



Bridging the gap: The use of STEM and premedical journal clubs in undergraduate education

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ABSTRACT

Journal clubs provide a platform that uses primary literature to facilitate student transitions into professional life. The use of journal clubs, particularly those related to the science, technology, engineering, mathematics (STEM) and medical fields, is common practice among many graduate institutions and medical programs. Reading and understanding primary literature have been shown to positively impact academic outcomes and future careers of graduate students who participate in journal clubs. However, there remains a lack of exposure to primary literature at the undergraduate level, often due to constraints within traditional classroom education. Limited exposure to scholarly articles as an undergraduate student can lead to voids in education and knowledge acquisition, especially for those continuing on to graduate or professional school. Undergraduate journal clubs are an easy and effective way to expose students to primary literature and increase their familiarity and understanding of primary research material. Such learning can improve students' critical evaluation and problem-solving skills, boost confidence in sharing ideas and partaking in their own scholarly research, and also better prepare them for continued education and future careers in STEM and medical fields.

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Primary literature is a platform to present ideas, research, and results. It is a space of learning and evaluation. Journal clubs are groups of individuals who come together to appraise and discuss articles of primary literature [1]. The review of primary literature, particularly in the areas of science, technology, engineering, and mathematics (STEM), and medicine allows students to become a part of the collaborative platform and access opportunities to develop deeper intellects, stronger sets of research skills, and a greater understanding of scientific methods. There are numerous types of journal clubs, which can be adapted to diverse learning environments to meet the goals of different groups. Some of these types include: traditional (critical appraisal), problem- and evidence-based, methodology-based, and problem-solving focused [2].

There is currently a lack of organized, primary literature discussion and appraisal at the undergraduate university level [3]. While such review can be used to strengthen the abilities to think critically,

solve problems, and present and defend one's own ideas, it is often not included in classroom curriculums. Undergraduate journal clubs can provide a setting to teach students how to critically appraise primary literature. The evaluation of primary literature offers students opportunities to enhance their development in STEM and medical courses, and can help them excel in graduate school and future careers.

The first undergraduate journal club was formed in 1875 at McMaster University to better prepare students for lives and careers after graduation by teaching them how to read and comprehend primary literature, solve problems, and both test and express their own ideas [1,4]. Journal clubs also allow students to sharpen the essential skills of critical analysis and debate. Since their inception nearly 150 years ago, journal clubs have become a cornerstone of graduate education in STEM fields, as well as medical residency programs, allowing for learning, comprehension, and expression of ideas among numerous students and residents [3,5–7].

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At the graduate level, journal clubs are driving education forward by helping to create well-rounded students who have the ability to understand and discuss primary literature, as well as generate and showcase their own original research. For some schools, journal clubs have even “become an educational institution” providing both educators and students with opportunities for discovery, data interpretation, collaboration, and the formulation of scientific questions [4]. Students who participate in journal clubs are better prepared for future studies and careers in science, research, and medicine [8]. Furthermore, physicians in residency programs use journal clubs to gain a deeper understanding of evidence-based medicine, while staying up-to-date with the current research and practices [7].

However, despite the personal growth and knowledge afforded by journal clubs, as well as their extensive use and success at the graduate, medical, and residency levels, they are still uncommon in undergraduate settings, often due to time constraints and the volume of material that must be covered in traditional classroom curriculums [3,8]. The lack of familiarity with primary literature creates a gap in student education, particularly when students continue on to graduate or medical school [9]. In light of the benefits of primary literature appraisal in graduate schools and residency programs, undergraduate journal clubs could help to fill this educational void and provide substantial advantages to students who participate in them. Students would have the opportunity to develop critical evaluation, application, and communication skills earlier in their educational process and may even decide to pursue their own research endeavors, matriculate into graduate school, and enter careers in STEM or medicine.

Graduate schools often note the lack of proficiency in the reading and understanding of peer-reviewed journals by incoming students. For instance, program coordinators from University of California, Los Angeles (UCLA) Medical School observed that a major weakness of many new medical students was a lack of exposure to primary literature, which places these students at a disadvantage early in their medical education. To this point, undergraduate journal clubs present a viable option to better prepare students for continued education in STEM and medical fields and to also decrease the amount of remedial learning often needed at the beginning of graduate programs [10]. The ability to navigate scholarly articles and understand basic

scientific and mathematics principles is critically important to advancement and success in these areas. The implementation of journal clubs would be an important and effective tool to allow students to excel above and beyond the scope of traditional undergraduate education by sparking their interests in specific careers and helping them to become familiar, early on, with the current work being done in those areas.

The implementation of premedical or STEM-related journal clubs at the undergraduate level can better prepare students for graduate school and their future careers. One proposed model of organization is to have students meet together biweekly or monthly, with at least one faculty member who is educated in the particular area of primary literature being discussed. Articles should be read before meeting and should reflect the goals relevant to the group. Group discussion should be encouraged and articles should be discussed meticulously, with students arranged roundtable and at least one faculty facilitator within this arrangement [7]. Students should have new articles chosen at the end of each session for the next meeting. Furthermore, to aid in the learning process, when students have questions, peers in the group should have the opportunity to answer these questions to showcase their knowledge and improve their communication and teaching skills. It is also encouraged that throughout the duration of the journal club, students provide their own feedback to how the club is run, as well as what they believe would help them benefit more from journal club.

As one way to measure outcomes, at the beginning and end of the semester or year, students should fill out survey questions about their current ease in understanding primary literature and research methods; differential success in science and mathematics courses during and after participation; improvements in confidence speaking in front of others and asking questions in front of a group; collaborating with peers; differing interests in new fields; desires to pursue higher education or STEM careers because of their experience in journal club; changes in desires to understand or participate in research; and improved success on examinations such as the Medical College Admission Test (MCAT), Graduate Record Examination (GRE), and National Council Licensure Examination (NCLEX). In addition, professors should be surveyed on changes in classroom success or communication of students who participated in journal club. Student and faculty survey answers should be considered in optimizing journal club meetings and outcomes.

Ultimately, journal clubs should be used to facilitate student understanding of basic science and research methodologies as well improve undergraduate students' skills in critical evaluation, problem-solving, and communication. Implementing such a learning platform can bridge a serious gap in undergraduate education and help students understand and present scholarly research, as well as prepare for, and excel in, graduate school and future careers in STEM and medicine.

Conflict of interest

The authors declare they have no conflicts of interest.

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