

Evidence-Based Practice, Research Literacy, and the Undergraduate Health Sciences Curriculum

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Abstract:

Evidence-based practice (EBP) is critical for healthcare practitioners to deliver high-quality, personalized care by integrating the best available research, clinical expertise, and patient preferences. Preparing students to become research-literate professionals is essential for equipping them to practice effectively in evidence-based environments. This paper introduces a five-step hierarchical model designed to foster research literacy across undergraduate health sciences curricula. The model emphasizes key curriculum development, implementation, and evaluation strategies to ensure graduates are competent in applying EBP principles. The findings offer valuable insights for educators and institutions aiming to align health sciences education with modern, evidence-based healthcare demands.

Keywords: evidence-based, research literacy, inquiry-based curriculum, curriculum development

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Evidence-based practice (EBP) is a concept rooted in medicine in the early 1990s that rapidly became interdisciplinary. It is now widely advocated among healthcare practitioners worldwide and across several health sciences fields such as medicine, dentistry, nursing, public health, physician assistant, and mental health, to name just a few (Trinder & Reynolds, 2000). This paper adopts ‘evidence-based practice (EBP)’ as its standard terminology since practice applies to all health fields, such as evidence-based medicine, dentistry, pharmacy, nursing, etc., and is even utilized to qualify evidence-based research.

EBP became part of most professional accreditors’ accreditation standards. The Liaison Committee on Medical Education (LCME) expects the medical curriculum to cover the analysis and synthesis of relevant information and infuse medical students with the capacity to appraise the credibility of information sources. It goes further to say that the medical curriculum must allow students to acquire skills of critical judgment based on evidence and experience and to include instruction on how clinical and translational research is conducted, evaluated, explained to patients, and applied to patient care (Liaison Committee on Medical Education, 2021). The Accreditation Council for Pharmacy Education (ACPE) stresses the importance of developing and regularly assessing evidence-based clinical reasoning skills throughout the curriculum to provide evidence-based therapeutic recommendations to healthcare providers and the public (Accreditation Council for Pharmacy Education, 2015). The Commission on Dental Accreditation (CODA) says that curricular content and learning experiences in dental education programs must incorporate the principles of evidence-based inquiry (Commission on Dental Accreditation, 2022). CODA highlights that ‘the capacity to think scientifically and to apply the scientific method is critical if students are to analyze and solve oral health problems, understand research, and practice evidence-based dentistry’ (p. 14).

EBP is the conscientious, explicit, and judicious use of current and rigorous research evidence, clinical experience and expertise (where applicable) that considers patient’s values and preferences under unique circumstances when making decisions about the care of patients (Sackett, Rosenberg, Gray, Haynes, & Richardson, 1996; Samonte & Vallente, 2016; Strauss et al., 2019). Evidence-based practice constitutes the changes we make in practice in response to

research evidence (Dancey, Reidy, & Rowe, 2012). As mentioned by Trinder and Reynolds (2000), evidence-based practice ‘relays a devastatingly effective and simple message: the argument that practice should be based on the most up-to-date, valid and reliable research findings’ (p. 3). CODA offers a well-crafted definition for evidence-based dentistry that can be extrapolated to other health sciences fields: ‘evidence-based dentistry (EBD) is an approach to oral health care that requires the judicious integration of systematic assessments of clinically relevant scientific evidence, relating to the patient’s oral and medical condition and history, with the dentist’s clinical expertise and the patient’s treatment needs and preferences’ (Commission on Dental Accreditation, 2022, p. 14).

EBP is an approach to clinical decision-making that relies on clinical expertise, knowledge of disease mechanisms, and pathophysiology (McKibbin, 1998), the platform modern medicine was built on (Mukherjee, 2015). To properly rely on evidence-based practice, practitioners must have the skills to search for and understand the available information and know what to do with the information. Without the ability to judge the quality of research, its methodological rigor, validity, and reliability, healthcare practitioners will not be equipped to apply EBP successfully. In short, EBP requires research literacy. Practitioners need to speak the language of research, even if they do not intend to become researchers. They must be able to judge the evidence they will use in their practice and evaluate the results against the evidence. While not all healthcare practitioners conduct research, all practitioners must be skilled consumers of research, and as a result, healthcare education must develop their overall research literacy skills (Jacobs-Halsey, 2021).

Many healthcare practitioners guide their clinical decision-making based on their expertise, advice from senior colleagues, knowledge gained during primary care training, and experience with similar cases. However, as Trinder and Reynolds (2000) point out, there is a recognized gap between research and practice, and the translation of research findings to practice is often erratic and unsystematic. Healthcare education must bridge this gap, providing future practitioners with appropriate training from early undergraduate and continuing throughout professional and graduate studies.

