International Conference
NEW PERSPECTIVES in SCIENCE EDUCATION
3rd Edition

Development of Skills Necessary for Public Communication of Science within an Undergraduate Health Science Curriculum

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Abstract

Dissemination of scientific knowledge is a skill that is necessary for any undergraduate student within the sciences to acquire. Traditionally, if addressed, this is accomplished through the instruction of scientific presentation or writing. Though important, this type of education tends to encourage students to focus on peer-to-peer communication of scientific knowledge, subsequently abandoning the dissemination of knowledge to a non-scientific (lay) audience. This has presented itself within the traditional media, popular culture and education as a apprehension in regards to science scientific knowledge general populace, an aloof attitude within scientists and an inability to discuss scientific issues. To that end, we have created a methodology to aid in the development of the ability to discuss of scientific ideas within non-scientific arenas. Specifically, students were given a task to address the problem of non-traditional scientific dissemination of knowledge: an informal discussion with a non-scientific audience. In this experience, students, in groups, were asked to describe physiological phenomena in non-traditional scientific terms, either to an educated lay-audience while maintaining scientific accuracy. By fulfilling the requirements for this assignment, students were encouraged to examine their ability to communicate the knowledge they had gained throughout their Anatomy and Physiology course to a non-scientific audience - gaining a skill that is sought in a variety of science related fields.

1. Introduction

The ability of a scientist to disseminate knowledge to a wider audience is essential to the career of any scientist regardless of their field and profession [1] even so much as it is generally considered a requirement of funding from national granting agencies[2]. Within the sciences, learning how to communicate is often accomplished through a combination of trial and error through practical application of communication skills ([3] p 31 but lacking from “Example Curricula”) through specific projects during undergraduate and graduate education or by taking specifically designed “scientific communication” courses within specific postgraduate programs[4;5]. Outside of these applications, there also exist numerous publications that expound on a variety of science communication topics aimed at improving communication skills[6-8]. While important for the advancement of an individual within their field of choice, this is largely learned at the expense of learning to disseminate scientific knowledge to a wider, non-scientific audience due to a general focus upon specialized scientific training over interest in language as a medium[8; 9]. Despite this sentiment, a number of legislations and community efforts have been put forth to ensure that the general public is well informed when it comes to science and scientific knowledge [10]. Even with these initiatives, there persists a sentiment that scientists either exist as those who do well within their field and those who can communicate with others (for example Carl Sagan or Neil de Grasse Tyson) and rarely the intersection of the two [9;11]. This perceived lack of ability to communicate outside of the sciences has been commented upon within a variety of media ranging from scientific journals and published media, to popular television shows [12-14]. Generally, these sources describe the scientist as disconnected from "normal" society and unable to communicate without the use of field specific jargon. Despite this sentiment, scientists have been increasingly concerned with public communication and increasing scientific literacy ([15] p70). While it has been argued that the lay public should simply learn to understand science, it also falls upon the shoulders of the scientist to communicate in reliable, distinct terms that can be

understood by a wider audience. Unfortunately, this type of description often requires an alternative thought processes to successfully communicate with a non-scientifically trained audience ([15] p85). While it is possible to be gained through experience, educators can aid a student's comprehension of the gap in communication that exists and how to remove this communication gap.

Traditionally, academia has encouraged students within the sciences to explore course options outside of the scientific realm within the field of communication. Academic courses focusing on science communication exist at numerous undergraduate and postgraduate institutions across the United States [16]. However, most of these courses are taught exclusively within a communication studies or journalism curriculum [16]. More recently, some institutions have begun to develop communications courses within science departments successfully employing a multidisciplinary approach to science communication [17]. These heralded courses in communication of science have provided a necessary step in the education of the dissemination of scientific knowledge but are often seen as extraneous within already course burdened majors[3, 17]. To avoid this, it would be suggested to include the development of the ability to communicate with non-scientists within the pre-existing framework of other courses.

The most efficient manner to expose the majority of students to the skills necessary to communicate well with non-scientists is by embedding the teaching of the needed skills within an introductory course. Unfortunately, the majority of these courses are overladen with information that is needed for the student's success throughout the remainder of the curriculum[3]. One method of teaching these additional skills can be accomplished by overlaying the instruction of the needed skills onto an already included assignment. Pairing a semester review with the development of non-scientific communication skills allows the students to accomplish both the learning of new skills with the needed review before a comprehensive exam. Additionally, it removes some of the burden of preparing a semester review from the instructor.

