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Teaching oral communication in undergraduate science: Are we doing enough and doing it right?

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Abstract

Communication skills and insights form an important basis for employability and participation in society. Universities aim to produce graduates with effective communication skills. Effective oral communication is critical for the advancement and sharing of scientific knowledge. There is increasing recognition within tertiary institutions of the need for science graduates to develop better presentation skills, in particular. This paper addresses the importance of embedding, teaching and assessing oral communication in university science subjects. It also describes several simple and authentic oral learning/assessment exercises.

Keywords

Oral communication, undergraduate science, poster presentation, PowerPoint presentation, authentic learning tasks

Introduction

Reading, writing and oral communication are critical abilities in many facets of society and indeed across many different professions. Whilst the necessary skills and insights are often subconsciously used and are invariably incorporated into many aspects of our daily living, they require ongoing development and form an important basis for employability and participation in society.

In sciences, effective reading, writing and presenting make possible the investigation, comprehension and communication of ideas, problem solving and enhances understanding (Krajcik & Sutherland, 2010). They add substantial value to a conventional science degree as well as expanding career options (Longnecker, 2009). A report published by the Department of Education, Science and Training (DEST) has also identified communication skills and insights as being critical to employers (DEST, 2002).

Universities aim to equip graduates the knowledge, skills and abilities to empower them for their future, future careers and ongoing development, as well as to bolster their contributions to their own profession and to society. As with other universities, the Queensland University of Technology (QUT) has listed "effective communication" as one of its core graduate capabilities (QUT, 2011). Specifically, QUT aims to "*develop graduates who can demonstrate effective communication in a variety of contexts and modes including effective written and oral communication with discipline specialists and non-specialists and in cross-cultural contexts*" (QUT, 2011). There is increasing recognition within tertiary institutions of the need for science graduates to improve their communication as well as the need to integrate such development into the tertiary curriculum (Gray, Emerson & MacKay, 2006; Longnecker, 2009).

Whilst training and developing both written and oral communication skills and insights are important across many disciplines, the ability to communicate orally in an effective way in science disciplines is of particular significance. In the modern era of abundant and dynamic scientific

discoveries and research, and indeed thanks to modern technologies and the role of the media, scientists need to be able to effectively explain their research to peers, stakeholders and indeed to public audiences in face-to-face and broadcast forums. After all, there is no point in making a Nobel Prize discovery if one cannot communicate its findings, implications and significance! Additionally, scientists are increasingly required to explain scientific research and its broader implications to various private and non-scientific communities and even to influence government policies (Noblitt, Vance & Smith, 2010). Despite its importance, studies have identified insufficient communication skills, insights, and related abilities especially in science graduates (Longnecker, 2009).

This paper addresses the importance of embedding, teaching and assessing oral communication. The aim is to adequately train and equip future scientists. This paper describes several simple but realistic oral assessment exercises/tasks that the author have previously utilised in undergraduate biomedical sciences classes. Advantages and disadvantages of these tasks are explained. Even though these practices/assessment tasks are not novel, they are often under-utilised and under reported in the teaching of undergraduate biological and biomedical sciences.

Teaching oral communication and presentation skills in undergraduate science

Communication skills and insights, including oral communication abilities, are critical scientific literacy practices not simply for the field of science inquiry but also for participation in a global society in the 21st century and thus its implementation is imperative and should be supported (Krajcik & Sutherland, 2010). Science communication training makes a crucial difference to how scientific and technical knowledge is circulated and received (Longnecker, 2009). Furthermore, surveys from a range of English-speaking countries show that employers consistently rank oral and written communication abilities highly, and even more highly than, quantitative or technical skills (Gray, Emerson & MacKay, 2005). Additionally, it has been noted that many enterprises reflect that they do not want technical "boffins" or operators who cannot communicate about their work with peers (DEST, 2002; Longnecker, 2009).

In medicine and indeed in many other allied health programs, for example pharmacy and nursing, effective oral communication skills are critical competencies and are heavily emphasised in their respective curriculums. These skills can have a significant impact on patient care and correlate with improved healthcare outcomes (Rider, Hinrichs & Lown, 2006; San Miguel, Roga, Kilstoff & Brown, 2006). Equally, regulatory and other medical organisations recognise the importance of teaching and assessing communication and require assessment of competence in these areas (PSA, 2010; Rider et al., 2006). Biological/biomedical science professions do not possess such strict oral competency requirements. Yet, even though its essential importance and implications may not seem obvious, oral communication has a significant impact on the advancement of science, with an important a role such as it has in healthcare disciplines.