There are many reasons behind such a research-practice gap. Among them is that all healthcare fields are flooded with new information from research almost daily. Such a storm of publications makes it difficult for practitioners to keep up with all the latest information. In addition, many practitioners do not have the skills to distinguish between rigorous and valuable

research and poor or unreliable research (Trinder & Reynolds, 2000). The number of predatory journals is increasing exponentially, leading to many methodologically weak publications. Many of these lack reliability, internal validity, credibility, or dependability. This issue extends beyond predatory journals to some legitimate journals, which do not always uphold methodological rigor across various research traditions.

Research Literacy

Evidence-based practice is a complex endeavor that requires research literacy. This paper adopts the following definition of research literacy, modified from Hines (2016) and Senders et al. (2014): Research literacy is the ability to access, read, understand, interpret, and critically appraise research literature, including its cognitive and social purposes, processes, contexts, and the value of research. Figure 1 portrays the critical elements of research literacy, organized hierarchically into five steps. Except for step one, each subsequent step builds upon the mastery of the preceding. We can only assert that an individual is research-literate if they are competent through level five. To master such a competency, a coordinated effort across the curriculum is necessary. Research literacy does not necessarily imply the development of the essential expertise for one to become a skilled researcher; not all healthcare practitioners will become producers of research, but as stated before, all of them will be consumers of research. Research literacy's benefits go beyond its application to EBP as it equips professionals with the necessary skills to analyze, evaluate, and make inferences from information in all fields. Moreover, it is a powerful tool to foster critical thinking in all human endeavors beyond professional practice.

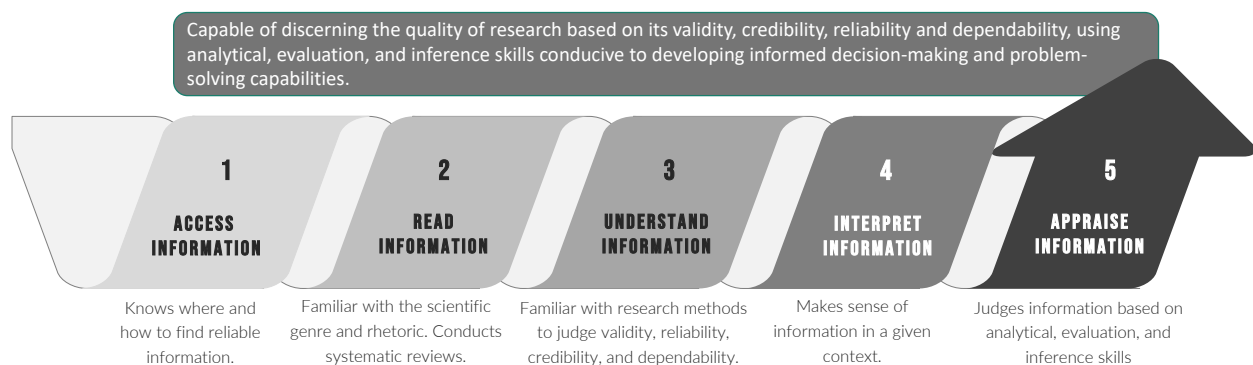


Figure 1. A hierarchical model for research literacy

Research literacy starts with the ability to identify reliable information and understand where and how to access reputable sources. The first consideration is to know how to identify and avoid predatory journals. The term predatory was first used by Jeffery Beal in 2010 (Garrard, 2022) and is defined as the systematic publication of purportedly scholarly content deceptively or fraudulently and without regard for quality assurance (COPE Council, 2019). Predatory publishing has reduced ethical standards, particularly those related to intellectual property, methodological weaknesses, scholarly quality of information (lack of editorial oversight and/or peer-review criteria), and financial issues. A general advice is to look for sources that are well-established and widely recognized as reliable, such as peer-reviewed journals. Avoid sources that make grandiose claims or show no credible or valid scientific evidence. The safest way is to look into subscription-only databases, such as PubMed Central, EBSCO, Elsevier, ERIC, JSTOR, Library of Congress, Web of Science, and many other electronic databases available through public and higher education institutions' libraries.

