they are so well known."	
4. "Students should quote extensively from textbooks and other authoritative sources, and should acknowledge the source of the information by the use of citations regardless of whether these sources are well known."	
5. "Students should not quote extensively from textbooks and other authoritative sources."	
6. "When referring to ideas from textbooks and other authoritative sources, students should try to re-state the ideas in their own words."	

7. "When referring to ideas from textbooks and other authoritative sources, students should not acknowledge these sources by the use of citations because the sources are so well known."	
8. "When referring to ideas from textbooks and other authoritative sources, students should acknowledge these sources by the use of citations regardless of whether these sources are well known."	
9. "Students should use permanently-bound books to take notes in laboratory because the teaching staff require it."	
10. "Students should use permanently-bound books to take notes in laboratory regardless of whether the teaching staff require it."	
11. "Students should wear protective safety glasses in laboratory when doing experiments."	
12. "Students should wear protective safety glasses in laboratory when not doing experiments."	
13. "Students should wear protective lab coats in laboratory when doing experiments."	
14. "Students should wear protective lab coats in laboratory when not doing experiments."	
What is your age? 	What is your gender? 

In what year of post-secondary study are you currently enrolled? This is the number of years of study, not the number of years (amount of time) since completing or leaving secondary school (high school). Post-secondary study is TAFE, university, or other study after secondary school (high school).	
Please select the response that best describes the discipline area of your degree.	
Please select the response that best describes where you had most of your secondary schooling, especially the last 2-3 years of secondary school?	
Please select the response that best describes the region of the world, which characterises your family culture. For example, if your parents worked for a transnational company or were in the diplomatic corps, you might have lived and gone to school in one country, but experienced a different family culture.	
Key for Questions 1-14: SA = “Strongly agree”; A = “Agree”; N = “Neither agree or disagree”; D = “Disagree”; SD = “Strongly disagree”. The order of Questions 1-14 was randomized for each respondent by use of the Blackboard learning management system. Only summaries of the questions about students’ enrolment (faculty/discipline of study), secondary schooling and family background have been given here.	

RESULTS

The results in Table 1 indicate that students are in broad agreement that sources of information should be cited (Questions 1, 2, 4, 7, and 8) and that generally personal protective equipment should be worn in laboratories, while doing experiments (Questions 11 and 13). There is some uncertainty about the use of extensive quotations (Questions 3-5), permanently bound notebooks to record experimental results in the laboratory (Questions 9 and 10), and about the use of personal protective equipment in general (Questions 12 and 14). In addition to the overall responses shown in Table 1, the following highlights where there are statistically significant differences between different groups of respondents.

The gender distribution of the responses (77% female, 23% male) is very similar to the overall cohort population (74% female, 26% male). There were no statistically significant (p =0.05) differences between responses from males and females.

As the survey population is enrolled in an undergraduate class, it is not surprising that the bulk of respondents are under the age of 21 years (74%). Students, who are 21 years or older, are generally mature-age students who have had some work experience. In general, there were no statistically significant (p =0.05) differences between respondents under the age of 21 years (74%) and those who are 21 years or older. The only significantly different set of age-dependent responses was the question about wearing protective lab coats when doing experiments (question 13). All respondents aged 26 and above, responded, “strongly agree”, as did most respondents aged 21-25. One respondent (under 21 years) strongly disagreed about wearing protective lab coats. All the other respondents either agreed or strongly agreed with the statement, though there was some difference (p =0.05) in that older students had more responses in the strongly agree category than the younger

students. This is consistent with other studies (e.g., Honore, 2011), which show that young people aged between 18-24 having slightly riskier lifestyles than their older counterparts.

All respondents had undergone laboratory safety training and induction, in which they were informed:

> Students will not be allowed to attend laboratory practical classes unless personal protective equipment (PPE) is worn. PPE = Laboratory coat, protective footwear and eye protection (Deakin University, 2010).

