Medical myth busting to engage physiology students in scientific literature

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TEACHING STUDENTS to critically evaluate scientific literature can be an onerous task for students and the instructor alike. To overcome this challenge and to add intrigue, creativity, and critical thinking to literature analysis, medical myth busting was developed as an assignment for a senior undergraduate basic medical science course.

OVERVIEW OF COURSE

This assignment was offered in a fourth-year medical sciences course for students enrolled in an honors specialization in interdisciplinary medical sciences. A basic medical science course is a course that focuses on a discipline that is related to the study of human health (e.g., human physiology, human anatomy, pharmacology, etc.). The course has a “flipped” design wherein students complete independent online learning modules before attending class. Class time is then spent on discussion, case studies, and group projects. The course is offered in multiple sections with fewer than 30 students per section to foster collaboration and discussion. The course covers fundamental aspects of inflammation, such as wound healing and chronic inflammation, as well as the role of inflammation in specific disease states such as cancer.

OVERVIEW OF ASSIGNMENT AND GROUP WORK DYNAMICS

This assignment asks students to evaluate whether medical myths such as “you only use 10% of your brain” are supported by peer-reviewed scientific literature. This assignment is group based, and students are assigned to groups of three or four. Students are required to evaluate the primary literature source based on its methodology and conclusions. Before this assignment, students complete an online module and in-class discussion on chance, bias, and confounding variables. Students present their findings as an oral presentation or video.

To begin the assignment, students select from a list of common medical myths (see Table 1) or are invited to come up with their own. In their groups, they then have to find and critically evaluate primary scientific literature that supports and/or refutes the myth. Students are encouraged to use multiple resources and find research articles that both support and refute the myth (if possible). Students then design an experiment in an “ideal world” (where they have infinite time, money, and resources) that would add significant evidence to the myth being supported or refuted. The experimental design component of this assignment is significant; students are expected to develop a hypothesis, identify positive and negative controls, and outline their methods for data collection and analysis.

LEARNING OUTCOMES OF ASSIGNMENT

There are four key learning outcomes that this assignment is designed to assess. By the end of the medical myth busting assignment, students should be able to do the following:

1. Skillfully critique primary scientific literature by applying the concepts of chance, bias, and confounding variables.
2. Accurately distinguish between pseudoscientific sources of information and peer-reviewed scientific literature.
3. Design an experiment to test the myth using an appropriate experimental design such as proper controls, variables, and data collection methods.
4. Continue to develop scientific communication skills and group work skills by preparing a group-based oral presentation.

Students were motivated to complete this assignment due to the creativity for which the assignment allowed (such as the option to develop a video) and also because they were “busting” commonly accepted medical knowledge. This was articulated by several students during the initial class session. Some students stated that evaluating scientific literature in this manner was preferable to performing a literature critique, which was an assessment in a previous iteration of this course. One of the most important aspects of this assignment is the development of soft skills such as teamwork and collaboration. The development of a group dynamic begins when students are placed into groups based on their strengths. Students are asked to reflect on their strengths as they relate to group work (i.e., “I am best at clearly articulating my ideas” or “I am best at being a leader”). Students are then randomly assigned into their groups, such that each group should have members with different strengths. These groups carry forward throughout the term for the medical myth busting assignment as well as a larger group capstone project.

One of the first tasks for the group was to complete a “group charter” (Fig. 1). The group charter was introduced to proactively deal with group conflict and was modeled after the charter used by Hicks (1). The purpose of the group charter was to develop and discuss strategies to deal with group conflict and to come up with a group goal (Fig. 1). This strategy was introduced following some minor conflicts with group dynamics during previous iterations of the course. Ever since the group charter was introduced, there have been far fewer complaints and/or instructor interventions in regard to group work dynamics.

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EVALUATION OF ASSIGNMENT

The evaluation of the assignment involves assessing students’ critiques of the scientific literature, their design of their “ideal” experiment, and their overall oral presentation skills and visual aids. The assignment is worth 5% of their final mark. There are 30 marks allotted for this assignment; 25 of those marks are based on the group performance, and five marks are allocated for an individual’s oral presentation (see below).

1. Explanation of the myth/5
   - Do they clearly define the myth?
   - Do they offer suggestions as to how the myth was perpetuated?

2. Discussion of evidence to support or refute the myth/5
   - Do they use primary scientific literature?
   - Do they accurately describe the studies in terms of methodology, results, and conclusions?
   - Do they identify potential sources of error in the studies?

3. Design of the experiment/5
   - Do they state their hypothesis?
   - Do they identify independent and dependent variables in their experiment?
   - Do they offer appropriate controls for their study?
   - Do they clearly articulate their methods of data collection?