The ability to give an effective and engaging presentation requires a substantially different set of skills and techniques compared with writing a report (Race, 2007). Further, it is also suggested that communication skills involved in giving good presentations are very relevant to professional competences in the world of work (Race, 2007). Collins (2004) has suggested that the effectiveness of any presentation does not depend predominantly on the quality of the visual aids but on the ability of the presenter to communicate with the audience. In contrast to some people who may be "born" with communication abilities, most need to learn and continually practise (Collins, 2004). Some students may learn oral presentation by trial and error rather than through learning from a specific educational model (Haber & Lingard, 2001).

Effective oral communication cannot be simply "studied" by reading. It needs to be planned, strategised, practised and assessed, preferably in an "authentic" setting. "Authenticity" implies that the learning tasks and assessments represent activities or issues that the students may encounter in workplace or other real life situations (Gulikers, Bastiaens & Kirschner, 2006).

Science graduates who are likely to go on to research and higher degrees need practice and experience so that they can give effective presentations at conferences and scientific meetings (Race, 2007). In addition to such presentations, public engagement activities require active and effective communication to promote science to the wider audience. It is a responsibility that education of the public about science should be made an equal priority with the education of physician-scientists (Ausiello, 2007). In order for the lay public to shape an informed opinion of scientific discoveries and controversial developments, it is critical that scientists can communicate about research and the implications of that research to promote awareness, clarity, as well as to respond to public concerns. These are the abilities that are lacking amongst many new science graduates (Longnecker, 2009).

Oral communication skills should be introduced and developed early in the undergraduate science curriculum and not delayed until students reach the postgraduate level or after they enter the workforce. There is value in developing literacy skills early in an undergraduate curriculum to provide a good foundation for the students (Freeman & Lynd-Balta, 2010). Furthermore, as a significant portion of undergraduate students will not undertake studies at a postgraduate level, inclusion of science communication training in undergraduate courses becomes even more significant (Edmondston, Dawson & Schibeci, 2010a). It is also proposed that formal science communication training should be introduced in early stages of career development as this form of training will place the students in a better stage as they begin their careers as willing and able scientists after they graduate (Edmondston, Dawson & Schibeci, 2010b). Many academics surveyed believed that graduate attributes were least effectively developed if they were integrated into a late capstone course or left to be developed by the students independently (De La Harpe, Radloff, Scoufis, Dalton, Thomas, Lawson et al., 2009). In contrast to continually teaching basic technical skills toward the latter part of a science degree, it is perhaps more significant to use this important latter period of the degree as an opportunity to reinforce the necessary effective professional communication abilities that would be needed as students enter the workforce, and thus, ensuring that the graduates would depart adequately equipped and prepared. This later training is especially crucial if communication skills have not been taught and introduced early in the curriculum.

Some may argue that specific technical laboratory competencies, for example micropipette skills, are more important in the production of a proficient laboratory scientist than oral communication and presentation skills. It is important to acknowledge that accurate and proficient technical skills are indeed critical and should not be neglected. Thus, they should rightly remain a vital component in teaching undergraduate sciences, especially laboratory-based sciences. It is not the intention of this paper to challenge this fact. Although it is undeniable that oral communication across many sciences is of critical importance, it is often under-taught and under-assessed, especially compared with traditional assessment items that examine written communication, such as laboratory reports, written assignments and indeed written examinations (Haworth & Garrill, 2003; Race, 2007).

Most undergraduate laboratory science courses do not adequately address the lack of communication ability (Watson & Lom, 2008). A study by Edmondston et al (2010b) reported that undergraduate biotechnology students do not value scientific communication and science communication training. Further, the study concluded that their graduates may graduate with only a limited understanding of science communication (Edmondston et al., 2010b). In contrast, it has been shown that undergraduates and graduates who have taken science communication subjects place a high value on these units (Longnecker, 2009). Although science communication is relatively young as an academic discipline, there is a great deal of diversity in the structure and curricula of science communication programs in universities around Australia and indeed around the world (Longnecker, 2009; Mulder, Longnecker & Davis, 2008). It remains an interest as to whether science communication training should be included as a core component in science subjects or in separate subjects within the science curriculum. In an interesting report funded and released by the Australian Learning and Teaching Council (ALTC), it was found that a majority of academic staff surveyed believed that graduate attributes (including oral communication) should

be included in the curriculum and that it should be an important focus for their universities (De La Harpe et al., 2009). However, many did not teach or assess such attributes citing a lack of willingness or confidence (De La Harpe et al., 2009). Perhaps it is important for the academics to simply take the first step!