This requirement does not depend on the activity that is being conducted – there is no difference in the requirement when students are doing experiments or merely reading instructions or writing. Nevertheless, a significant number of respondents disagree with the need to wear protective safety glasses and protective lab coats in laboratory when not doing experiments (Questions 12 and 14). This indicates that the compulsory laboratory safety training and induction has not achieved its aim. Since safety induction has similarities across institutions, this may also indicate problems at other Australian universities and workplaces.

There are some differences (p =0.05) in responses on the use of permanently bound laboratory notebooks and the wearing of safety glasses, depending on where respondents did the final years of secondary schooling. This may indicate some cultural differences about expectations of professional practice in the areas of record keeping and occupational health and safety. However, the number of respondents from particular countries (2% southern Asia, including Indian subcontinent and Sri Lanka, 1% Middle East, 1% another part of Asia, not listed above, 1% Africa, 0% UK, 1% other parts of Europe and Russia, including Iceland, 2% USA / Canada, 1% other) is so low that it is difficult to determine if this difference is real. This aspect requires further investigation.

Respondents were clearly able to distinguish between where they did their schooling (usually associated with country of residence) and their family culture. There are some differences (p =0.05) in responses on the use of permanently bound laboratory notebooks, depending on the family culture of the respondents. Again this may indicate some cultural differences about expectations of professional practice in the area of record keeping. However, as number of respondents from outside Australia and New Zealand is quite diverse (4% southern Asia, including Indian subcontinent and Sri Lanka, 7% south-east and eastern Asia, 4% Middle East, 3% Africa, 1% United Kingdom, 5% Other parts of Europe and Russia, including Iceland, 1% USA / Canada, 1% Mexico and Central America, 1% South America, 1% other) it is difficult to determine if this difference is real. Again this aspect requires further investigation as the teaching of professional practice and generic skills may need to be tailored for different groups of Australian students.

It is noticeable that respondents agree that they should re-state the ideas in their own words (paraphrasing) when referring to ideas from textbooks and other authoritative sources (Question 6), but they are confused whether they should (or should not) quote extensively from textbooks and other authoritative sources (Question 5). The commonly accepted practice in chemistry is that the use of paraphrasing removes the need to use extensive quotations (Dodd, 1997; Lim, 2003). Although there is no significant difference (p =0.05) in responses on the extensive quotations from authoritative sources (Question 5) by age, there is a significant difference (p =0.05) by the year of post-secondary of study. It would be hoped that as students progress through their academic studies, they become more proficient in professional practices and generic skills. However, the data show that for this cohort, students in their first year of university study are more likely to agree that one should not quote extensively from authoritative sources (Question 5), while students in higher years are more likely to quote extensively, which is contrary to the professional practice (Dodd, 1997; Lim, 2003). It is uncertain why these upper-year students have attitudes that are less consistent with professional practice than first-year students. The class roll indicated there were very few upper-year students doing this first-year subject as an elective: these students are probably repeating the subject after previously failing the subject, or have been avoiding what they perceive to be a more difficult subject until later in their university studies. Hence a possible reason is that the attitudes of these upper-year students are less consistent with professional practice than first-year students, is that these upper-year students are unrepresentative sample consisting of academically weaker-than-average students.

The extensive use of quotations, in general and with and without citation, are in three interrelated statements (Questions 3-5). Recall that all questions are presented to respondents in randomized order. There were significant differences (p =0.01) in the responses by the Australian Bureau of

Statistics (2006) Non-School Qualification Field of Study (QALFP). When referring to ideas from authoritative sources, students in science were more likely to cite the source (Questions 3 and 4) than students in other disciplines. This result is consistent with the concept of science and non-science being two cultures (Snow, 1960).

CONCLUSION

This paper reports on a survey of student's attitudes to professional practices. The survey group consisted of students enrolled in an undergraduate 1st year, 2nd semester, chemistry subject. Students generally agreed that they should paraphrase and should cite sources of information. However, there was confusion about the use of extensive quotations and occupational health and safety. There were no significant difference (p=0.05) in the responses by the country of secondary schooling or family background, but some significant differences (p=0.05) by the respondents' age, number of years in university and by the discipline area of study.

