The Use and Creation of Analogies as a Teaching Tool for Science and Health Professional Trainees Inside and Outside of the Classroom

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Introduction

With analogies, we utilize knowledge of a familiar situation to build associations toward learning, understanding, retaining, and communicating complex concepts.[1] Educators have utilized analogies to enhance understanding of topics such as the structure of the pancreas as compared to a sweet potato.[2] Interested in the potential for analogies to enhance basic science understanding, we utilized analogies as a teaching tool during an immunology course for dental, medical, physician assistant, and graduate students to explain complex concepts and enhance the learning and retention of complex immunology concepts. The impact of learning complex concepts through the use of analogies resulted in self-reported increased confidence in learning the material.

Besides use in the classroom, analogies have been employed to facilitate physician-patient education in fields like dermatology, with literature to suggest that analogies can be useful in increasing objective understanding.[3-4] To further explore the use of analogies as a science communication tool to help patients engage with a clearer understanding of medical concepts, we collected survey data longitudinally from medical students in their clinical years (spent managing patients in both outpatient and inpatient settings), inquiring whether the use of analogies was helpful for patient education and communication.

Health literacy significantly impacts the ability of patients to engage in shared decision making and follow through with agreed upon management plans for care. Components of the patient encounter including communication of prognosis, diagnosis, procedural steps, complex medical concepts, risks and benefits of medical interventions, importance of lifestyle and preventative health interventions (including vaccinations), and more can be intimidating for patients who have varying levels of scientific backgrounds.

In our initial survey data, we found that the significant majority of health professions students perceived that the use of analogies would benefit scientific communication to the general public and other health providers. Our data showed that a sizeable majority of students reported analogies helpful in communicating clinical concepts and medical terminology to patients and families. In general, the incorporation of analogies into the learning process augmented scientific communication skills and acts as a model for effective communication while speaking to patients about medical conditions and/or associated treatments.

Aims

1. To survey health professional and science trainees on the effectiveness of analogies in furthering their learning, understanding, and communication of immunological concepts in the ('learning phase') didactic classroom.
2. To survey medical students after a year of consistent clinical experiences ('clinical phase') to assess the overall use and perceived usefulness of analogies when communicating complex scientific concepts and/or medical information to the general public and/or patients in clinical practice.

Methods

1) **Learning Phase Surveys**: Using Google Forms and OASIS evaluation system (in collaboration with the University of Colorado SOM Office of Assessment, Evaluation and Outcomes) an anonymous 6-question survey was offered to health professional trainees (i.e. medical student, physician assistant students, dental students). A free-response section was also provided to allow for participants to provide additional feedback and any original analogies they had created. In total, 390 responses were collected from medical, dental, physician assistant and graduate students within their designated programs immunology course.
2) **Clinical Application Survey**: Using the OASIS evaluation system, an anonymous survey was offered to second-year medical students upon completion of their Longitudinal Integrated Clerkship clinical year for the CU Anschutz School of Medicine classes of 2026 and 2027. Responses to 8 questions were collected in relation to the application of analogies in the clinical setting. In total, 371 responses were collected.
3) **Sample Selection Inclusion Criteria**: Responses submitted through Google Forms were excluded to prevent duplicate counting, as some students completed both Google Forms and OASIS surveys. Quantitative analyses therefore included only the 82 medical students who completed both surveys.
4) **Qualitative Analysis**: Copilot AI along with Microsoft Excel was utilized to categorize analogies into relevant organ systems, relevant medical specialties, and a general category. All categorizations were manually confirmed by the first author.
5) **Quantitative Analysis**: The Kruskal-Wallis test was conducted to identify significant differences in the medians of the three groups for each of the Likert questions followed by pairwise comparisons to assess the specific pairings of health professional student roles revealed any significant differences.
6) **Visualization Tool**: Microsoft Excel to analyze and visualize response data.