One key to addressing this graduate attribute is to develop and embed realistic, reliable and constructive learning tasks that would enable and motivate students to see the value and to develop in their own communication and presentation skills, insights, and styles. It is important to articulate the purposes and significance, the types of skills and insights to be developed, as well as the objectives from these learning tasks to the students prior to the commencement of these tasks. This would enable the students to appreciate not only the rationale for the implementation of these tasks, but the expectations required of them and thus would make their learning more focused. Students can gain confidence and experience through practice. Exercises can initially be conducted in a formative setting and would be useful in aiding diagnosis and development. Eventually, these tasks may be used as summative assessment pieces for grading and continual development purposes. Progressive assessment and targeted feedback from students' peers, our academic colleagues, and/or employers can help determining whether these tasks are beneficial.

Discussed below are three examples of realistic oral communication tasks that the author has used in teaching undergraduate biomedical sciences. That is: (1) the use of PowerPoint presentations/seminars; (2) the use of poster presentations; and (3) the use of student-driven, task/case study-based tutorials. Similar communication and assessment items have been employed in other undergraduate programs, such as teaching undergraduate chemists in the United Kingdom, with positive feedback and evaluation indicating successful motivation and learning (Kerr, Murray, Moore & Nonhebel, 2000).

Learning tasks for training oral communication

The use of PowerPoint presentations/seminars

Technology has allowed for advances in numerous different types and styles of attractive, interactive and effective presentation options. Presentation software packages such as Microsoft PowerPoint® are being increasingly utilised not only in academia and in the field of science, but throughout many professions.

This exercise aims to enable graduates to develop skills and insight in oral presentation and to develop the ability to plan, prepare, identify, extract, present and communicate precise and concise information. It also develops the ability to create a presentation using this form of media. This will also provide experience in learning the effective use of their presentation visual aids. Furthermore, this will endeavour to give the students experience in authentic oral presentations which is relevant in the workplace, during postgraduate studies and indeed presentation at scientific conferences. As many students may find public speaking daunting (Race, 2007), this exercise can be used to overcome apprehension and develop confidence. There are numerous possibilities for implementing this type of assessment. Some options are listed below:

- Presenting can be done individually or in a group;
- The presentations can be of any defined length (for example, a short 5-minute or a longer 30-minute presentation);
- Presentations can be based on a research project, laboratory experiment, or assignment topic;
- The presentation slides *per se* (for example the PowerPoint file only with a defined page limit) can be assessed solely with or without an oral presentation component;
- The presentations can be recorded for review and reflection purposes;
- The presentations can be assessed by staff, tutors or students' classmates;
- A short question-and-answer session following the presentation would be useful for the students to explore what it takes to present effectively in different settings.

It has been suggested that due to the "public performance" nature of oral presentations, students take this type of exercise quite seriously and therefore are likely to engage in deep learning about the topic concerned (Race, 2007). Furthermore, it is beneficial for students as they can learn a great deal from observing and critically appraising performances and presentations by their peers (Kerr et al., 2000; Race, 2007). It is important to clearly inform the students of the assessment criteria (for example, eye contact with the audience, effective use of slides, clarity of the verbal presentation, and ability to answer questions) and to provide timely feedback to enhance the effectiveness of this learning experience. Alternatively, asking the students to brainstorm and generate the assessment criteria, then posting them in a class forum could also be a useful way to promote learning. Having clearly defined assessment criteria can overcome the non-anonymous nature of this type of assessment by allowing for objective and fair evaluation by the examiners by eliminating subjective bias.

The major disadvantages of such assessment are the logistics and time and workload implications involved, especially for large undergraduate classes. This perhaps can be overcome by splitting larger classes into smaller groups (not dissimilar to running repeated undergraduate laboratory practical classes) and utilising several examiners assessing based on a set of agreed assessment criteria. Additionally, having the students to electronically submit their presentation files before the actual presentations can ensure consistency in formatting and the files can be preloaded in the presentation room ready for the students.