In addition to providing a snapshot of the current state of student's attitudes to professional practices, this paper indicates that professional practice and generic skills training should be tailored for delivery to different target audiences, according to students' age, number of years in university and by the discipline area of study. Additional data would also be helpful.

REFERENCES

ACU (Australian Catholic University) (2010). Style guide for essays presented in the Faculty of Theology and Philosophy Retrieved August 9, 2011, from http://www.acu.edu.au/about_acu/faculties_schools_institutes_centres/faculties/theology_and_philosophy/about_the_faculty/philosophy/students/style_guide_for_essays_pdf.

Australian Bureau of Statistics (2006) Census Dictionary, 2006 (Reissue). Retrieved November 17, 2006, from http://www.abs.gov.au/ausstats/abs@.nsf/vwDictionary/40B980A4D60E84F5CA25720A007B67D0.

Australian Standard (2005) Australian Standard 2243.1 - Safety in Laboratories – General. Sydney (NSW): Standards Australia.

Australian Standard (2006) Australian Standard 2243.2 - Safety in Laboratories – Chemical aspects. Sydney (NSW): Standards Australia.

Australian Standard (2010) Australian Standard 2243.3 - Safety in Laboratories – Microbiological safety and containment. Sydney (NSW): Standards Australia.

Ballard, B., & Clanchy, J. (1991). Teaching students from overseas: a brief guide for lecturers and supervisors. Melbourne: Longman Cheshire.

Berger, P. L., & Berger, B. (1972). *Sociology: A Biographical Approach*. New York: Basic Books.

Chesney, D., Mahaffy, P. G., & Lim, K. F. (organisers) (2010). Cultural Influences on Professional Ethics (Pacifichem Symposium #273), Retrieved December 14, 2010, from http://www.pacifichem.org/symposia/c_symp_273.htm.

Commonwealth of Australia (2002). *Style Manual for Authors, Editors and Printers*. Canberra: John Wiley and Sons, p 188.

Deakin University (2010) *Laboratory & Fieldwork Safety Induction Program*. Melbourne, Vic: School of Life and Environmental Sciences, Deakin University.

Dodd, J. S. (Ed.). (1997). *The ACS Style Guide: A manual for authors and editors* (2nd ed.). Washington (DC): American Chemical Society.

Donaldson, T. (1996). Values in tension: Ethics away from home, *Harvard Business Review, 74*(5) (September/October), 48–58.

Hinchy, R. (2008). *The Australian Legal System: History, Institutions and Method*. Frenchs Forest (NSW): Pearson Education Australia.

Honore, T. (2011) Young adults' beliefs about their health clash with risky behaviours. American Stroke Association. Retrieved May 2, 2011, from http://www.newsroom.heart.org/index.php?s=43&item=1324.

Jegede, O. J., & Okebukola, P. A. (1989). Some socio-cultural factors militating against drift towards science and technology in secondary schools. *Research in Science and Technological Education 7*(2), 141– 151.

Kimberley, N., & Cotesta, P. (1997). *Student Q Manual*. East Caulfield (Vic): Faculty of Business and Law, Monash University.

Lim, K. F. (2003). *The Chemistry Style Manual* (revised 2nd ed.). Geelong (Vic): Deakin University.

Pavia, D. L., Lampman, G. M., Kriz, G. S., & Engel, R. G. (2002). *Microscale and Macroscale Techniques in the Organic Laboratory*. Orlando (FL): Harcourt College Publishers.

Snow, C. P. (1960). *The Two Cultures and the Scientific Revolution*. London: Cambridge University Press.

Zubrick, J. W. (2004). *The Organic Chem Lab Survival Manual* (6th ed.). Hoboken (NJ): John Wiley and Sons.