We have developed an assignment that teaches these skills to heath science undergraduates that easily fits within the framework of an pre-existing course as a concept review. Specifically, at the end of our required Anatomy and Physiology I course, students were given the opportunity to describe a previously covered topic through an informal "cocktail party" discussion aimed at a non-scientifically trained audience. The goal of this project was to introduce our students to the difficulties of communicating scientific knowledge to non-scientific audiences while simultaneously allowing students to review the knowledge gained within the course. It also allows students to interact with volunteers and alumni.

2. Program Pedagogy Objectives and Examples

2.1 Program Description

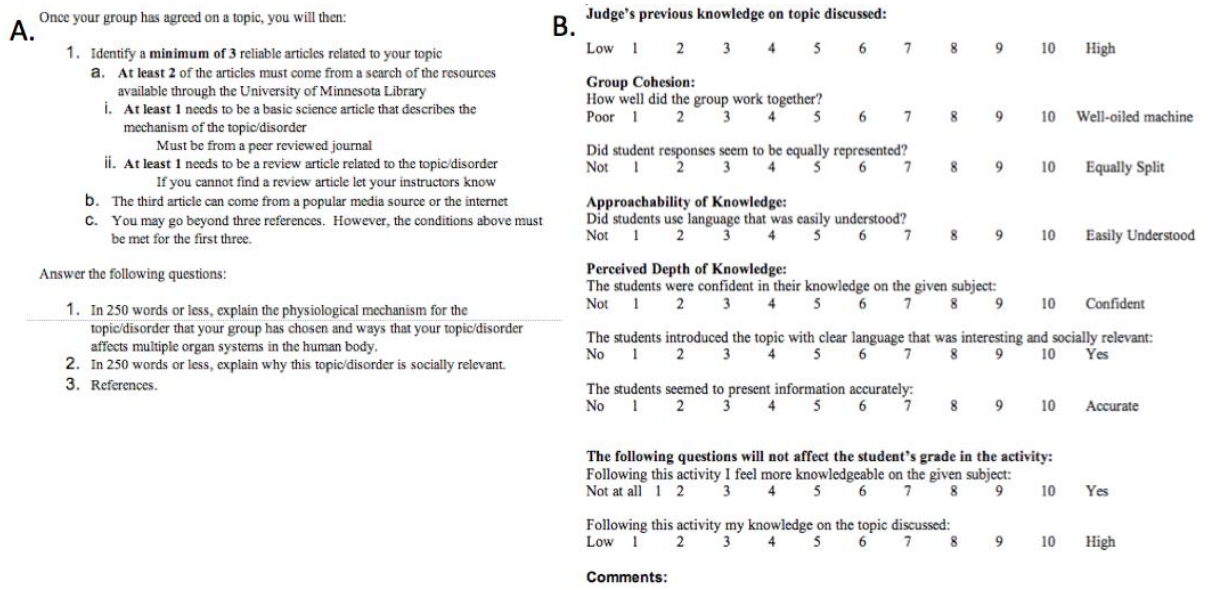
The Bachelors of Science in Health Science (BSHS) program at the University of Minnesota Rochester (UMR) integrates diverse areas of health science: natural sciences, social sciences, quantitative sciences and humanities into a single program. Students who enter the BSHS are mostly traditional-aged college students coming from within 50 miles of campus, located in the upper Midwest of the United States. Approximately 70% of students identify as female and 17% identify as persons of color. Students progress through a common curriculum during their first three semesters allowing faculty to design curricula across disciplines. During their fourth semester, students begin to specialize the remainder of their degree program targeting their courses toward their eventual career aspirations.

All students are required to take Anatomy and Physiology I during the first semester of their sophomore (2nd) year. This course is means basic human anatomical and physiological concepts to students who will follow a path both within and outside of patient care.