Once comfortable finding and accessing the best sources of information, one must become familiar with the academic/research language as a “literary genre.” This process must start on the first day of college (or even in high school) and continue to be developed throughout the entire higher education journey. It includes providing students with multiple opportunities to master the jargon, conventions, language, purpose, and rhetorical elements that guide research and academic literature. Understanding that research is a rhetorical process and being attentive to the rhetorical triangle is critical. Teaching students how to read and judge research throughout the curriculum is essential, more than just teaching statistics and research methodology and giving students punctual experiences with research (Hines, 2016). The process of selecting information is by itself a point that requires special attention. Besides knowing how to identify reliable sources of information, how you frame your research question rhetorically and objectively is paramount. One must create a structured and comprehensive approach, from a properly framed question to reviewing existing research on a specific topic, using predefined criteria to identify, evaluate, and synthesize relevant studies that are systematic, transparent, and replicable to avoid bias. A less time-consuming alternative is to use systematic reviews conducted by reputable national and international organizations such as the Cochrane Collaboration (Forister & Blessing, 2020).

The third step towards research literacy is the ability to understand information. A solid foundation in statistics and research methods – both quantitative and qualitative – and, in some

cases, clinical research serves as the cornerstone for equipping students with the skills to understand information effectively. It is also critical to understand generalizable information and its limitations, the importance of the context, and the need to be cautious when establishing causal relationships. Statistics in the health sciences should focus on data analysis, minimizing the mathematical complexity to only what is essential for students to understand and interpret statistical tests. It is necessary to keep in mind that we are not training future mathematicians or statisticians but future health professionals who need a firm grasp of how to read and apply statistical concepts to interpret health sciences research data effectively. Key concepts such as hypothesis testing, statistical significance, confidence intervals, incidence and prevalence rates, relative risk and odds ratio, reliability analysis, and clinical trial designs are fundamental and must be thoroughly understood by students. Additionally, students must understand when and how to use and interpret statistical tests such as Chi-square, t-tests, correlation, regression, ANOVA, and their variations. Evidence-based practice requires these skills for analyzing and drawing meaningful conclusions from research in the health sciences.

Research methods and clinical research courses must build upon a solid statistical foundation and expand to include qualitative research methods, particularly naturalistic inquiry, as extensively suggested in the literature (Guba, 1978; Patton, 2015). This expansion is crucial because health sciences is a multidisciplinary discipline at the intersection of natural and behavioral sciences, merging methods from psychology, sociology, policy analysis, economics, epidemiology, nursing, medicine, and pharmacology, among others (Shi, 2008). Research methods courses are essential for equipping students with the tools to critically analyze and interpret scientific literature. These courses should emphasize diverse study designs across research traditions, providing students with a comprehensive understanding of critical concepts such as validity and reliability in quantitative research and credibility and dependability in qualitative research. In addition, such courses must adequately address ethical concerns in conducting research, from human subjects' protection to ensuring the humane treatment of animals, minimizing harm, and beyond. These foundational principles are crucial for enabling students to accurately interpret, evaluate, and appraise research findings, advancing their progress in the hierarchical framework of research literacy. A solid grounding in research methods ultimately empowers students to contribute meaningfully to improving health outcomes and addressing complex medical challenges, reinforcing the vital connection between research literacy and evidence-based practice.

The ability to interpret information, identified as step four in our hierarchical research literacy model, depends significantly on a solid understanding of statistical concepts and qualitative data analysis, as established in step three. Interpretation involves assigning meaning to a dataset—whether quantitative or qualitative—by analyzing and making sense of the data in its respective context. To interpret information, one must possess the skills to evaluate a study’s **internal validity** in quantitative designs or **credibility** in qualitative designs, as well as its **reliability** in quantitative research or **dependability** in qualitative research. These represent key learning outcomes expected from research methods and clinical research courses. Achieving these outcomes is a shared responsibility of the faculty teaching those courses and all program faculty, mainly when delivering an inquiry- and evidence-based curriculum. Internal validity is defined as the extent to which the research accurately measures what it intends to measure, while credibility is understood as the extent to which the study accurately reflects the participants’ experiences, perspectives, and the context being studied. Table 1 brings some non-exhaustive critical questions one must ask to judge a study’s internal validity or credibility.

Table 1. Critical questions to judge the internal validity or credibility of a research study

Internal Validity (quantitative)	X	Credibility (qualitative)
1. Does the study design appropriately align with the research questions and effectively support the findings?		1. Is the data high-quality, collected through systematic, in-depth fieldwork?
2. Are sampling procedures sufficient in size, properly framed, and following adequate selection criteria?		2. Does the data analysis follow systematic procedures to minimize bias, consider context, and thoroughly explore all possible themes?
3. Are study’s variables clearly defined and measured using properly validated instruments?		3. Does the study use inductive analysis, consider the context, and incorporate diverse perspectives?
4. Does the study apply appropriate statistical tests and accurately interpret <i>p</i> -values and confidence intervals?		4. Are the findings backed by a thorough description of the context and participants?