Table 1. Example medical myths and their related disciplines

<table>
<thead>
<tr>
<th>Medical Myth</th>
<th>Disciplines Involved</th>
</tr>
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<tbody>
<tr>
<td>Exercise helps relieve depression</td>
<td>Neurophysiology, psychology,</td>
</tr>
<tr>
<td></td>
<td>digestive physiology, nutrition,</td>
</tr>
<tr>
<td></td>
<td>renal physiology, microbiology</td>
</tr>
<tr>
<td>Organic food is more nutritious</td>
<td>Reproductive physiology,</td>
</tr>
<tr>
<td></td>
<td>neurophysiology, pharmacology</td>
</tr>
<tr>
<td>Urine is sterile.</td>
<td>Digestive physiology, nutrition</td>
</tr>
<tr>
<td>Wearing tight underwear will make men</td>
<td>Reproductive physiology</td>
</tr>
<tr>
<td>infertile.</td>
<td></td>
</tr>
<tr>
<td>The placebo effect is negligible</td>
<td></td>
</tr>
<tr>
<td>Eating food in the evening promotes</td>
<td></td>
</tr>
<tr>
<td>weight gain.</td>
<td></td>
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<tr>
<td>You can predict the sex of a baby</td>
<td></td>
</tr>
<tr>
<td>without a physician or medical technology</td>
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Fig. 1. Sample group charter used in Medical Sciences 4200, adapted from Hicks (1), and published under a Creative Commons License (https://creativecommons.org/licenses/by/3.0/).

Group Charter for Medical Sciences 4200

What is/are the goal(s) of your group for this course (i.e. what do you want to achieve in the group activities)? Note: Goals should be simple, measurable and attainable.

What pressures do you think your group will encounter in this course that might influence your ability to work together/achieve your goals?

How will you proactively deal with or compensate for your pressures?

What is one strength that each group member can provide to the group for this course?

<table>
<thead>
<tr>
<th>Group Member Name</th>
<th>Strength</th>
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What process will you follow if someone does not live up to their responsibilities (e.g. arrives late, doesn’t participate, is not prepared, doesn’t come to the activity, etc.)? Be specific.
4. Quality of oral presentation/5
   • Are the speakers engaged and articulate?
   • Do the speakers speak with an appropriate tone and pace?
   • Do the speakers make eye contact with the audience?
5. Quality of visual aids/slides/5
   • Did the visual aids add to the interest of the material being presented?
   • Were the visual aids clear and without spelling/grammatical errors?
   • Were the visual aids easy to see and professional looking?
6. Individual oral presentation/5
   • Was the speaker prepared?
   • Did the speaker speak loudly, clearly, and at an appropriate pace?
   • Was the speaker engaging?

Groups receive written feedback on their presentation based on the above criteria through the learning management system. Each group member also receives individual feedback from both the teaching assistant and the instructor on their oral presentation skills.

Overall, this assignment engages students to challenge their preconceived ideas about scientific facts and motivates them to critically evaluate scientific literature in a creative manner. To aid students’ development of oral presentation skills, it is recommended that the instructor or teaching assistant model a myth-busting presentation and facilitate a group discussion regarding oral presentation skills.

CHALLENGES

Resource selection for establishing the myth and/or explaining the basic physiology of the myth. One challenge with this assignment was students’ use of online resources. Students always selected valid peer-reviewed research articles when finding evidence to support or refute the myth. However, some groups selected inappropriate online resources when providing background information on their myth. For example, some groups would use information from blogs when discussing some basic scientific principles related to their myth (i.e., how the male reproductive system works when trying to explain the myth behind the “pullout” method of birth control). To address this issue, students were provided feedback via the learning management system (LMS) as to why these sources of information were not reliable and were given suggestions for future work as to how to determine the reliability of a resource.

Experimental design. As stated earlier, one component of this assignment was for students to design an experiment in the “ideal world” that would add significant value to the myth being supported or refuted. In terms of the ideal world, students were told that they could have unlimited money, time, and resources, but ethical principles would still apply. The experimental design component of this assignment was the most challenging component and clearly distinguished students who understood the assignment from those who did not. Most students were able to clearly state their hypothesis, independent and dependent variables, and their study population. Some groups struggled to clearly define their measurements and/or offer a cohesive picture of their experiment. For some, it appeared as though the experimental design was an afterthought and the majority of the assignment was focused on the critique of the primary literature. However, some students expertly synthesized information and were able to design experiments that considered chance, bias, and confounding factors. For those students that were not as successful, they were given feedback via the LMS regarding proper experimental controls and measurements to strengthen their experimental design skills.

Informal student feedback on the intervention. Following the completion of the medical myth busting presentations, the class engaged in an informal reflective exercise. This exercise was performed to assess student learning and attitudes toward the assignment. Students were asked, “Why do you think that this assignment was offered in this course?” Many students stated during the reflective exercise that the purpose of the medical myth busting assignment was to further cement the concepts of chance, bias, and confounding variables. Other students suggested that this assignment was offered as a low-stakes method to engage their group and establish group norms, since the assignment was low stakes and occurred early in the term. Finally, some students suggested that this assignment was offered to further solidify the notion that scientific findings can be conflictual. Indeed, the majority of groups found that there was evidence both supporting and refuting their medical myth, therefore leaving the group unable to conclusively state whether the myth was true or false. Because challenging and evaluating scientific information was a key learning outcome of this course, this assignment was perfectly aligned with the course goals.

DISCLOSURES

No conflicts of interest, financial or otherwise, are declared by the author.

AUTHOR CONTRIBUTIONS

S.M. conception and design of research; S.M. prepared figures; S.M. drafted manuscript; S.M. edited and revised manuscript; S.M. approved final version of manuscript.

REFERENCE