It is also possible to ask the students to record their presentations on video (using their own computers) and upload the recordings to a designated learning management site or social media site such as YouTube. They can then be assigned to review and comment on the presentations of other classmates. This approach can save a great deal of class time, enhances students' abilities and confidence in multi-media (with little instruction needed from the lecturer), reduces marking time, and eliminates much of the boredom that may be experienced by listening to consecutive presentations by fellow classmates. Recorded presentations also tend to be more creative than those done in class, and they can be more polished, as students will do repeated "takes" to improve the quality of their presentations.

The use of poster presentations

Similar to the use of PowerPoint presentations, the use of poster presentations allow graduates to develop their oral communication and the ability to plan, prepare and present visually, in a poster. Poster presentation exercises provide the opportunity for students to develop written and graphic presentation skills (Kerr et al., 2000). Scientific conferences provide poster display opportunities as a way of disseminating findings and ideas, particularly by younger scientists (Race, 2007). Undergraduate lab science courses do not actively teach students to communicate effectively through the use of images, which are a powerful means of communication (Watson & Lom, 2008).Posters can be assessed on the spot with comments and discussions from fellow students or lecturers, a process that can be extremely valuable (Race, 2007). The posters are generally prepared in size A0 format on a PowerPoint template (or something similar), which can be provided for the students as a pre-set template. It may also be useful to show the students samples of previously prepared posters for additional guidance. Similar to PowerPoint presentations, it is important that students clearly recognize what makes a poster effective (their assessment criteria) and that they receive useful feedback from peers and the lecturer. Poster displays can be a positive step in diversifying assessment (beyond exams and lab reports), and they provide an excellent opportunity for students to engage in peer-assessment (Kerr et al., 2000; Race, 2007).

Involving students in peer review promotes collaborative learning and is gaining significance in higher education (Pearce, Mulder & Baik, 2009). However, peer assessment needs to be carefully controlled and conducted to avoid bias, collusion, or unfair assessment. Similar to PowerPoint presentations, the use of clearly defined assessment criteria or external examiners can overcome the non-anonymous nature of this type of assessment by making the assessment more fair and objective. However, it has been suggested that it may be more difficult to make poster assessment demonstrably reliable as it is harder to formulate 'sharp' assessment criteria for diverse assessment artefacts, and a degree of subjectivity may necessarily creep into their assessment (Race, 2007).

If funding permits, the relevant faculty/department should provide print-outs of the posters for the students. This measure will have implications, particularly as the production of posters takes time and costs money. Working collaboratively in smaller groups may help to minimise the number of posters required. Further, it may be useful to organise for the poster presentations to be held over an informal lunch or morning/afternoon-tea session with refreshments. An informal, semi-public or public session would enable participation by other staff and students and would help to promote the work being done in the course/department. A selection of student posters can be displayed afterward in the department or returned to the students if they wish to keep them. Practical arrangements (space, poster boards etc.) for the organisation of poster sessions can add to difficulties with this form of assessment and thus would require planning and organisation.

Student-driven task/case study-based tutorials

Task/case study-based tutorials and discussions require primarily oral communication and the ability to engage an audience. This strategy inverts a traditional relationship. Tutorials and lectorials are typically led by an academic staff member or tutor where students generally have little direct input, unless the tutorials were specifically designed as interactive exercises.

Student-driven tutorials/discussions allow students (whether individually or in small groups) to initiate and lead the discussion with occasional facilitation and guidance from the tutor/academic. Tasks, exercises or case studies can be assigned to a small group of students during the tutorial. They are allowed time to discuss amongst themselves and prepare, before presenting on the task or case scenario back to the rest of the class. They can use their response to initiate discussion. The "horizontal peer relationship" and collegiality in these small group discussions is essential in breaking down the barriers – for example, lack of insight or confidence in one's answers – which will aid the development of verbal communication ability (Haworth & Garrill, 2003). Alternatively, the discussion topics/tasks can be assigned to the student(s) prior to the tutorial in order for the students to prepare in advance as well as to save time during the tutorial. The tasks or case studies do not need to be large or complex and the presentations do not need to be long, but should be relevant to what the students are currently learning and would help add to and reinforce the lecture material and learning objectives. A number of broad questions could be provided for the students to help focus and initiate the initial discussions.