Reliability, the other critical concept necessary to make sense of a quantitative study's results, refers to the consistency and stability of the measurement instruments and their results over time and across different conditions. Reliable research produces consistent results when repeated under the same conditions, ensuring that the findings are not due to random errors or inconsistencies in measurement. There are statistical tests designed to estimate the reliability of data collection instruments. Dependability, the parallel concept to reliability in qualitative studies, is also concerned with the stability of the data over time (Guba & Lincoln, 1989). Notwithstanding, the approach to judging dependability is focused "on the process of the inquiry and the inquirer's responsibility for ensuring that the process was logical, traceable, and documented" (Patton, 2015, p 685). Table 2 depicts some non-exhaustive critical questions one must ask to judge a study's reliability or dependability.

Table 2. Critical questions to judge the reliability or dependability of a research study

Reliability (quantitative)	X	Dependability (qualitative)
1. Were data collection procedures and protocols applied consistently across all participants and settings?		1. Is the study properly documented and transparent (data collection methods, analysis steps, and interpretation process)?
2. Were multiple researchers or observers involved? If so, do they agree in their assessments or measurements?		2. Were any changes to the study's context, participants, or design during the research process clearly identified and justified?
3. Were measurement instruments tested for internal consistency?		3. Were consistent protocols (e.g., interview guides, observation checklists, etc.) used across participants and settings?
4. Are there indications that the measurement instruments are consistent over time?		4. Did the researcher engage in peer debriefing, or was the study subjected to an external audit?

At this stage, a research-literate individual can articulate how the conclusions of a particular study were reached, critically evaluating all aspects that contribute to the study's rigor, particularly its validity (or credibility) and reliability (or dependability). This marks the transition to the fifth and final step of our proposed research literacy ladder: the ability to make informed inferences based on the conclusions drawn from the study and apply them to a specific context. This step involves considering all contextual factors, discerning what is relevant, identifying alternatives for exploration, and extrapolating findings to the situation at hand. It defines a fully research-literate professional capable of integrating evidence-based practices into daily decision-making. Such competence requires the ability to apply findings from valid/credible and reliable/dependable research while thoughtfully assessing the potential implications of data, expert recommendations, principles, evidence, judgments, beliefs, opinions, concepts, descriptions, questions, or other forms of information representation (Facione, 2015).

Implications for curriculum development

When research literacy is effectively infused into a curriculum, students become skilled at identifying problems, evaluating sources, testing ideas, analyzing the quality of information in general, drawing critical conclusions, and making informed inferences based on solid evidence. Research literacy encourages active questioning and fosters curiosity, creativity, and imagination, fueling lifelong learning. A curriculum that effectively infuses research literacy prepares students to become inquiry-driven learners who can explore and cultivate ideas that will enable them to successfully navigate constant change, capitalize on career opportunities, enjoy their personal lives, and thoughtfully engage in public life (Conrad & Dunek, 2012).

Two critical capabilities are expected to be developed throughout an evidence-based curriculum: an understanding of different research traditions (sometimes divergent) and the capacity to express and communicate complex ideas in both written and oral fashion. Preparing future professionals for evidence-based practice is the most effective way to differentiate education from training in the health professions.

Integrating research literacy into a curriculum requires the active participation of all academic personnel across disciplines. General education courses play a crucial role in this process, and faculty must collectively recognize that healthcare professionals work with individuals who are more than a sum of cells, anatomical structures, and physiological processes.

Human beings are shaped to a great extent by their thoughts, emotions, and social contexts, all of which influence the biological functioning of their bodies. It is, therefore, essential to emphasize the interconnectedness of mental and emotional processes, social determinants of health, and pathophysiology in understanding human well-being. This holistic perspective must be woven throughout the curriculum, ensuring that behavioral and natural sciences courses are given equal importance. Such an approach fosters a comprehensive understanding of disease mechanisms, empowering future healthcare professionals to effectively interpret and communicate the complex interplay between biology, psychology, and social factors.

A curriculum that aims to prepare professionals for evidence-based practice must prepare inquiry-driven individuals through the mastery of research literacy. All courses must be interconnected and interdependent to offer a balanced and harmonious learning experience that ensures students understand concepts comprehensively by exploring the relationships between disciplines, fostering critical thinking, and promoting holistic education. While research methods courses are instrumental, every curriculum component must work in tandem to ensure students can make meaningful connections, approach problems from multiple perspectives, and communicate effectively both orally and in writing. This interconnected approach fosters the development of analytical and problem-solving skills while enabling students to evaluate information critically. Ultimately, it provides a deeper understanding of pathophysiology within the broader context of social determinants of health, allowing for an evidence-based practice that, as mentioned by Mukherjee (2015), reconciles knowledge with clinical wisdom.

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