2.2 Pedagogy and Design

Towards the end of the first semester of our Anatomy and Physiology course series, we assigned a two-day activity that encouraged students to review topics that had previously been covered within the course. This began with the instructions: "Your group’s first assignment is to agree to focus on a

specific physiologically relevant topic, disease, or disorder that may come up in conversations with people outside the sciences." This simple instruction was then followed by a number of topics and exemplary scenarios including discussing a variety of topics covered within the course: the body's use of vitamin D, osteoporosis and bone formation, exercise and the relationship between muscle contraction and force, tetreodotoxin and its effects on the nervous system, color vision and deficiencies, diffusion and binding of oxygen at altitude, oral-rehydration therapy, smoking's effects on the body and a popular choice amongst the students: the effects of alcohol on the concentration of urine. After students chose a topic, they then were tasked with explaining the physiological mechanism of the topic and how the topic is socially relevant in two separate responses of under 250 words (Figure 1A). This activity was meant to prepare the students for a discussion with non-science based visitors to the class for an informal discussion of the topic chosen by the students. This informal "cocktail-party" discussion consists of the group of students describing their topic to an audience comprised of a self-described non-scientist member of the public as well as a biology instructor. This audience is instructed to "ask as many questions as possible if confused" and to treat the event informally. To further encourage creativity as well as scientific accuracy while discussing their project with their audience, students were assessed using a rubric that encourages an artful, yet accurate representation of the review material (Figure 1B). As this is meant to provide an opportunity for students to interact with a non-scientific audience the development of a broad rubric allows the reviewer to be of any comfort level with the given subject being discussed.



A.

Once your group has agreed on a topic, you will then:

1. Identify a **minimum of 3** reliable articles related to your topic
   a. **At least 2** of the articles must come from a search of the resources available through the University of Minnesota Library
      i. **At least 1** needs to be a basic science article that describes the mechanism of the topic/disorder
         Must be from a peer reviewed journal
      ii. **At least 1** needs to be a review article related to the topic/disorder
         If you cannot find a review article let your instructors know
   b. The third article can come from a popular media source or the internet
   c. You may go beyond three references. However, the conditions above must be met for the first three.

Answer the following questions:

1. In 250 words or less, explain the physiological mechanism for the topic/disorder that your group has chosen and ways that your topic/disorder affects multiple organ systems in the human body.
2. In 250 words or less, explain why this topic/disorder is socially relevant.
3. References.

B.

Judge's previous knowledge on topic discussed:

Low 1 2 3 4 5 6 7 8 9 10 High

Group Cohesion:
How well did the group work together?
Poor 1 2 3 4 5 6 7 8 9 10 Well-oiled machine

Did student responses seem to be equally represented?
Not 1 2 3 4 5 6 7 8 9 10 Equally Split

Approachability of Knowledge:
Did students use language that was easily understood?
Not 1 2 3 4 5 6 7 8 9 10 Easily Understood

Perceived Depth of Knowledge:
The students were confident in their knowledge on the given subject:
Not 1 2 3 4 5 6 7 8 9 10 Confident

The students introduced the topic with clear language that was interesting and socially relevant:
No 1 2 3 4 5 6 7 8 9 10 Yes

The students seemed to present information accurately:
No 1 2 3 4 5 6 7 8 9 10 Accurate

The following questions will not affect the student's grade in the activity:
Following this activity I feel more knowledgeable on the given subject:
Not at all 1 2 3 4 5 6 7 8 9 10 Yes

Following this activity my knowledge on the topic discussed:
Low 1 2 3 4 5 6 7 8 9 10 High

Comments:

Figure 1. A. Prompt assigned to students during the class time prior to "cocktail-party" discussion includes the requirement of peer-reviewed literature and brief descriptions of the discussion topic. B. Example rubric for assessment of scientific communication of student groups during "cocktail-party" assignment used by both scientists and non-scientific public. Aside from being used as a grading tool, the judge's previous level of comfort and knowledge of a given topic are also assessed.

3. Conclusions

The difficulty of finding time within a traditional undergraduate science curriculum to include important aspects of the soft-skills required to be an informed scientist has become increasingly difficult. To be able to prepare any science student to be able to communicate not only amongst their own community but also within a non-scientific public, we must find nontraditional methods of accomplishing this goal. The approach outlined within this paper is not necessarily a novel approach of accomplishing this, but it may aid to include the concepts of communication of science within an already filled schedule by overlaying the instruction of such skills upon an area that is often included within most courses. By

providing an opportunity for health science students to interact with an educated public, the students themselves are given an opportunity to understand some of the challenges that face them in the future if they chose to enter into patient care. This project also allows the general public to gain more knowledge within physiology and about their own health by providing an approachable and informal method of instruction. Finally, it will aid in removing the perceived differences between the sciences and the humanities. "A major difference between the humanities and sciences is that composing, critiquing and revising papers forms a central part of learning in the former, while in the sciences it does not."[8] It is this mindset that separates the traditional teaching methodology of the sciences from the humanities beginning to create the perceived divide in communication.

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