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Conflicts of Interest Disclosure: None

COMIRB Protocol#: 19-2093 (deemed exempt)
Medical School Immunology Course Methodology

Results

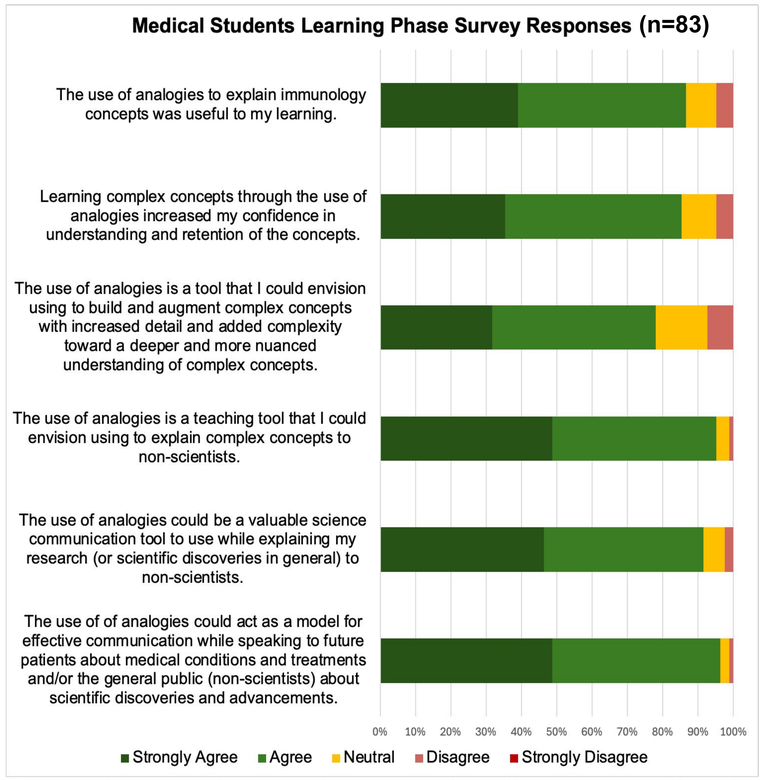

Figure 1. Responses Breakdown for Learning Phase Survey: Medical Students

Figure 2. Responses Breakdown for Learning Phase Survey: PA Students

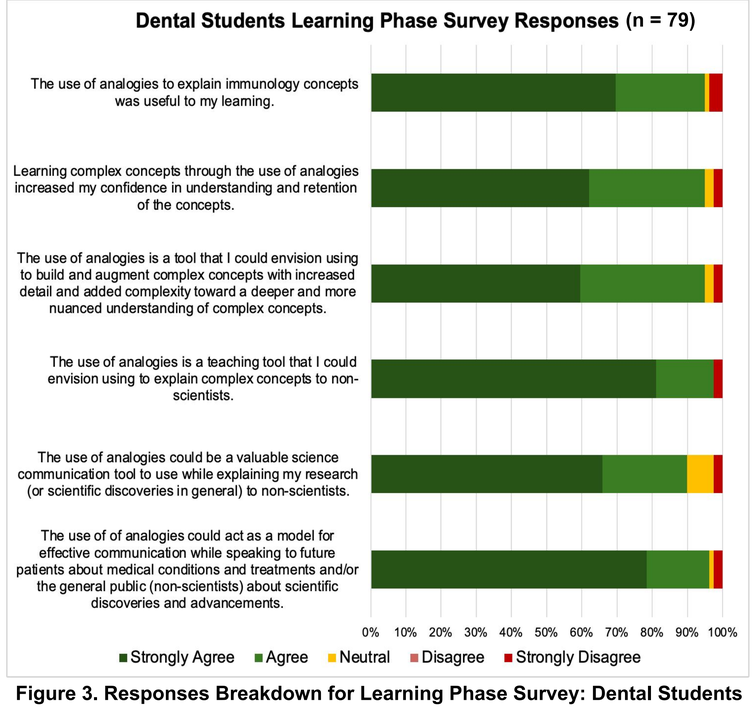

Figure 3. Responses Breakdown for Learning Phase Survey: Dental Students

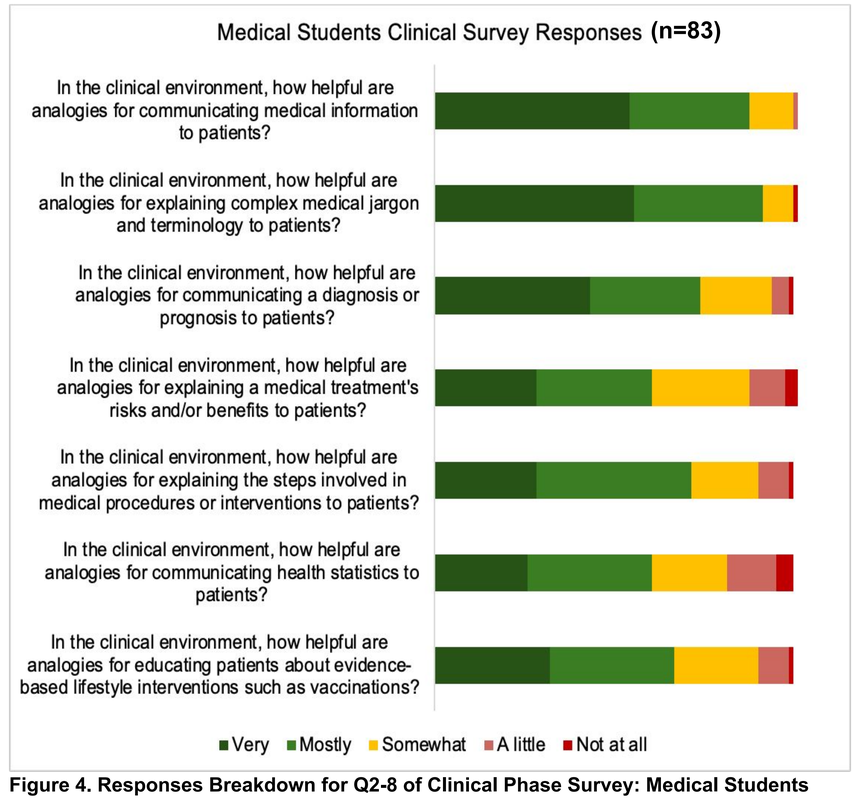

Figure 4. Responses Breakdown for Q2-8 of Clinical Phase Survey: Medical Students

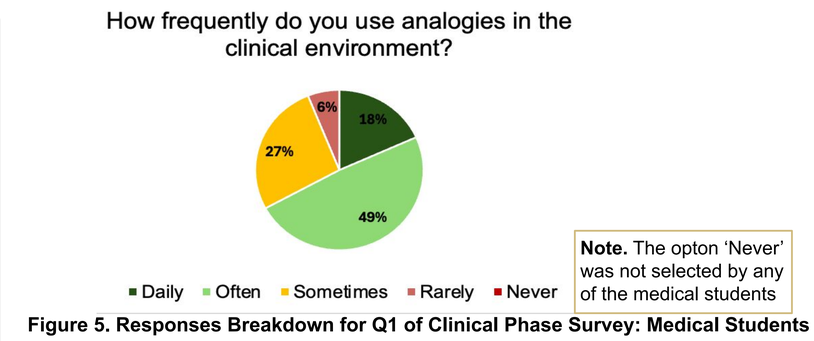

Figure 5. Responses Breakdown for Q1 of Clinical Phase Survey: Medical Students

Discussion

Based on the quantitative Likert scale data and qualitative survey responses, overall respondents found analogies to be quite effective for a variety of purposes. While finding analogies useful for retaining information encoded during classes, students also reported using analogies as an important tool for communicating complex medical conditions and/or associated treatment options with patients. The highest percentage of learners (97%) found analogies helpful for explaining complex concepts to non-scientists (LPQ4). Learners also found that analogies could be a useful tool for communicating scientific research and scientific discoveries to non-scientists (LPQ5).

Most notably, every student response included from the medical student clinical application phase survey reported using analogies in the clinical environment (CAPQ1). In the clinical setting, medical students most widely endorsed the use of analogies as being helpful tools for communicating complicated medical information (CAPQ2) and explaining complex medical jargon (CAPQ3).

For future directions, we plan to continue collecting data from health professional students longitudinally to assess whether trainees continue to find analogies useful in patient communication and improving patient health literacy as they progress in their clinical training.

Conclusion

Learners overwhelmingly found analogies effective for understanding and communicating complex scientific and medical concepts. Nearly all students (97%) reported using analogies to explain difficult ideas to non-scientists, and every clinical-phase medical student reported using analogies in patient care. In clinical settings, analogies were most frequently used to clarify complicated medical information and simplify jargon. Overall, analogies serve as a valuable communication tool across educational and clinical contexts. The results reinforce the importance of intentionally incorporating science communication strategies and tools, such as analogies, into healthcare professional curricula to strengthen learners' ability to convey complex information and to improve how future clinicians explain complex concepts.

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