As an example in health sciences, simply encouraging rote learning of laboratory blood test raw data would be unproductive and mundane. However, students could be asked to discuss and present this data in a relevant and applicable clinical scenario (or it could be given to them in a clinical scenario) such as in a disease state or condition that they are currently learning or familiar with, and to provide suggestions on how this information is relevant and ways to learn it.

The use of "real-life" case studies and genuine clinical scenarios where possible are particularly important. They provide authenticity and consolidate the link from basic science and foundation knowledge to its application in the real world. Realistic case studies are particularly important in biomedical and health sciences, where it is essential to promote relevance and the application of undergraduate learning to future professional work. Hartfield (2010) introduced case-based learning activities into undergraduate advanced-level biochemistry. This promoted alignment between learning and teaching activities and assessment, improved student satisfaction, and improved student academic performance (Hartfield, 2010). Furthermore, there is evidence to suggest that the use of case studies improves critical thinking and is a more effective approach for promoting and teaching scientific oral communication (Noblitt et al., 2010). The use of authentic case studies are also useful for advanced-level students to integrate, consolidate, apply, and draw on knowledge acquired throughout the course of their degree.

A major problem with student-driven discussions occurs when no student appears willing to speak, or when discussions become dominated by the same student(s). All students should be given an opportunity and support to lead, present and initiate discussions with the rest of the class or group. This may involve specifically allocating students to tasks/roles, or by putting a summative assessment value to the particular tasks. Although difficulties in maintaining continued student interest and maintaining constant engagement with fellow students can be issues (especially if another student is leading), these can be addressed by careful planning of the tasks/exercises and facilitating with stimulating discussion points and emphasising the relevance and its application. Students should be rewarded for their participation and they are more likely to appreciate the significance of a concept covered in lectures if they are asked to reflect upon and discuss its relevance based on their personal experience from placements, their work, or even from their daily lives.

Providing the right tools

The use of PowerPoint and poster presentation tasks may seem like a fairly straight-forward oral communication exercises to perform. However, it would be naive to simply set these tasks and expect that the students can perform them without sufficient guidance. The students need to be provided with insight, reference sources, and developmental activity. Specialised tutorials and workshops can be particularly helpful to provide students with the help and assistance in order for them to competently accomplish these assessment tasks. Ultimately, these workshops/tutorials should aim to adequately equip and prepare the students and aid them in the preparation for similar tasks and ventures in the future.

Workshops may be held by academics or more senior students with the required experience. Alternatively, they can be held by specialised learning/teaching support personnel who have experience and expertise in conducting such workshops.

These workshops should provide targeted training on issues such as:

- how to plan, prepare and develop a good poster/PowerPoint presentation;
- what makes a good/bad presentation;
- how to understand and cater to the different interests and learning styles in an audience;
- how to work effectively in groups and handle conflict;
- how to develop questions and to constructively critique work by others;
- how to respond to questions;
- identification of ineffective presentation techniques, such as body language, eye contact, tone and pace.

As with other forms of learning and assessment, students should be given sufficient opportunities to discuss and to practise as well as to receive constructive feedback from the tutor/academic member. These types of workshops should be included within the undergraduate science curriculum and participation should be rewarded. Students learn best when the right tools are provided and they have subsequently been given the opportunity to use them. In addition to these workshops, the students can be asked to recommend (or post in class forums) resources or reference websites that they have found to be useful while learning about giving effective presentations.

Conclusion

Oral communication is important in all walks of life. While it should be stressed that teaching and training in technical skills and written communication are equally important and should not be undermined, this paper have argued that teaching and assessing oral communication and presentation skills are important and prepares undergraduate students for future endeavours, whether they remain in sciences or progress into other professions.

Understandably, overcoming the lack of willingness and confidence in academics, as well as finding the time and space in the curriculum to address these areas may be difficult. However, science communication needs to be strengthen at the undergraduate level and the implementation of oral communication training and assessments should be encouraged to ensure that undergraduate science graduates are proficient in not only technical and critical thinking skills, but also in the ability to talk about their science and research. It is imperative that educators support students in communicating in science and to develop these graduate skills.

The various learning tasks discussed in this paper, whilst not meant to suggest that they are comprehensive and suitable for all, provide useful examples that can be of experiences, exposure and training for future scientists. Students and teachers must understand the importance of development of these communication skills and insights through authentic tasks. More such exercises need to be implemented and embedded into the undergraduate science curriculum if tertiary institutions are to train and produce effective science graduates.

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